The Academic Use of WhatsApp and Technostress: Investigating the Experience of Fatigue and Coping Behaviours among University Students

By

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Abstract

The use of mobile instant messaging applications, such as WhatsApp, WeChat and Facebook messengers, has grown remarkably in recent years. WhatsApp is one of the most adopted mobile messaging apps, with two billion users worldwide. Due to its popularity among students, WhatsApp is being increasingly adopted for learning purposes in higher education. WhatsApp can provide students with various benefits that facilitate online learning and knowledge exchanges. However, despite these benefits, using WhatsApp can also have negative effects for students and their well-being. Research has demonstrated that the excessive use and heavy reliance on information and communication technology (ICT) can lead to technostress, a phenomenon that refers to the stress experienced by individuals due to the use of ICT. Thus, although WhatsApp offers students an effortless and fast means for communication and information sharing, the use of WhatsApp for academic and non-academic-related purposes can create fatigue for students. Research indicates that university students are vulnerable to different sources of stress including academic stressors. With the increased use of mobile technology for learning, students could face an additional source of academic stress caused by the educational use of technology. While there has been a growing interest in studying the educational benefits of using mobile instant messaging, there is still a lack of understanding around its negative effects on students and their academic performance. Addressing this issue becomes important given the consequences of technostress on individuals. The current study, therefore, aims to shed light on the negative aspects of the educational use of WhatsApp. Using the transactional model of stress and coping, the study seeks to explore factors that cause fatigue among university students when using WhatsApp for learning purposes and investigate students' coping behaviours to reduce fatigue.

The study was conducted in two phases. In the first phase, a qualitative exploratory study was conducted to identify the main reasons for the experience of fatigue and to understand coping behaviours. The data were collected through semi-structured interviews with 21 students. The findings of the interviews were used to guide the development of the conceptual research model. In the second phase, a cross-sectional survey approach was used to examine the proposed research model. The data were collected via online questionnaires from 1,188 students between March and April 2020 during the COVID-19 lockdown. The data were analysed using partial least squares structural equation modelling. The participants in both phases were undergraduate students at a public university in Saudi Arabia. The findings suggest that a consequence of using WhatsApp for learning purposes is that students suffer from fatigue, which leads to the perception of decreased performance. The reasons for the experience of fatigue were information overload, communication overload, distraction, and invasion of privacy. Students engaged in two main coping strategies in order to deal with stressors and fatigue: disturbance handling, and self-preservation strategies. The findings also revealed that during the shift to remote learning, students faced technostress mainly because of the increased adoption of ICT for teaching and learning, a high level of technology dependence, increased communication and an increase of academic work, particularly group-based work which required the use of WhatsApp and other ICT. Overall, this study extends existing technostress and coping research by examining technology-related stressors and coping behaviours in the context of the educational use of WhatsApp. The findings of the current study provide insights and guidelines for decision-makers, educators and institutions in higher education with regard to the use of mobile instant messaging in education. Understanding fatigue associated with academic use and coping strategies to deal with fatigue can help students to reduce techno-stressors, thus enhancing the effectiveness of mobile learning via WhatsApp.

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Declaration

I hereby confirm that the work presented in this thesis is my own work and original work. I declare that the material of this thesis has not been submitted either in whole or in part for the award of any other degree or diploma at this university or any other university.

The following paper has been published as a direct result of the research presented in this thesis:

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Abbreviations

Abbreviation	Full term
AU	Academic use
AVE	Average Variance Extracted
CMB	Common Method Bias
CO	Communication overload
COVID-19	Coronavirus disease 2019
CR	Composite Reliability
DH	Disturbance handling
DS	Distraction
EFA	Exploratory Factor Analysis
FT	Fatigue
GPA	Grade Point Average
HTMT	Heterotrait-Monotrait
IAU	Imam Abdulrahman bin Faisal University
ICT	Information and Communication Technology
IPL	Invasion of personal life
IP	Invasion of privacy
IO	Information overload
IS	Information Systems
IT	Information Technology
KMO	Kiser-Meyer-Olkin
MGA	Multigroup Analysis
MICOM	Measurement Invariance of Composite Model
MIM	Mobile Instant Messaging
NA	Negative affectivity
NAU	Non-academic use
PCA	Principal Component Analysis
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares Structural Equation Modelling
PP	Perceived performance
SNS	Social Networking Services
SEM	Structural Equation Modelling
SP	Self-preservation
TOL	Tolerance
VIF	Variance Inflation Factor

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Chapter 1: Introduction

1.1 Chapter overview

This chapter provides an overview of the research problem and the use of mobile messaging applications in learning with a focus on WhatsApp. The chapter introduces the concept of technostress, technology overload, and coping with technostress, and highlights gaps in technostress literature. It explains the motivations of the study and the importance of studying technostress and coping in the context of academic use. The chapter also provides an overview of the study context and online learning in Saudi Arabia. After that the research questions, aims and objectives are explained, followed by an overview of the research design and methodology. The chapter discusses the main contributions of the study and concludes with the structure of the thesis.

1.2 Background and research problem statement

Mobile instant messaging (MIM) applications have increasingly become popular over the past few years, particularly with the rapid development of mobile devices and ubiquitous Internet connectivity. In 2021, over three billion mobile phone users around the world accessed MIM applications, and this number is expected to grow by half a billion in 2025 (Ceci, 2021). WhatsApp, owned by Facebook, is currently the most popular MIM application worldwide, with around two billion monthly active users (Statista, 2022). Owing to the portability, ease of use and prevalence of MIM among young adults, there has been growing interest in incorporating such technology into teaching and learning (Gikas & Grant, 2013; Tang & Hew, 2017; So, 2016). MIM applications can provide significant benefits to students. For instance, research has demonstrated that WhatsApp has the capability to promote mobile learning whereby teaching and learning are not restricted to the classroom (Barhoumi, 2015; Bere & Rambe, 2016). This offers students the flexibility to learn at any time and from any location. WhatsApp offers spaces for collaboration, information sharing and knowledge exchange

(Pimmer et al., 2019; Rambe & Bere, 2013). Through group chat on WhatsApp, students can share learning materials in different forms (e.g. text, audio, images and video), engage in academic discussion, and organise and work on collaborative projects (Kim, Lee & Kim, 2014; Pimmer et al., 2021). In addition, WhatsApp enables students to stay connected with other students and facilitates online communication with lecturers, which can be helpful especially for distance learning (So, 2016). However, in spite of the benefits that MIM provides for education, there is also a side to this technology that can negatively impact students and learning outcomes (Aharony & Zion, 2019; Dhir et al., 2019; Fox, Rosen & Crawford, 2009). Recently, there has been a growing interest among researchers in the 'dark side' of information and communication technology (ICT), namely negative phenomena associated with ICT use, such as technostress (Pirkkalainen & Salo, 2016; Salanova, Llorens & Cifre, 2013; Tarafdar, Gupta & Turel, 2013; Turel et al., 2019). Technostress has been described as stress experienced by individuals due to their use of ICT (Ragu-Nathan et al., 2008). Technostress includes "any negative impact on attitudes, thoughts, behaviours, or body physiology that is caused either directly or indirectly by technology" (Weil & Rosen, 1997, p.5). Researchers have suggested that the use of ICT places demands on individuals and that they experience technostress due to an inability to cope with IT-related demands (Ayyagari, Grover & Purvis, 2011). Technostress has become an issue facing individuals, especially with the excessive use and the increased dependence on ICT to perform various daily activities (Salo et al., 2022; Shu, Tu & Wang, 2011). Although it is generally recognised that ICT has the capability to boost performance, evidence has demonstrated that the relationship between technology use and productivity represents an inverted U-shape (Karr-Wisniewski & Lu, 2010). In other words, increasing ICT usage can enhance performance until an optimum level is reached; once such level is exceeded, adverse outcomes occur. This issue is referred to as technology overload, which has been identified as one of the major factors creating technostress (Tarafdar et al., 2011). The main dimensions of technology overload include information overload and communication overload (Karr-Wisniewski & Lu, 2010; Zhang et al., 2016). Research has indicated that individuals experience information overload when they are exposed to a large amount of information that exceeds their information-processing abilities (Eppler & Mengis, 2004; Jackson & Farzaneh, 2012). In addition, communication overload occurs when individuals have to deal with too many incoming messages and notifications, which leads to frequent interruptions of their work (Batista & Marques, 2017; Stephens et al., 2017). Thus, while WhatsApp offers students an effortless and fast means for communication and information sharing, the use of WhatsApp for academic and non-academic-related purposes might create information and communication overload for students. Empirical research has shown that individuals who are exposed to information and communication overload can exhibit symptoms such as mental and physical fatigue, anxiety, depression, loss of motivation, frustration, and inability to concentrate (Bucher, Fieseler & Suphan, 2013; Eppler & Mengis, 2004; Matthes et al., 2020; Ravindran, Kuan, & Lian, 2014). Other negative outcomes of technostress include reduction in performance, lower job satisfaction, decreased productivity, and reduced quality of life (Tarafdar, Tu & Ragu-Nathan, 2010; Lee, Lee & Suh, 2016; Yu et al., 2018).

While many studies have focused on the advantages of using MIM in teaching and learning, little is known about how the educational use of MIM can create stress for students. Addressing this issue becomes important given the damaging effects of technostress and technology overload on individuals and their performance. Research has shown that university students are prone to different sources of stress including academic stressors, such as exam preparation and taking, meeting grade requirements and excessive numbers of assignments (Beiter et al., 2015; Karaman et al., 2017; Kumaraswamy, 2013; Misra & Castillo, 2004). The current study suggests that with the increased use of mobile technology for learning, students could face an additional source of academic stress, which is caused by the educational use of MIM. Thus, the study aims to shed light on the negative aspects of the educational use of WhatsApp. Using the transactional model of stress and coping (Lazarus & Folkman, 1984), the study seeks to identify and examine techno-stressors that lead to fatigue among university students and examine the effect of fatigue on student performance.

Another topic that the present study focuses on is coping with stress induced by academic use. Coping with technostress refers to various efforts an IT user makes to manage IT-related stressors (Bala & Venkatesh, 2016; Bhattacherjee et al., 2017). As technostress can have serious consequences on individuals' work and their well-being, there has been an increased interest in studying user coping behaviours to deal with various IT-related stressors (Tarafdar et al., 2017; Tarafdar et al., 2020; Weinert, 2018). Technostress and coping research suggest two major coping strategies that individuals are likely to use when they encounter stressful IT situations: problem-focused coping strategies, and emotion-focused coping strategies (Beaudry & Pinsonneault, 2005). In problem-focused coping strategies, individuals tend to deal with technostress by directly addressing the problem, while in emotion-focused coping strategies, individuals try to manage the stressful situation caused by IT use through changing the negative emotions associated with the situation (Lazarus & Folkman, 1984). There are different types of problem-focused and emotion-focused coping strategies identified in technostress literature. A number of studies have shown that individuals who feel fatigued by ICT usage tend to reduce fatigue by discontinuing the technology usage or by switching to alternatives (Gao et al., 2018; Luqman et al., 2017; Maier et al., 2015a). Although reducing or stopping ICT usage may help users to mitigate stress, nevertheless, in terms of fatigue created by academic use, discontinuation of technology use may not be possible for students and may have negative impacts on learning. Thus, given the potential negative impacts of technostress on students, there is a need to understand how students cope with stress induced by academic use and how coping strategies affect learning. Building on prior research into users' adaptation to IT, the current study attempts to investigate this issue. The study seeks to examine problem-focused and emotion-focused coping strategies that students use in order to deal with fatigue. Moreover, the study aims to examine the effect of coping strategies on performance.

1.3 Research motivation

There are a number of motivations for the present study, which are summarised as follows. First, research shows that mental health issues have increased among young adults in recent years (Auerbach et al., 2018; Duffy, Twenge & Joiner, 2019; Twenge et al., 2018). Among the reasons for such an increase is high academic pressure (Galloway, Conner & Pope, 2013). Research has also found a link between the time students spend on social media and poor psychological well-being (Brooks, 2015; Dhir et al., 2018; Luqman et al., 2017; Stead & Bibby, 2017; Twenge et al., 2018). However, it is still not clear whether the academic use of MIM negatively affects students' well-being or contributes to academic stress. Second, the adoption of mobile technology in education has been growing (Pimmer, Mateescu & Gröhbiel, 2016; Wu et al., 2012). Various kinds of mobile devices and applications have been increasingly used in education (Gikas & Grant, 2013), especially with the recent shift from classroom learning to remote education due to the COVID-19 pandemic (Dhawan, 2020). WhatsApp has been among the most used MIM applications for learning purposes, and its potential in education has been addressed in mobile-learning literature (Rambe & Bere, 2013; Pimmer et al., 2019; Pimmer et al., 2021; Tang & Hew, 2017). While mobile-learning research provides valuable knowledge on the role of MIM applications in supporting teaching and learning, this research has often focused on the positive sides of MIM, and little attention has been paid to the consequences of their educational use on students' well-being. Some researchers suggest that online teaching and learning is the future of education (Afshan & Ahmed, 2020; Darby, 2020). Online learning provides a solution when face-to-face teaching becomes impossible or difficult, such as in the recent situation of COVID-19; however, there is a need to address the consequences of the increased adoption and use of ICT for learning on students and learning outcomes. The present study addresses this issue by investigating how the academic use of WhatsApp creates fatigue for students and how fatigue influences their performance.

Third, technostress research has focused on techno-stressors caused by ICT use in organisational and work contexts (e.g. Galluch, Grover & Thatcher, 2015; Ragu-Nathan et al., 2008; Stich et al., 2017; Tarafdar et al., 2011). Such research examines technostress that encounters employees and its effect on job-related outcomes, such as productivity, job satisfaction and commitment. Another stream of research has examined fatigue and techno-stressors that face users in the context of ICT personal use, such as the use of social networking services (SNS) (e.g. Bright, Kleiser & Grau, 2015; Maier et al., 2015b; Tarafdar et al., 2019). This stream of research focuses on the voluntary use of ICT, as users can quit the technology usage when they feel fatigued (Maier et al., 2015a; Zhang et al., 2016). The academic use of MIM is a different context and may not be voluntary. While students using ICT for learning purposes are vulnerable to technostress, little attention has been given to this issue. For instance, in technostress literature, information overload has been identified as one of the main techno-stressors (Bucher, Fieseler & Suphan, 2013; Tarafdar et al., 2011). However, existing studies on technostress do not explain how the use of MIM for learning creates information overload for students. Thus, the current study extends technostress research by focusing on technostress experienced by students as a result of using WhatsApp for learning purposes. Furthermore, technostress studies have significantly employed a quantitative approach using surveys, and yet there has been a scarcity of technostress research based on qualitative and mixed-methods approaches (Fischer & Riedl, 2017; Tarafdar, Cooper & Stich, 2017). Researchers call for more studies employing multi-method design in the technostress domain in order to gain a richer understanding of complex technostress phenomena (Fischer & Riedl, 2017). Hence, instead of using a single method, the present investigation adopts a mixed-methods approach, which combines qualitative and quantitative methods to understand technostress in the context of academic use.

Fourth, technostress research has focused on identifying technostress creators and outcomes; however, coping with technostress has been less explored in the information systems (IS) field

(Tarafdar et al., 2020). A number of studies have focused on user adaptation to an IT event, such as the implementation of a new form of IT at the workplace (e.g. Bala & Venkatesh, 2016; Beaudry & Pinsonneault, 2010). Yet, user adaptation with daily IT-related stressors is still limited in IS literature (Pirkkalainen & Salo, 2016; Tarafdar, Cooper & Stich, 2017; Weinert, 2018). As a result, there has been a lack of knowledge on different coping strategies that individuals engage with in order to deal with techno-stressors. Therefore, the current study attempts to address this gap in the literature by focusing on students' coping mechanisms to deal with fatigue associated with WhatsApp. Given the potential negative effects of technostress on students and performance, focusing on coping behaviours can help to understand different efforts students make to reduce the negative outcomes of technostress. In addition, existing studies on coping and technostress have focused on the effect of coping behaviours on the relationship between techno-stressors and strains (e.g. Galluch, Grover & Thatcher 2015; Pirkkalainen et al., 2017); only a few studies have examined how coping strategies lead to different outcomes (Tarafdar, Cooper & Stich, 2017; Weinert & El-Robrini, 2021). Furthermore, a review of existing research on coping and technostress by Weinert (2018) suggests a need for research investigating the effects of coping strategies on the relationship between strain and IT outcomes. Thus, to address this gap in the literature, the present study examines the influence of coping strategies on performance as well as the role of coping strategies on the relationship between fatigue and performance.

1.4 Research context

1.4.1 WhatsApp

The use of mobile instant messaging (MIM) applications has dramatically grown over the last few years. There are many MIM applications available. The most popular MIM application in the world is WhatsApp, with two billion monthly active users, followed by Facebook Messenger, WeChat, QQ, Telegram and Snapchat (Statista, 2022) (see Figure 1.1). WhatsApp is a cross-platform instant messaging application that enables communication free of charge between users or a group of users through texting, voice and video calling (Church & De Oliveira, 2013). It allows the exchange of different types of content including text, photos, videos, audio, documents, location information, emojis and stickers. WhatsApp was developed by Jan Koum and Brian Acton in 2009 and was then acquired by Facebook in 2014 (Anderson, 2016). There are many factors contributing to the popularity of WhatsApp. First, the development of mobile phones along with the availability of Internet connection at an affordable cost (Church & De Oliveira, 2013), in addition to the availability of free access to the Internet in many public places, such as public libraries, universities, airports and shopping centres. The ability to communicate at no cost has facilitated international communication (Anderson, 2016). WhatsApp users can stay in touch with family, friends, and other people across the world without temporal or geographical restrictions. Second, the app is compatible with different devices and mobile operating systems (Anderson, 2016), and works on both iOS and Android, the two most dominant mobile operating systems. The app is free to download from Apple's and Google's app stores. In addition to WhatsApp's version for smartphones, there is also WhatsApp desktop, which can be downloaded on to Mac or Windows computers, and WhatsApp web, which is a web-based version of the app. The ability to use the app across platforms provides a more convenient way for users to connect from any device based on their preferences (Anderson, 2016). Third, the app is connected to phone numbers, and does not have a login feature. This makes communication via WhatsApp more personal between friends, family and other contacts the person usually knows or meets in real life (Aharony & Gazit, 2016; Anderson, 2016; Karapanos, Teixeira & Gouveia, 2016). Fourth, the app is easy to use and has user-friendly features (Yoon, Jeong & Rolland, 2015). The main function of WhatsApp is texting. This includes creating and exchanging content such as videos, photos and voice notes. Users also can share content from social media, such as tweets and YouTube videos on WhatsApp. An important function that WhatsApp offers its users is group chat. A group can be created by selecting users to be group members and giving the group a name and profile photo. Users can also join an existing group and leave a group at any time. A group can include up to 256 members. The ability to create and join groups can give users a sense of community and connection (Church & Oliveira, 2013). It enables a group of users, such as family members, friends or people who share similar interests to stay in touch, share information, engage in conversations, and exchange news. WhatsApp also enables sending messages to a broadcast list, which is different from a group chat. In a broadcast list, the recipients do not know other recipients in the list and cannot see their responses to broadcast messages, while in a group chat, the contacts are known and can see and respond to group messages (Aharony & Gazit, 2016). Another function of WhatsApp is that it provides notifications of new messages in individual and group chats. WhatsApp notifies a user of new messages through three types of notification: sounds, banners (a banner that appears on the mobile phone screen) and badges (a number that appears on the application icon showing the number of new messages). The app also notifies a user when a message has been delivered and when it has been read by the recipient. Further, in a group chat, the app provides information on who has read the message. The app enables users to set and disable notifications according to their preferences.

The current study focuses on WhatsApp rather than MIM applications in general for the following reasons. First, the examination of technostress in the context of specific IT rather than ICT in general can yield a better understanding of the technostress phenomenon (Ayyagari, Grover & Purvis, 2011; Maier, Laumer & Eckhardt, 2015). WhatsApp was chosen because it is the most popular MIM application, as discussed above, yet despite this popularity, there is still a lack of research on WhatsApp and how it can create fatigue for individuals. In addition, the app is being increasingly adopted in education for mobile learning and its positive effects on learning have been discussed in mobile-learning literature, as will be discussed in the next chapter. However, the negative effects of the educational use of WhatsApp on students and learning outcomes are still unexplored.

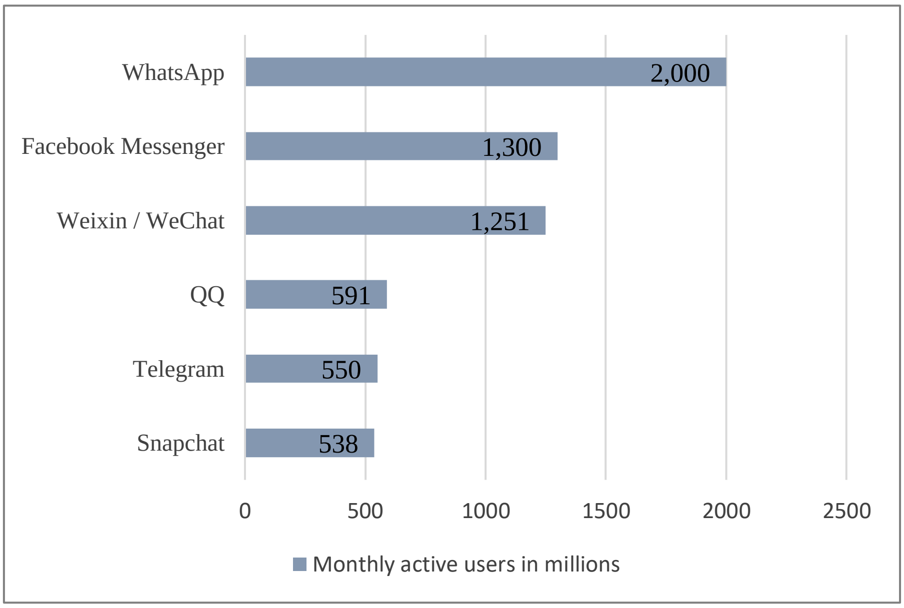

Figure 1.1: Most popular mobile messaging applications in 2021 (Statista, 2022)

1.4.2 Mobile learning in Saudi Arabia

The current study was conducted on students in Saudi Arabia. This section offers a brief overview of education in Saudi Arabia and the use of smartphones for learning in higher education.

Over the past few decades, there has been significant growth in the higher education system in Saudi Arabia. Such growth is due to the Saudi government's large investment in education. In 2021, education was the highest-spending sector, with 18% of Saudi Arabia's total budget (Gov.sa, 2021). Currently, there are 29 public and 14 private universities, along with hundreds of community colleges and an increasing number of technical and vocational training schools[1]. Technology-based learning has played an important role in the teaching and learning process in higher education. Blended learning has been adopted by most higher education institutions in Saudi Arabia, in which a combination of traditional teaching methods and online learning activities are used (Aljaber, 2018). Learning tools, such as virtual learning environments, virtual classrooms and learning management systems, are being used to support online learning (Anas, 2020). Blackboard is the most used learning management system in Saudi universities (Aldiab et al., 2019). In addition, smartphones and mobile social networking applications have been widely used by students for educational purposes (Alhaddad, 2018; Alqahtani & Issa, 2018; Alsaleem, 2013). The rapid growth of Internet services and the widespread ownership of smartphones among young adults in Saudi Arabia have facilitated online learning. The first Saudi university to connect to the Internet was King Fahd University of Petroleum and Minerals in 1993 (Alshahrani, 2016). Today, all universities and colleges in Saudi Arabia offer free Internet access (Alqahtani & Issa, 2018; Alshahrani, 2016). In addition, the Communications and Information Technology Commission (CITC) has offered 60,000 free Wi-Fi hotspots in a number of public locations across the country including hospitals, malls and public parks (Citc, 2020). Saudi Arabia is considered one of the fastest-growing Internet markets (Alshahrani, 2016). The latest statistics published by Statista research department show that the number of Internet users in Saudi Arabia rapidly increased from 18 million in 2015 to 30 million in 2020, with a population penetration of 97% (Statista, 2020a). In addition, Saudi Arabia has one of the highest smartphone penetration rates in the world, with 90% of the

[1] https://www.moe.gov.sa/en/education/highereducation/Pages/UniversitiesList.aspx

population owning a smartphone (Statista, 2020b). This ubiquitous connectivity and widespread mobile phone use have enabled students to access learning resources including lectures, assignments and quizzes, and to engage in collaborative learning at any time and from any location (Alasmari & Zhang, 2019). Students use mobile devices to search for information, share learning materials and communicate with peers and teachers (Barhoumi, 2015; Dashti & Aldashti, 2015).

The use of smartphones and mobile devices in education in Saudi Arabia has attracted research attention. The majority of existing studies have focused on the acceptance and use of mobile technology in learning from students' perspectives (Al-Azawei & Alowayr, 2020; Alasmari & Zhang, 2019; Dashti & Aldashti, 2015). Other studies have focused on the positive effects of mobile learning on learning outcomes (Alsaleem, 2013; Barhoumi, 2015; El-Sofany & El-Haggar, 2020; Fattah, 2015; Hazaea & Alzubi, 2016). Thus, existing studies in the Saudi context have mostly focused on the positive side of using mobile phones in education, while the negative effects of such technology on students and learning have received scant research attention. Few studies have investigated the negative influence of mobile phones on students. For example, studies have found that university students in Saudi Arabia suffer from consequences such as smartphone addiction, poor sleep quality, unhealthy lifestyles and low academic performance due to smartphone and SNS usage (Aljomaa et al., 2016; Alosaimi et al., 2016; Asiri et al., 2018). While these studies highlight some consequences of smartphone usage on students, they do not focus on academic use. Furthermore, stress caused by technology use has been largely ignored.

The current study focuses on Saudi Arabia for the following reasons. First, given the growing usage of mobile phones among university students and the increasing interest in adopting mobile learning in higher education in Saudi Arabia, there is a need to investigate the effects of using mobile technology on students and learning, from both a positive and negative perspective. Second, WhatsApp is the most used MIM application in Saudi Arabia, with over 26 million active users (about 80% of the population) (Statista, 2021). Considering that the study focuses on WhatsApp, the popularity of WhatsApp among students in Saudi Arabia makes this country appropriate for the current investigation to explore the academic use of the app and to shed light on its negative effects. Finally, the Saudi government invests largely in education and educational technology, thus in order to leverage educational use and achieve better learning outcomes, there is also a need to address the negative effects of technology use on students' well-being and educational outcomes. The results of the study would be useful for researchers, educators and policymakers in Saudi higher education who are interested in mobile learning and its effect on learning outcomes.

1.5 Research questions, aim and objectives

Given the importance of understanding students' experience of technostress and the absence of research addressing this topic, the aim of the current study is to investigate techno-stressors that are associated with the academic use of WhatsApp, and which lead to fatigue among university students. In addition, the study aims to investigate students' coping behaviours to deal with fatigue and to examine the effects of fatigue and coping on performance. The stated aims of the study will be achieved by fulfilling the following research objectives:

1. Develop a deep understanding of the concept of technostress and its components, and of the concept of coping in the IS domain.
2. Understand students' perception of the academic use of WhatsApp and the negative side of such use that creates fatigue.
3. Investigate how the use of WhatsApp for learning purposes creates information and communication overload.
4. Explore students' coping behaviours to reduce fatigue, and techno-stressors associated with WhatsApp.
5. Develop a theoretical model that explains the relationships between techno-stressors, fatigue and coping behaviours.
6. Empirically validate the proposed model by examining the effects of techno-stressors on fatigue and the influence of fatigue on performance and coping strategies.
7. Examine the role of coping strategies as mediators of the relationship between fatigue and performance.

The research objectives lead to the formulation of the following research questions for this study:

RQ1. What are the significant techno-stressors that lead to fatigue among students?
RQ2. What factors contribute to information and communication overload when using WhatsApp for learning?
RQ3. What are the main coping strategies that students use to deal with fatigue?
RQ4. What are the effects of fatigue and coping strategies on performance?

1.6 Research design and methodology

In order to develop a better understanding of fatigue created by the academic use of WhatsApp, the study follows a mixed-methods approach, specifically exploratory sequential design. This is a two-phase design, starting with a qualitative approach to explore the topic of interest in depth followed by a quantitative study (Creswell & Clark, 2007). A mixed-methods design was chosen because the combination of qualitative and quantitative methods enables a better understanding of different aspects of the phenomenon under study (Mingers, 2001; Venkatesh, Brown & Bala, 2013). Qualitative methods can offer rich information and in-depth insights on the research problem while quantitative methods can produce a comprehensive view and provide breadth to the study by allowing researchers to collect data from many participants (Venkatesh, Brown & Bala, 2013). Several data collection methods and data analysis techniques were used throughout the execution of the study. It was conducted in two phases as described below.

In the first phase, an extensive review of relevant literature on the concepts of technostress and coping was conducted in order to develop a deep understanding of the study constructs and to build the theoretical foundation of the study framework. Given the limited studies on stress caused by educational use in general and in the Saudi context in particular, a qualitative exploratory study was conducted in the first phase of the current investigation. The overall aim of the exploratory phase was to develop an in-depth understanding of fatigue and technology overload associated with WhatsApp use and to investigate coping behaviours. Semi-structured interviews were carried out with 21 undergraduate students at Imam Abdulrahman bin Faisal

University (IAU), a public university in Saudi Arabia. The interviews helped to obtain rich information about techno-stressors associated with academic use from students' perspectives. In addition, this method was used to gain insight into how academic use leads to information overload and the factors contributing to this problem. The interviews also focused on students' coping behaviours to deal with fatigue and techno-stressors. The qualitative data were analysed using thematic analysis (King & Brooks, 2017). The results of the qualitative phase identify key factors that create fatigue for students and determine the main coping strategies. The results provided insights for the development of the study's conceptual model. Furthermore, the qualitative data were used to guide the development of the measurements for the quantitative phase.

The second phase used a cross-sectional survey approach to collect the necessary data that would enable the examination and validation of the proposed research model. This phase began with the development of the research hypotheses, using technostress literature as well as the findings of the qualitative phase. To test the hypotheses, an online questionnaire instrument was developed. To ensure the validity of the measurements of the key construct, items from existing literature were adopted. Furthermore, prior to the distribution of the main survey, multiple pilot tests were performed to ensure the validity and reliability of the study instrument. The main study was conducted between March and April 2020, specifically during the shift to remote learning due to the spread of COVID-19. The online questionnaires were distributed via university email to students at IAU. In total, 1,188 complete responses were obtained, which were enough for the execution of structural equation modelling (SEM) in the data analysis stage. Prior to implementing SEM, data examination and cleansing, including the detection of missing data and outliers and testing normality, were performed to ensure the data met the requirements of the SEM technique. Partial Least Squares (PLS), a form of SEM, was performed using SmartPLS software to validate the research model and test the hypotheses (Hair et al., 2017a). The analysis was conducted in two steps. First, the reliability and validity of the measurement models were evaluated using several tests. Once the validity and reliability of the measurements were established, the structural relationships between the constructs were tested. Given the fact that the qualitative study was conducted before the COVID-19 pandemic, whereas the survey was administered during the transition to remote learning, follow-up interviews with five students who also participated in the main interviews were carried out in April 2020. The purpose of the follow-up interviews was to obtain additional information that would help to understand how the academic use of WhatsApp was influenced by the shift to remote learning and the COVID-19 lockdown. The follow-up interviews were needed to explore how this shift might affect students' responses in the quantitative study. The results of the interviews were used to provide an explanation for the quantitative phase results.

1.7 Research contribution

The current study aims to investigate fatigue created by academic use and its effect on performance, as well as coping strategies. The findings of the study will provide contributions to technostress and coping literature as well as to mobile-learning research. The findings will also offer several practical implications. From a theoretical perspective, the present study will extend existing technostress research and contribute to emerging research on the dark side of information technology by focusing on stress caused by the use of technology for educational purposes and its consequences on students and their performance. This study is among the first to address fatigue experienced by university students due to the academic use of MIM. The study advances the understanding of technostress in the context of academic use by identifying and empirically examining stress creators. Moreover, the study will explore how the academic use of WhatsApp leads to information and communication overload and will identify factors that contribute to overload in WhatsApp study groups. Distinct from previous studies that have focused on the benefits of MIM in education, the current study will enrich mobile-learning research and distance-learning literature by shedding light on the consequences of using MIM in learning. In addition, the findings of the study will contribute to literature on coping with technostress by examining coping strategies that students use when faced with WhatsApp fatigue. Furthermore, the study will examine the effect of coping strategies on performance as well as on the relationship between fatigue and performance.

From a practical perspective, the findings of the current study will provide insights and guidelines for decision-makers, educators, and institutions in higher education with regard to the use of MIM in education. By addressing the negative effects of MIM on students and their performance, the findings of the study can be used to minimise the negative outcomes of MIM by helping students to reduce techno-stressors associated with academic use, while at the same time leveraging MIM to enhance learning outcomes. By focusing on fatigue and techno-stressors, teachers and educators can use the findings of the study to increase awareness among students on the consequences of technology use on their psychological well-being and learning. Moreover, by addressing coping strategies, the findings would be useful for students to help them to develop coping strategies to deal with techno-stressors, thereby reducing fatigue and increasing the effectiveness of the academic use of MIM. The study will also offer implications relevant to WhatsApp service providers and designers. As fatigue caused by MIM use can drive people away from using the technology, thereby negatively affecting MIM business (Luqman et al., 2017; Ravindran, Kuan & Lian, 2014; Zhang et al., 2016), highlighting aspects of technology that contribute to the experience of fatigue might help WhatsApp service providers to eliminate users' exposure to techno-stressors, thereby enhancing user experience and maintaining their user base.

1.8 Structure of thesis

This thesis consists of eight chapters. The content of each chapter is described below.

Chapter 1: Introduction. This chapter provides background on the research problem and the use of MIM with the focus on WhatsApp for learning purposes. It gives an overview of the context of the study and of mobile learning in Saudi Arabia. It then explains the gaps in the technostress and coping literature, which have motivated the current investigation. Afterwards, the research questions and objectives are presented, followed by an overview of the research design used in this study. Then the chapter provides a summary of the study's contribution.

Chapter 2: Literature review. This chapter presents a comprehensive and critical review of existing literature on technostress and coping with technostress, as well as the key constructs in the current study, namely technology overload, information overload, communication overload, IT-related fatigue, and technology invasion. The chapter also provides background on the concept of stress and coping and explains the transactional model of stress. It begins with an overview of the concept of mobile learning and the educational use of WhatsApp in order to present the research's contextual background and establish the importance of the research topic. The overall aim of the chapter is to build a deep understanding of the concept of technostress and its components, highlight gaps in the literature and provide the underlying theoretical foundation of the study framework.

Chapter 3: Methodology. This chapter explains the philosophical assumptions underpinning the current study and the selected research design and methods. It describes the chosen research paradigm, namely pragmatism, and justifies the use of a mixed-methods approach. The chapter provides information and explanation on different data collection methods, data analysis methods, and sampling techniques used in the qualitative and quantitative phases of the study. The chapter also discusses the ethical considerations that were followed in the study phases.

Chapter 4: Qualitative data analysis and results. The chapter describes the procedures of data collection and data analysis that were followed in the qualitative phase of the study, provides an in-depth analysis of the collected data, and reports the findings. The chapter also provides a discussion and interpretation of the findings.

Chapter 5: Academic use of WhatsApp during the COVID-19 lockdown. This chapter provides information on how the academic use of WhatsApp was affected by the shift to remote learning due to the spread of COVID-19. The chapter briefly describes remote learning during the pandemic, then explains the procedure of data collection and data analysis and presents the findings of follow-up interviews.

Chapter 6: Development of the conceptual model and the study instrument. This chapter focuses on the quantitative phase. It starts with the development of the conceptual model of the current study and the proposed research hypotheses, then describes the process of developing and validating the study instrument. It describes the design of the questionnaires and the procedure followed in the development of the measurement items for the study constructs. It then presents the results of the pilot study that was conducted to validate the study instrument.

Chapter 7: Quantitative data analysis and results. This chapter provides information on the data collection procedure and statistical analysis techniques used in the quantitative phase. It provides descriptive statistics of respondent characteristics, then presents in detail the statistical methods that were performed to analyse the collected data, including the detection of normality and outliers, PLS analysis, collinearity assessment, common method bias test, and multigroup analysis. The chapter reports the results of the data analysis and provides an overall discussion and interpretation of the quantitative findings.

Chapter 8: Discussion and conclusion. The final chapter in this thesis provides a summary and a general discussion of the overall results of the qualitative and quantitative phases. It discusses the theoretical contributions and the practical implications of the study findings. The chapter concludes with the limitations of the study and provides suggestions for future research.

Chapter 2: Literature review

2.1 Chapter overview

This chapter reviews the relevant literature on technostress and coping with technostress, and provides theoretical background on the key concepts used in this study. The aim of this chapter is to build a thorough understanding of the theoretical background to the study as well as to identify gaps in the existing literature. The chapter covers three main topics: WhatsApp and mobile learning, technostress theories and research, and coping theory and research in the IS domain. It starts with an overview of mobile learning then explains the educational use of WhatsApp as a form of mobile learning and highlights the discrepant findings regarding the effectiveness of WhatsApp in learning. The chapter provides background on the technostress phenomenon and explains how it has been defined in the literature, followed by a review of existing research on technostress in IS literature in order to identify gaps in the literature. After that the concept of stress and the transactional model of stress, which constitutes the theoretical basic of technostress are discussed. The key concepts used in this study, namely technology overload, information overload, communication overload, technology invasion and social media fatigue, are then defined and discussed in detail. The chapter then focuses on coping with technostress. This part of the chapter sets out the concept of coping, gives an overview of studies on coping in IS literature, highlights gaps within coping literature, and discusses the coping model of user adaption.

2.2 WhatsApp and mobile learning

Mobile learning, a form of distance learning is defined as the utilisation of ubiquitous portable technologies as well as wireless and mobile networks to facilitate, promote, enhance and extend teaching and learning (Hashemi et al., 2011). The main characteristic of mobile learning is *mobility*; learning can take place at any time and anywhere through mobile devices, such as smartphones, laptops, and tablets (Moreira et al., 2018; Wu et al., 2012). Learning can occur in traditional settings, such as classrooms, and outside of classrooms, such as at home and work

(Hashemi et al., 2011; Pimmer et al., 2019). Other important features of mobile learning include *collaborative learning* (enabling a group of students in different locations to work together on a project) and *interactivity* (enabling students to interact with other students and teachers at different locations) (Gikas & Grant, 2013; Moreira et al., 2018).

The educational use of WhatsApp has been recognised as a form of mobile learning (Barhoumi, 2015; Pimmer et al., 2019; Rambe & Bere, 2013; So, 2016). Research has indicated that WhatsApp can promote collaborative learning and knowledge co-construction (Nyasulu & Chawinga, 2019; Rambe & Bere, 2013). By enabling up to 256 people to form a group, WhatsApp offers dialogic spaces for students in which academic discussions as well as informal conversations can take place (So, 2016). WhatsApp creates spaces for formal and informal teaching and learning, and encourages interaction between students and lecturers (Gachago et al., 2015). In addition, WhatsApp can facilitate students' work outside classrooms. It can help a group of students to effectively coordinate and perform group projects (Ngaleka & Uys, 2013). Information availability is another educational benefit that WhatsApp provides through anywhere, anytime access to learning resources (Tang & Hew, 2017). As WhatsApp enables quasi-synchronous communication, conversations are retained and information can therefore be accessed and retrieved at any time using chat history (Nyasulu & Dominic Chawinga, 2019). Moreover, WhatsApp facilitates just-in-time learning (Rambe & Bere, 2013). Students can get help when they need it by asking their peers or lecturers, such as when they need help with coursework or during exam preparations. WhatsApp also has the potential to enhance social presence through functions, such as audio, video, voice notes, images and emoticons, which enable expression of emotions and feelings (Tang & Hew, 2017). The app can be used by students as a tool to provide social and emotional support for their peers (Park & Noh, 2018; Timmis, 2012). Research has demonstrated that social presence can help students overcome negative feelings, such as stress, loneliness and isolation (Pimmer et al., 2018).

In spite of the growing number of studies on the educational benefits of WhatsApp, mobile-learning literature has shown inconsistent findings regarding whether WhatsApp has significant effects on students' learning outcomes. Studies have shown positive influences of WhatsApp. For example, So (2016) found that the use of WhatsApp outside school improved students' knowledge on the course they were studying. Pimmer et al. (2019) reported that students who used WhatsApp for learning purposes developed higher levels of knowledge and fewer feelings of professional isolation compared to their peers who did not use the app. Tarighat and Khodabakhsh (2016) found that WhatsApp can be an instrumental tool for language learning. Students can practise their speaking skills by recording their speech and sharing it on WhatsApp group chat in order to get feedback from their lecturers and peers. Likewise, Alsaleem (2013) examined the effect of WhatsApp on learning English as a foreign language and showed that WhatsApp significantly improved students' writing vocabulary. Barhoumi (2015) indicated that the use of WhatsApp to support blended learning positively influenced students' learning performance and their attitudes towards mobile learning using WhatsApp.

Neutral or negative findings regarding the effectiveness of WhatsApp in learning have also been reported in the literature. Studies have shown no significant effect of using MIM on students' performance. For example, a systematic review of the use of MIM in education by Tang and Hew (2017) revealed that five studies found positive association between MIM use and learning outcomes, whereas two studies reported no influence or even an adverse influence of MIM use. An experiment by Lai (2016) found no significant difference between a WhatsApp-based learning group and a control group with regard to English vocabulary gain. Gon and Rawekar (2017) reported no significant difference in knowledge acquisition between learners who received teaching and learning via WhatsApp and those who were taught through didactic lectures. Similar to these findings, a study by Jayarajan, Lee and Mwaikambo (2017), which employed WhatsApp group chat to provide a training programme for health workers and students, found no significant difference between pre-test and post-test assessment with regards to knowledge gain. Furthermore, Aharony and Zion (2019) conducted an experiment to examine the influence of distractions caused by WhatsApp use on students' working memory. They showed that using WhatsApp during performing a learning task declined working-memory performance and led to a decrease in learning effectiveness.

In summary, the above discussion suggests that although WhatsApp can provide numerous benefits to education, its influence on student cognitive outcomes, such as learning performance, is still not conclusive. A possible explanation of such inconsistent findings can be that existing studies have focused mostly on the advantages of using WhatsApp in education; however, its negative effects on students are often overlooked. Some studies highlighted challenges of using WhatsApp for learning. For example, Nyasulu and Dominic Chawinga (2019) reported factors hindering the adoption of WhatsApp by students and educators, namely the high cost of ICT used to access WhatsApp, internet connection issues and WhatsApp distractions. The issue of distractions was also discussed by Yeboah and Ewur

(2014), who reported that students wasted their time on WhatsApp chatting with friends instead of engaging in learning activities. Another challenge of using WhatsApp reported by Rambe and Bere (2013) included participants' dissatisfaction with the merging of academic and personal lives on WhatsApp. Moreover, a recent review of existing studies on the educational use of WhatsApp reports that the app promotes addictive behaviour, wastes students' time and creates communication overload for students and teachers (Suárez-Lantarón et al., 2022).

Other studies addressed the disadvantages of mobile learning in general and did not focus on specific technology. The reported disadvantages were mostly concerned with technical aspects, such as unreliable and unsafe internet connection and the small size of mobile devices, particularly smartphones (Milošević et al., 2015; Moreira et al., 2018). However, no attempt has been made to empirically examine the negative effects of educational use of WhatsApp on learning outcomes. Moreover, prior studies do not take into account the consequences to students' well-being through the use of WhatsApp for learning.

The adoption of mobile learning in education has become increasingly inevitable, particularly during crises where face-to-face teaching is not possible, such as the COVID-19 pandemic (Bygstad et al., 2022; Gutentag, Orner & Asterhan, 2022). This transition into digital education during COVID-19 created additional stress for students associated with managing ICT and gaining the required knowledge for ICT use (Sharma & Gupta, 2022). Recent studies have demonstrated that students can suffer from learning burnout and technostress due to the increased use of ICT for learning (Fauville et al., 2021; Upadhyaya & Vrinda, 2021; Zhao et al., 2022). Technostress among students might consequently lead to a decrease in productivity and academic performance (Upadhyaya & Vrinda, 2021). While MIM can be an effective tool promoting remote learning (Gutentag, Orner & Asterhan, 2022), research also shows that ICT use does not always result in enhancing academic achievement (Zhu & Li, 2022) and students can achieve better learning outcomes without relying on digital tools such as social media and virtual learning environment (Lacka, Wong & Haddoud, 2021).

Given the growing interest in mobile learning and the increasing use of mobile devices among students, it becomes necessary to consider both positive and negative effects of MIM on students and their academic performance. Furthermore, the inconsistency of research relating to the effectiveness of mobile learning suggests a need for an empirical investigation to examine the negative sides of MIM in education, which might also have impacts on learning outcomes. Addressing this issue can provide a better understanding of the effectiveness of mobile learning via MIM in general and via WhatsApp in particular. It might also provide an explanation for how the use of MIM can lead to reduced academic performance. For instance, Dhir et al. (2019) examined the effect of fatigue caused by WhatsApp on students' performance and found that fatigue was positively associated with decreased performance. Nevertheless, they focused on WhatsApp for non-learning purposes and did not link fatigue to educational use, which results in a lack of understanding of how educational use of WhatsApp can lead to fatigue and consequently influence performance. The current study seeks to explore such an issue.

2.3 The concept of technostress: Background and definition

The development in information and communication technology (ICT) has brought many advantages for individuals and organizations. Advanced ICT has facilitated communication, information sharing, collaboration and enabled individuals to perform tasks more effectively. Although ICTs can provide significant benefits for individuals at work and in daily life, they also have negative side effects (Tarafdar et al., 2015; Turel et al., 2019). In recent years, there has been an increasing interest in the negative effects of ICT use that have consequences for individuals and organizations, particularly stress caused by ICT use, a phenomenon known as technostress (Fischer & Riedl, 2017; Salanova, Llorens & Cifre, 2013). The term 'technostress' is developed based on the root concept of stress, which is described as an individual's physiological and psychological response to external demands or stimuli (Cooper, Dewe & O'Driscoll, 2001). Researchers suggest that stress is not always harmful for individuals but can be beneficial depending on how the person appraises a stressor (Califf, Sarker & Sarker, 2020; Lazarus & Folkman, 1984; Weinert & El-Robrini, 2021). Selye (1974) distinguishes between eustress 'good stress' and distress 'bad stress'. While eustress is associated with a positive perception of stressors and can lead to positive outcomes, distress is associated with a negative reaction to stressors and can result in negative outcomes (Le Fevre, Matheny & Kolt, 2003; Selye, 1974). An individual's appraisal of a stressful demand as a challenge or a threat can lead to eustress or distress (Lazarus & Folkman, 1984). Thus, in terms of stress caused by IT use, techno-eustress is a result of an individual's appraisal of techno-stressors as challenges whereas techno-distress is a result of the perception of techno-stressors as threats (Salo et al., 2018;

Tarafdar, Cooper & Stich, 2017). In the IS literature, technostress has been widely investigated as a phenomenon associated with the "dark side" of ICT use, namely from the techno-distress perspective (Tarafdar, Cooper & Stich, 2017). The terms technostress and techno-distress have been often used interchangeably in technostress research. The current study focuses on technostress from the distress perspective in order to investigate the negative effect of academic use and its consequences on students. Thus, the term technostress is used in this study to indicate techno-distress, namely the negative side of stress.

Stress associated with computer technology usage is not a recent issue facing individuals; in fact, the concept of technostress was introduced first in the 1980s by Brod, who defined it as "a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner" (1984, p. 16). Likewise, Hudiburg (1989) indicated that computer technology places demands on individuals, and people experience stress when they become unable to deal with these demands. Weil and Rosen (1997) extended the definition of technostress to encompass "any negative impact on attitudes, thoughts, behaviours, or body physiology that is caused either directly or indirectly by technology" (p. 5). As information technology is rapidly developing and has become ubiquitous, technostress has become an issue facing everyone, as Weil and Rosen (1997) described in their book *Technostress: Coping With Technology @ Work @Home @Play* : "*Today, there is more technology than ever before…Technostress is for everyone. Each of us experiences some degree of stress from technology. Even if we are comfortable with certain technologies, others leave us frustrated, overwhelmed, or feeling downright stupid"* (p. vii). The main reasons for technostress can be summarised in two points. First, technostress occurs due to the inability of individuals to cope with continuously evolving ICT and the changing physical, mental and social demands associated with ICT usage (Tarafdar, Tu & Ragu-Nathan, 2010). As ICTs have facilitated information sharing and communication, individuals can easily be exposed to too much information, which can lead to an increase in the pace and volume of the workload (Ayyagari, Grover & Purvis, 2011; Tarafdar et al., 2011). In addition, the availability of different sources of information and communication can create frequent interruptions in individuals' work and lead to communication overload (Galluch, Grover & Thatcher, 2015). ICT makes it possible for individuals to be reached anytime and anywhere and creates a feeling of being constantly connected to work, thus leading to invasion of work into personal life (Bucher, Fieseler & Suphan, 2013; Lee, Lee & Suh, 2016). The complexity of ICT and frequent changes and updates in system features can also create stress for individuals associated with an inability to adapt to new software and hardware updates (Karr-Wisniewski & Lu, 2010; Tarafdar et al., 2007). Second, technostress is an outcome of increased dependency and reliance on ICT that has been witnessed in every aspect of peoples' lives (Salo et al., 2022). Although ICT can enhance the performance of individuals at work, the extensive use and increased reliance on ICT can result in adverse outcomes (Gaudioso, Turel & Galimberti, 2017). Research has shown that technostress is experienced by individuals who are heavily dependent on ICT in their work (Arnetz & Wiholm, 1997; Shu, Tu & Wang, 2011).

Technostress can lead to adverse outcomes for individuals and their work (Tarafdar, Cooper & Stich, 2017). The effects of technostress on individuals can be psychological, physical or behavioural. Psychologically, individuals can suffer from symptoms, such as fatigue, anxiety, burnout, reduced job satisfaction and decreased satisfaction with IT use (Agogo & Hess, 2018; Maier, Laumer & Eckhardt, 2015; Salanova, Llorens, & Cifre, 2013; Tarafdar et al., 2011). Physically, individuals can experience physical fatigue, an increase in stress hormone levels and other health problems (Galluch, Grover & Thatcher, 2015; Tams et al., 2014). Technostress can cause behavioural strains, such as reduced user productivity, lack of innovation at work and reduce IT usage (Tarafdar et al., 2011; Yu et al., 2018).

2.4 Overview of prior research on technostress

In the IS literature, the phenomenon of technostress has gained much attention over the past decade (La Torre et al., 2019; Tarafdar, Cooper & Stich, 2017). Given the significance of technostress and its consequences on organisations and individuals, technostress research has focused on investigating technostress creators and their negative outcomes (Lee, Lee & Suh, 2016; Tarafdar et al, 2011 Whelan, Islam & Brooks, 2020a). Studies have also investigated antecedents of techno-stressors, such as technical characteristics that can influence techno-stressors and consequently lead to strain (Ayyagari, Grover & Purvis, 2011; Maier et al., 2015b; Salo, Pirkkalainen & Koskelainen, 2019). Other studies have focused on technostress inhibitors, which are moderators of technostress that can mitigate the effects of technostress on individuals, such as technical support provision, technology involvement facilitation and innovation support (Ragu-Nathan et al., 2008; Tarafdar, Pullins & Ragu-Nathan, 2015). Moreover, technostress research has examined the effects of personality characteristics, such as neuroticism, extraversion, openness to experience, conscientiousness, agreeableness, locus of control, self-efficacy on technostress creators and strain (Galluch, 2015; Pflügner, Mattke & Maier, 2019; Srivastava, Chandra & Shirish, 2015; Xiao & Mou, 2019).

Existing research on technostress can be classified into two research streams (see Table 2.1). The first research stream has examined the technostress phenomenon in organisational contexts. Studies in this stream explore how the use of ICT for work-related tasks can create stress among individual employees and the consequences of this stress on job-related outcomes. For example, Tarafdar, Pullins, and Ragu-Nathan (2015) examine the effects of techno-stressors (i.e. overload, invasion, complexity, insecurity and uncertainty) on innovation and task performance. They reported that techno-stressors have negative impacts on overall employees' work performance. Hung, Chen and Lin (2015) investigated the impact of accessibility, information overload and communication overload on mobile phone users' productivity at work. Park, Kim and Lee (2020) addressed the impact of using smartphones for work-related purposes outside of working hours on individuals' well-being and found that smartphone use after work leads to job burnout.

The other research stream includes studies that have focused on technostress experienced by individuals in the context of the personal use of ICT. For instance, Salo, Pirkkalainen and Koskelainen (2019) explored SNS stressors and their consequences on users' well-being and found that SNS users suffered from concentration, sleep, identity and social relation problems. Fox and Moreland (2015) investigated psychological stressors associated with Facebook usage, such as managing inappropriate or annoying content, lack of privacy and control, and social comparison. Other studies in this stream investigate how social-media activities lead to fatigue among users and how they respond to SNS fatigue (e.g. Dhir et al., 2018; Xiao & Mou, 2019; Zheng & Lee, 2016).

In most organisational contexts, the use of ICT for work-related purposes is considered less voluntary and more mandatory (Bhattacherjee et al., 2017). Individuals rarely have control over their decision to use or not use ICT. Causes of technostress are mostly associated with work-related factors such as work overload, job insecurity and role ambiguity (Ayyagari, Grover & Purvis, 2011). In addition, in the context of organisational use, individuals have access to organisational resources that can help mitigate technostress, such as supervisor support and technical support (Park, Kim & Lee, 2020; Ragu-Nathan et al., 2008). On the other hand, in personal-usage contexts, the use of ICT is voluntary. Individuals can use ICT whenever they want to and stop using it at any time. Therefore, when individuals feel stressed by ICT usage they might abandon the technology causing the stress (Zhang et al., 2016), and might switch to alternatives in order to reduce stress (Maier et al., 2015b). In educational use contexts, students use MIM for various learning purposes such as to communicate with other students, share information, news and study materials, and to perform learning tasks. Students might also face stress associated with educational use, particularly with the increased reliance on mobile technology. Unlike personal use, educational use in most cases is considered necessary and without using ICT students may not be able to continue their learning effectively. Although educational use differs from the aforementioned usage contexts, it has not been given much attention. Little is known about how the use of MIM for academic purposes can be a source of stress for students and how they can adapt to it. A review of technostress literature shows that there is a lack of research on technostress in the context of educational use. Few studies have discussed the effect of technostress on students and their performance (e.g. Shi et al., 2020; Whelan, Islam & Brooks, 2020a); however, these studies focus on personal use and do not investigate how educational use can effect students' well-being. Understanding technostress in the context of educational use is important given the pervasive use of ICT in education. In addition, using ICT for learning is not totally voluntary, thus to discontinue using technology may not be a possible option for students feeling stressed by technology use. Focusing on educational use extends existing literature on technostress and allows better understanding of techno-stressors experienced by students and their consequences.

Table 2.1: Summary of prior studies on technostress

Article	Context	Techno-stressors	Strains	Outcomes	Technostress mitigations/ inhibitors
Tarafdar et al. (2007)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	Reduced productivity	-	-
Ragu-Nathan et al. (2008)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	Job satisfaction	Organisational commitment, continuance commitment	Literacy facilitation, technical support provision, involvement facilitation
Tarafdar, Tu & Ragu-Nathan (2010)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	End-user satisfaction, end-user performance	-	Innovation support, involvement facilitation
Ayyagari, Grover & Purvis (2011)	Organisational/ work ICT use	Work–home conflict, invasion of privacy, work overload, role ambiguity, job insecurity	Work exhaustion	-	-
Yan et al. (2013)	Organisational/ work ICT use	Work overload, role ambiguity	Work exhaustion	-	-
Fuglseth & Sørebø (2014)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	Reduction in employees’ satisfaction with ICT use	Employee intention to extend ICT use	Involvement facilitation, technical support provision, literacy facilitation

Galluch et al. 2015	Organisational/ work ICT use	ICT enabled interruptions, overload, conflict	Physiological strain (increased stress hormone excretion), psychological strain	-	Method control, resource control, timing control
Tarafdar, Pullins & Ragu-Nathan (2015)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	Sales performance	-	Technology self-efficacy, technostress inhibitors
Maier et al. (2015a)	Personal/ leisure SNS use	Complexity, uncertainty, invasion, disclosure, pattern, social overload	SNS exhaustion, discontinuous usage intention	Discontinuous usage behaviour	-
Maier et al. (2015b)	Personal/ leisure SNS use	Social overload	SNS exhaustion, SNS satisfaction, SNS discontinuous usage intention	-	-
Lee, Lee & Suh (2016)	Organisational/ work ICT use	Social interaction stressors (communication overload, social insecurity, compulsive usage), personal life stressors (work overload, invasion of life, work–home conflict)	Exhaustion	Productivity, decreased life satisfaction	-
Chaouali (2016)	Personal/ leisure SNS use	Information overload, social overload	Emotional exhaustion	Decreased continuous usage intention	-
Yao & Cao (2017)	Personal/ leisure SNS use	Social interaction overload, invasion of work, invasion of privacy	Exhaustion	Rational usage intention	

Pirkkalainen et al. (2019)	Organisational/ work ICT use	Techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty	IT-enabled productivity	-	IT control, positive reinterpretation, distress venting, distance from IT
Park, Kim & Lee (2020)	Organisational/ work IT use	Work-related smartphone use	Job burnout	-	Supervisor support, peer support, perceived organisational politics
Weinert et al. (2020)	Personal/ leisure ICT use	Techno-unreliability (computer freeze)	End-user performance, techno-exhaustion, physiological arousal		Instrumental support, emotional support
Whelan, Islam & Brooks (2020a).	Personal/ leisure SNS use	Communication overload, information overload	Deficient self-regulation	Reduced academic performance	-
Califf et al. (2020)	Organisational/ work IT use	Challenging techno-stressors (usefulness, technical support, involvement facilitation), hindering techno-stressors (overload, invasion, complexity, insecurity, uncertainty)	Positive/negative psychological response	Job (dis)satisfaction, attrition, turnover intention	-
Schmitt, Breuer & Wulf (2021)	Organisational/ work IT use	The use of video-conferencing tools, text-based tools	Cognitive overload	Work performance, Well-being	Digital detox

2.5 Theoretical foundation of technostress

2.5.1 Stress models and theories

The term ‘stress’ has been defined in many ways across different disciplines (Cooper, Dewe & O’Driscoll, 2001). It has been defined as a response to external stressors, stimuli or events in the environment, or interaction between the individual and the environment. The response-based model of stress originating in the fields of medicine and biology views stress as the response of an organism to a threat in the environment, with Cannon (1932) describing it as a fight-or-flight response. Similarly, Selye (1976) described stress in terms of a physical reaction as “a nonspecific response of the body to any demand made upon it” (p.137). One limitation of this approach is that it focuses on a physiological reaction of an individual to stressors but not on the nature or sources of stress (Lazarus & Folkman, 1984). Therefore, it is considered inadequate for explaining stress, as response cannot be addressed without reference to its cause (Cooper, Dewe & O’Driscoll, 2001). Stress has been also defined as a stimulus. The stimulus-based model of stress has its roots in engineering and physics, in which stress is viewed as a force exerted which in turn produces a demand or load reaction, thereby creating deformation (Cooper, Dewe & O’Driscoll, 2001). This approach focuses on external events or conditions in the environment, known as stressors, which cause stress; therefore, the major concern of this approach is to identify potential sources of stress (Lazarus, 1990).

Both response and stimulus approaches have limitations (Lazarus & Folkman, 1984). To define stress as a response or a stimulus means focusing on one component of the stress process, either on sources of stress or on its consequences, and ignoring the interaction between the two (Cooper, Dewe & O’Driscoll, 2001). In addition, neither approach takes into account individuals’ differences and their perceptions and appraisal of stressors because two individuals exposed to the same situation might react in different ways (Lazarus & Folkman, 1984). People differ in their sensitivity and vulnerability in certain situations and in their reaction to them (Lazarus & Folkman, 1984). Therefore, due to these limitations, these approaches have been considered insufficient to provide a comprehensive explanation for the phenomenon of stress (Cooper, Dewe & O’Driscoll, 2001; Lazarus & Folkman, 1984).

2.5.2 The transactional model of stress

The transactional model of stress has addressed the shortcomings of response and stimulus approaches, and it treats stress as a process that involves individuals transacting with their environments, appraising encounters and trying to cope with them (Cooper, Dewe & O'Driscoll, 2001; Lazarus & Folkman, 1984). It argues that stress is not a factor that exists as an environmental input, as a stimulus approach suggests, or in the person, as the response approach suggests, but is embedded in the person–environment relationship (Edwards & Cooper, 1990; Lazarus, 1990). Stress as a process includes an environmental event or condition facing the person; the person's appraisal of the encounter as harmful, threatening or challenging; coping responses to manage the stressful encounter, which then lead to outcomes (Lazarus & Folkman, 1984; Tarafdar, Cooper & Stich, 2017). The transactional approach emphasises the relationship between the person and the environment. It takes into account the characteristics of the person and the nature of the stressful events (Lazarus & Folkman, 1984). Stress arises due to imbalance between environmental demands and an individual's ability to meet these demands (Edwards & Cooper, 1990). The transactional approach places great importance on individual differences and the role of cognitive appraisal in stress and coping processes. There are two forms of cognitive appraisal in the stress process (Lazarus & Folkman, 1984). Primary appraisal involves the person evaluation of an encounter with regards to its significance for their well-being. The encounter is categorised as either irrelevant (i.e. has no implications on well-being), benign-positive (i.e. enhances well-being) or stressful (i.e. involves harm/loss, threat of harm or challenge). Secondary appraisal involves the evaluation of coping resources available to manage the stressful situation. Psychological stress occurs when the demands of a specific encounter are appraised by the person as exceeding their resources and endangering their well-being (Lazarus & Folkman, 1984). The transactional model of stress has constituted the foundation for theoretical conceptualisation of the technostress phenomenon in the IS field (Ragu-Nathan et al., 2008). The transaction-based approach defines three components of the stress process: *stressors*, which are environmental events or stimuli encountered by an individual; *strain*, which is a psychological, physiological and behavioural response to stressors; and *outcomes*: which refer to the consequences of strain at the individual and organisational level (Cooper, Dewe & O'Driscoll, 2001). This conceptualisation of stress has been used in several technostress studies (Ayyagari, Grover & Purvis, 2011; Lee, Son & Kim, 2016; Lee, Lee & Suh, 2016; Maier, Laumer & Eckhardt, 2015; Ragu-Nathan et al., 2008; Zhang et al., 2016). Using the transactional perspective, technostress can be described as a process that involves the presence of technology-related demands or stressors that are appraised by an IT user as exceeding their cognitive, social and technical resources. Such stressors then lead to physiological, psychological and/or behavioural responses (i.e. strain) and consequently lead to outcomes for the IT user (Ragu-Nathan et al., 2008; Tarafdar, Cooper & Stich, 2017). The technostress process also involves coping responses which are IT users' cognitive and behavioural efforts to deal with the detrimental effects created by techno-stressors (Fischer & Riedl, 2017; Tarafdar, Cooper & Stich, 2017). Three components of technostress are described below while coping responses will be explained in detail later in Section 2.12.

Techno-stressors, also known as technostress creators, refer to those technology-related factors, conditions, or stimuli that are appraised by an IT user as damaging and threatening to well-being (Tarafdar, Cooper & Stich, 2017). Technostress research has identified several techno-stressors that encounter IT users in work-related and personal use contexts. The well-known techno-stressors in the IS literature are identified and empirically validated by Tarafdar et al. (2007), which are as follows:
Techno-overload: describing conditions where individuals experience overload in their work because ICT forces them to work faster and for longer, which also leads to multitasking. *Techno-invasion*: referring to the notion that ICT allows work to be extended outside of normal working hours, causing conflict between work and private life. *Techno-complexity*: the constant updates in ICT and the complexity of ICT force individuals to spend time and effort in learning how to use new technologies.
Techno-insecurity: individuals feeling insecure about losing their job and getting replaced because other people have more knowledge and skills in new ICT. *Techno-uncertainty*: the continual upgrades in software and hardware and changes in ICT-use policies creating unsettled environments for employees that can hinder them from developing experience in a particular type of ICT. A large body of technostress research has used these five techno-stressors to investigate their effects on individuals' well-being as well as job-related outcomes and IT-related outcomes (Maier et al., 2015a; Pirkkalainen et al., 2019; Srivastava, Chandra & Shirish, 2015; Tarafdar et al., 2011).

Strain refers to the psychological, physiological and behavioural reactions of an IT user to techno-stressors (Tarafdar, Cooper & Stich, 2017). Examples of psychological strains in technostress research include exhaustion (Ayyagari, Grover & Purvis, 2011), fatigue (Dhir et al., 2018), burnout (Park, Kim & Lee, 2020), and end-user satisfaction (Tarafdar, Tu, & Ragu-Nathan, 2010). Behavioural strains include discontinuous usage behaviour (Maier et al., 2015b) and turnover (Tarafdar Tu, & Ragu-Nathan, 2010). Physiological strains include increased blood pressure and hormones (Tams et al., 2014).

Outcomes are the consequences of strain at individual and organisational levels. In technostress literature, strain and outcomes are sometimes used interchangeably (Tarafdar, Cooper & Stich, 2017). Nevertheless, many studies have also examined the negative outcomes of strain, such as reduced performance (Yu et al., 2018), decreased productivity (Tarafdar et al., 2007), lowered job engagement (Hwang et al., 2020), reduced job satisfaction and organisational commitment (Maier, Laumer & Eckhardt, 2015).

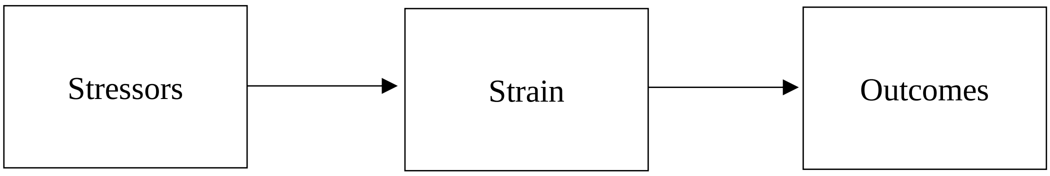

Figure 2.1: The transaction-based model of stress based on Cooper, Dewe & O'Driscoll (2001)

2.6 The theoretical framework of the current study

The current study adopts the transactional approach as a theoretical lens because it offers a comprehensive view for understanding the phenomenon of technostress. In addition, this approach has been widely adopted by technostress research as a theoretical foundation to understand stress experienced by users in different ICT usage contexts (Ayyagari, Grover & Purvis, 2011; Dhir et al., 2018; Galluch, Grover & Thatcher, 2015; Salo, Pirkkalainen & Koskelainen, 2019). The transactional approach takes into account different components of the stress process, namely sources of stress, the person's reactions to stress, coping responses and the consequences of stress. Therefore, it can be used as a theoretical basis to understand techno-stressors associated with the academic use of WhatsApp and their consequences on students and their performance. Based on the transactional model of stress, this study focuses on four components of technostress: techno-stressors, fatigue as a psychological response to stressors, coping behaviours and the outcome of fatigue (i.e. student performance) (see Figure 2.2). Among the five well-known techno-stressors (i.e. techno-overload, techno-invasion, techno-complexity, techno-insecurity, techno-uncertainty), this study focuses on technology overload and technology invasion as they are relevant to the context of the study, as will be explained in the next sections.

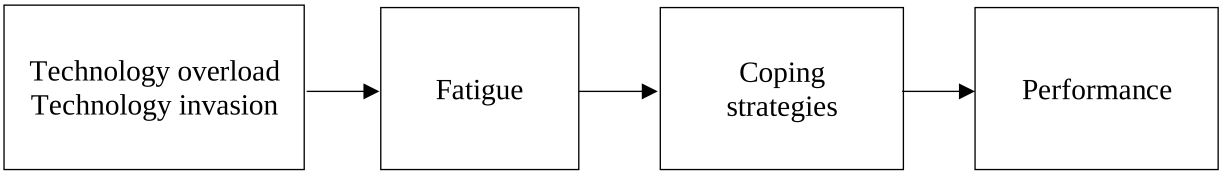

Figure 2.2: The preliminary research framework

2.7 Technology overload

The term 'overload', from a subjective perspective, describes an individual's subjective judgement and perception of the number of things that exceeds their ability to handle (Zhang et al., 2016). According to the person–environment fit model, overload arises out of a mismatch between environmental demands and a person's skills and ability (Edwards & Cooper, 1990). This term has been used to refer to several phenomena that confront IT users, including work overload (Ayyagari, Grover & Purvis, 2011), email overload (Barley, Meyerson & Grodal, 2011), information overload (Eppler & Mengis, 2004), social overload (Maier et al., 2015b), communication overload (Stephens et al., 2017), connection overload (LaRose et al., 2014) and social media overload (Yu et al., 2018). These phenomena have also been addressed under the concept of technology overload (Grandhi, Jones & Hiltz, 2005; Karr-Wisniewski & Lu, 2010). Technology overload has been defined by Tarafdar et al. (2007) as situations in which ICT users feel forced to work faster and for longer hours in order to cope with the increased workload created by ICT. Grandhi Jones & Hiltz (2005) explain that individuals experience technology overload because of two main factors: receiving and responding to too much information from multiple devices (i.e. information overload), and the use of multiple computer devices to accomplish multiple tasks in daily activities (i.e. gadget overload). Ragu-Nathan et al. (2008) indicate that ICT makes it possible for individuals to process lots of information from different sources at the same time, thereby leading to multitasking. Due to technology overload, IT users may have to exert more effort and spend additional time in order to complete their work duties. While ICT is meant to ease the work of people and facilitate human communication, the availability of multiple sources of information and communication may lead to cognitive overload, which can negatively influence individuals' performance (Tarafdar, Tu & Ragu-Nathan, 2010). Karr-Wisniewski & Lu (2010) indicate that there is an inverted U-shaped relationship between information technology use and employees' productivity. In other words, technology use can be leveraged to increase productivity until a certain level: once the optimum level is exceeded, productivity decreases.

Many studies have treated technology overload as a single construct that reflects work overload or information overload created by ICT (e.g. Ragu-Nathan et al., 2008; Tarafdar et al., 2011). However, Karr-Wisniewski & Lu (2010) conceptualise it as a multidimensional construct that has three dimensions: information overload, communication overload and system feature overload. This conceptualisation has been applied to the context of social media to address overload faced by social media users (Lee, Son & Kim, 2016; Zhang et al., 2016). Research on social media overload indicates that the increasing amount of information, news, and messages exchanged every day on social media as well as the frequent SNS feature updates create an overwhelming environment for SNS users that can negatively affect their well-being (Lee, Son & Kim, 2016; Zhang et al., 2016).

Existing studies on technology overload and social media overload provide the foundation for understanding this phenomenon in the context of academic use. These studies recognise three components of technology overload (i.e. information, communication and system feature overload), and examine their effect on individuals' well-being. However, the focus of these studies is on personal use and organisational use, thus it is still not clear how the academic use of MIM can lead to technology overload. In addition, existing studies on technology overload do not investigate what causes information and communication overload, which is addressed in the current study.

Addressing technology overload in the context of the educational use of WhatsApp is relevant for the following reasons. First, technology overload has been identified in the technostress literature as one of the major techno-stressors that can affect productivity and performance and lead to psychological strain (Tarafdar et al., 2011). Research has found an association between technology overload and fatigue (Lee, Son & Kim, 2016; Zhang et al., 2016). Second, students using WhatsApp to exchange information and study materials might be exposed to information overload and communication overload. This study adopts Karr-Wisniewski and Lu's (2010) conceptualisation of technology overload and focuses on two dimensions, namely information overload and communication overload, both of which will be discussed in the next sections. The third dimension, system feature overload, refers to a user's perception that a certain technology is too complex for a given task (Karr-Wisniewski & Lu, 2010). It occurs when frequent changes and updates in system features lead to redundant features and increase the complexity of the system (Lee, Son & Kim, 2016). This dimension is not relevant in this study because generally, mobile messaging apps have simple, user-friendly features. WhatsApp, as mentioned previously, is one of the most popular MIM applications, therefore it is rational to assume that a large number of people are familiar with its features. In addition, the subjects of this study are young adults who tend to be technically savvy (Bolton et al., 2013), thus the adding of new features to the system is not likely to be an issue for them. As smartphone applications continuously develop user-friendly interfaces, system feature overload becomes less of a problem for users (Hung, Chen & Lin, 2015). On the other hand, users are more likely to face the issues of information overload and communication overload. Due to the above considerations, system feature overload is considered less of an issue for university students.

2.8 Information overload

Information overload is not a new phenomenon. It has been recognised by researchers for several decades (Allen & Wilson, 2003; Eppler & Mengis, 2004; Jackson & Farzaneh, 2012). One of the earliest scholars to notice this phenomenon was Georg Simmel, who noted the overload of sensation in the modern world that caused people to become overwhelmed and interfered with their capability to react to new situations (Simmel, 1950; Edmunds & Morris, 2000). The issue of information overload has been addressed across various disciplines including management information systems (Eppler & Mengis, 2004), and different terms have been used to refer to this issue, such as data smog (White & Dorman, 2000), cognitive overload (Chen, Pedersen & Murphy, 2011), knowledge overload (Eppler & Mengis, 2004), and information fatigue syndrome (Wurman, 2001). Although it has been widely studied, there is no consensus among researchers on the definition of information overload. It is defined as a situation in which a person becomes unable to process all information and communication inputs, which leads to ineffective or discontinued information processing (Rogers & Agarwala-Rogers, 1975). It is also described as a state in which a person cannot extract needed knowledge from a large amount of information (Nelson, 1994).

Information overload occurs when information-processing requirements (i.e. the quantity of information required to accomplish a task) exceed information-processing capacity (i.e. the amount of information a person can process within a given period of time) (Eppler & Mengis, 2004). In other words, it occurs when the volume of information supply surpasses human information-processing capacity, which results in dysfunctional consequences, such as stress, anxiety and confusion (Meyer, 1998). The burden of information overload can interfere with an individual's ability to make optimal decisions. According to bounded rationality theory, decision makers cannot integrate more information into decision making than their information processing capacity, thus they tend to stop acquiring information and make satisficing decisions based on limited information and available time (Simon, 1955).

The concept of information overload is based on information processing theory and cognitive load theory (Miller, 1956; Sweller, Van Merrienboer & Paas, 1998). The central assumption of these theories is the limitation of human information-processing capacity, especially working memory. Basically, human cognitive architecture consists of sensory memory, working memory and long-term memory. The human brain receives various sensory information and immediately stores this in sensory memory for a very short amount of time, only a few seconds. Information that is relevant to the receiver is passed to short-term memory or working memory, where the information is processed, manipulated and controlled and then transferred into long-term memory (Sweller, Van Merrienboer & Paas, 1998). Information overload occurs because working memory has a limited capacity that can hold a maximum of five to nine pieces of information at a time (Miller, 1956). Furthermore, by processing these pieces of information in the sense of organising, contrasting and comparing, the capacity of working memory reduces to being able to hold only two or three items of information simultaneously (Miller, 1956). Thus, if the amount of incoming information that needs to be processed is greater than the capacity of working memory, the person may experience information overload (Sweller, Van Merrienboer & Paas, 1998).

2.8.1 Causes of information overload

Given the fact that little is known about the phenomenon of information overload in the context of online learning via WhatsApp, relevant literature on information overload was reviewed in order to identify potential contributors to perceived information overload in the WhatsApp usage context.

Eppler and Mengis (2004) identified five causes of information overload: information quantity and its characteristics, personal factors, tasks that need to be accomplished, organisational design, and information technology and how it is used. They indicated that usually information overload occurs not because of one of these five factors but due to a combination of all of them. Jackson and Farzaneh (2012) further distinguished between intrinsic and extraneous factors that contribute to information overload. Intrinsic factors are critical factors that directly affect information overload identified as information quantity, information-processing capacity and time available. On the other hand, extraneous factors indirectly contribute to information overload and can influence intrinsic factors, such as the characteristics and quality of information. In addition, sources of information or the means by which information is delivered and retrieved can influence information overload (Jackson & Farzaneh, 2012). Cognitive load theory suggests that information overload can arise due to the load on working memory imposed by the characteristics of information being processed (intrinsic cognitive load) and the way information is presented (extraneous cognitive load) (Sweller, Van Merrienboer & Paas, 2019).

Overall, information overload literature suggests that the amount of information to be processed along with its quality and other characteristics, such as complexity, are key factors of information overload. In addition, the way information is delivered, retrieved and presented via information technology can be another important factor. The following sections discuss these factors.

Quantity of information. The quantity of information is explained in terms of the amount of information that is available, is supplied or that needs to be processed (Jackson & Farzaneh, 2012). The volume of information directly influences information overload (Edmunds & Morris, 2000). In other words, the more information available to a person, the greater the possibility that the person suffers from information overload (Jackson & Farzaneh, 2012). Typically, the term information overload is used to refer to receiving too much information (Eppler & Mengis, 2004). Others have described it as information explosion, when the amount of information supply exceeds the ability of a person to find relevant and needed information (Edmunds & Morris, 2000; Nelson, 1989).

Information quality. The quality of information can have a great influence on information overload (Eppler, 2015). It is defined as the extent to which information meets the requirements of its users (Jackson & Farzaneh, 2012). It also refers to information that is of great value to its consumers (Eppler, 2015). These definitions emphasise important dimensions of information quality, namely the value of the information and its relevance to the need of the user. Information quality is considered subjective and difficult to capture or measure (Jackson & Farzaneh, 2012). It is usually defined based on criteria such as soundness, usefulness and relevance (Eppler, 2015). Butcher (1998) indicated that one of the main reasons managers face information overload is the supply of large amounts of unsolicited information. When supplied information is relevant to the interests of people, the likelihood of information overload is low because they do not have to deal with content that is low quality or irrelevant to their need (Lee, Son & Kim, 2016). Redundant, irrelevant and trivial information acts like noise that can hinder individuals from effectively processing information and being able to make use of it (Chen, Pedersen & Murphy, 2011).

Characteristics of information. In addition to quantity and quality, specific characteristics of information can also influence information overload (Jackson & Farzaneh, 2012; Schneider, 1987). Such characteristics include the degree of complexity, uncertainty, ambiguity and novelty associated with information (Eppler & Mengis, 2004). Information properties, such as complexity or ambiguity, have influence on information-processing capacity, as they determine the mental effort required for information processing (Jackson & Farzaneh, 2012). Complex information can impose an intrinsic cognitive load on individuals (Sweller, Van Merrienboer & Paas, 2019). Individuals can process clear and simple information more quickly and better than unclear or complex information. Further, complex information could demand clarification using an additional source of information, thus leading to more information to be processed.

Information technology. Information technology is one of the key factors influencing information overload (Eppler & Mengis, 2004; Jackson & Farzaneh, 2012). Although the issue of information overload existed before information technology (Allen & Wilson, 2003), the development of ICT and the internet has exacerbated this problem (Edmunds & Morris, 2000). Advanced information technology has facilitated the creation and dissemination of information, in various forms and in enormous quantities. Furthermore, technologies such as social media make it easy and seamless to spread misinformation, rumours, fake news and outdated information (Eppler, 2015). Thus, besides information overabundance, the quality of and trust in information have become issues facing information seekers online (Benselin & Ragsdell, 2016; Eppler, 2015).

In the literature, two types of information technology, push and pull technology, are identified to have effects on information overload (Savolainen, 2007; Jackson & Farzaneh, 2012; Eppler & Mengis, 2004; Roetzel, 2019). In push technology, pre-selected information is pushed to users and thus they can stay updated (Edmunds & Morris, 2000). An advantage of this technology is that it facilitates the dissemination of information and decreases information retrieval time (Allen & Wilson, 2003; Savolainen, 2007). On the other hand, pushing information can increase the amount of unnecessary and irrelevant information that an information receiver has to deal with (Edmunds & Morris, 2000). Users experiencing information overload may feel annoyed by too much information being pushed to them, which may have little value (Edmunds & Morris, 2000). Another issue with push technology is that it can create frequent interruptions to individuals' work (Edmunds & Morris, 2000). For example, email and MIM notifications. In pull technology, information is retrieved and used based on the need of the user (Jackson & Farzaneh, 2012), for example, seeking information through the internet or databases. Using pull technology may help to filter useless information, thus reducing information overload (Savolainen, 2007).

2.9 Communication overload

Communication overload is the second dimension of technology overload (Karr-Wisniewski & Lu, 2010). This issue is created by the prevalence of ICT and mobile devices that allows people to be reached anytime and anywhere (Batista & Marques, 2017; Bayer, Campbell & Ling, 2016). While it is true that ICT facilitates online interactions between people, with the availability of multiple ICT, people become easily flooded with emails, text messages and social media notifications, which can also create distractions and interruptions in people's work (Chen, Nath & Tang, 2020; Galluch, Grover & Thatcher, 2015).

In contrast to information overload, which has been widely addressed in the literature, the problem of communication overload has received less attention (Batista & Marques, 2017). This might be because communication overload is still an emerging phenomenon compared with information overload. Researchers have also noted that the problem of communication overload is often classified as information overload in the literature (Batista & Marques, 2017; Stephens et al., 2017). The term communication overload has been defined in different ways depending on the context. In many studies, communication overload has been treated from the perspective of information overload. For example, Cho et al. (2011) interpret communication overload as an individual perception that the quantity, complexity and/or equivocality of the information available exceed their desires, needs or ability to handle it in a given period of time. One of the earliest contributions to research that addressed the issue of communication overload was Meier's (1963) study, which highlighted the problem that faced librarians when they received too many requests for information and as a result became unable to respond to the requests. Meier (1963) defined communication load as "the rate of receipt of requests for service" (p. 540). Similarly, Farace, Monge and Russell (1977) described it in terms of "the rate and complexity of communication inputs to an individual" (p. 202).

Communication overload and information overload are two different issues, but they are also interconnected (Batista & Marques, 2017). Information-overload research is often concerned with information or knowledge that is used in decision making (Eppler & Mengis, 2004). In this sense, information overload is considered an issue facing individuals when the amount of information required for decision making is greater than what they can process in a given period of time (Eppler & Mengis, 2004; Simon, 1955). Research also indicates that people experience information overload when they seek information (Karr-Wisniewski & Lu, 2010). On the other hand, the term 'communication' involves various types of interaction (Yin et al., 2018). Batista and Marques (2017) indicate that the development of ICT posts an additional issue on people prior to information overload. That is, people have to deal with communication messages before they can digest their content. Communication overload is not only the problem of information assimilation but also the management of the communication process that involves dealing with communication messages, analysing, organising and filtering out message content to identify whether it is relevant and whether it needs a response (Batista & Marques, 2017). In other words, communication overload arises when a person becomes unable to manage and/or correctly interpret the meaning of messages. Communication overload is also known as connection overload, which occurs when communication demands (concerning receiving and responding to messages and maintaining a connection with friends and other people online) lead to detrimental effects on individuals' well-being (LaRose et al., 2014).

Another issue associated with communication overload is constant interruption (Stephens et al., 2017; Yin et al., 2018). Karr-Wisniewski & Lu (2010) indicated that communication overload occurs when an individual's work is constantly interrupted by different means, such as email, instant messages and phones calls, which results in a decrease in the individual's productivity. Karr-Wisniewski & Lu (2010) distinguish between information overload and communication overload. They argue that information overload occurs when an individual searches for information, whereas communication overload occurs when a third party interrupts the individual's work.

One study that attempted to conceptualise communication overload was a study by Stephens et al. (2017). They argued that communication overload is not a unidimensional construct but rather it encompasses seven dimensions. They identified dimensions or causes of communication overload as follows: compromising message quality, using many types of ICT, having many distractions, being overwhelmed with information, the piling-up of messages, feeling responsible to respond and feeling pressured for decisions.

This conceptualisation of communication overload addresses the key causes of communication overload. The number of messages a person receives and the quality of message content are key components of communication overload that is often addressed in the literature (e.g. Cho et al., 2011; Karr-Wisniewski & Lu, 2010). Message quality can refer to several meanings, as discussed previously in Section 2.8.1; however, Stephens et al. (2017) determined quality in terms of ambiguity. Confusing or vague messages contribute to an individual's perception of communication overload because individuals need to make efforts to interpret the meaning of the messages (Eppler, 2015). The individual may also need to make further communication in order to resolve the ambiguity of messages (Lee, Son & Kim, 2016). Another important factor that influences the perception of communication overload is perceived-response obligations (Stephens et al., 2017). Unlike other dimensions (i.e. message quantity and quality, having too many distractions and being overwhelmed with information) which are concerned with an individual's cognitive load, feeling responsible to respond reflects a social dimension concerning pressure deriving from an individual's social environment. This type of pressure, also referred to as social digital pressure, represents the norm or perceived expectation to respond quickly to communication and to be active and present online (Gui & Büchi, 2021). According to social influence theory, people tend to act in a way that meets the expectations of others (Kelman, 1958). Research demonstrates that individuals tend to feel obligated to respond to others in their networks because those others expect them to do so (Stephens et al., 2017). With the rapid development of mobile devices that allow people to be constantly connected and available, there is an increasing social norm that people can be reached at any time (Gui & Büchi, 2021; Stephens et al., 2017), and individuals who are inaccessible or do not respond within a socially acceptable time frame could be negatively evaluated as unresponsive (Bayer, Campbell & Ling, 2016). Social expectations regarding availability and responsiveness can place individuals under pressure and lead them to frequently check their mobile phones for new emails or messages and respond quickly, thereby contributing to increased communication load (Bayer, Campbell & Ling, 2016; Reinecke et al., 2017). Barber and Santuzzi (2015) argued that asynchronous communication, such as email or instant messaging, offers flexibility and control over response time; however, pressure occurs when individuals treat this form of communication as requiring an immediate response. Research also suggests that people can disconnect from their mobile devices to break from constant connectivity (Russo et al., 2019). Stephens et al. (2017) argued that individuals themselves can contribute to their own communication overload problems by being too available and too responsive. Therefore, part of the perceived overload problem might be self-induced.

2.10 Technology invasion

Smartphones, tablets and other modern ICT have penetrated people's lives, including at work. Mobile devices, through affordances such as ubiquitous connectivity, empower people to work at any time and from almost anywhere. With advanced technology, work can be performed and can continue outside workplaces (Lee, Lee & Suh, 2016). This is one advantage of mobile devices, particularly with the growing shift towards remote work around the world. While constant connectivity via mobile devices can have benefits for individuals, it also facilitates work being extended outside usual working hours, leading to the invasion of work into personal life (Barley, Meyerson & Grodal, 2011; Van Zoonen, Verhoeven & Vliegenthart, 2017). With increased access to work and individuals via ICT, people struggle to separate work from private life and spare time (Bucher, Fieseler & Suphan, 2013; Derks et al., 2015). Technology invasion, identified as one of the key technostress creators (Tarafdar et al., 2007), describes situations where individuals feel that work-related usage of ICT interferes with their personal lives and blurs the boundaries between work and private domains (Ayyagari, Grover & Purvis, 2011; Maier et al., 2015a). Invasion can occur when individuals spend less time with their family due to ICT usage (Gaudioso, Turel & Galimberti, 2017; Tarafdar et al., 2011). Individuals also might feel their personal life is invaded by technology when they have to sacrifice their holidays and private time for work-related communications or updates (Derks et al., 2015). Invasion has been linked with undesirable outcomes, such as increased distress (Bucher, Fieseler & Suphan, 2013), dissatisfaction (Lee, Lee & Suh, 2016), job burnout (Park, Kim & Lee, 2020), and work–family conflict (Gaudioso, Turel & Galimberti, 2017; Van Zoonen, Verhoeven & Vliegenthart, 2017).

In the academic context, students might also be exposed to technology invasion, especially with the increasing adoption of mobile technology in learning and the recent shift toward remote learning. Key features of mobile learning include accessibility, flexibility, connectivity and interactivity (Singh & Thurman, 2019). Mobile learning through its flexibility and accessibility enables students to access learning materials at any time and from anywhere. Moreover, it enables students to interact with each other outside school, share learning content, and engage in academic conversations. However, as interaction can continue outside school time, invasion of personal life can occur and students may struggle to separate study-related and personal time (Rambe & Bere, 2013). Research has shown that school–work–life balance is a key concern for students and they strive to balance their academic and personal lives (Berry & Hughes, 2020; Heijstra & Rafnsdottir, 2010; Martinez et al., 2013). This struggle to balance work and life becomes a source of stress, anxiety and depression for students (Martinez et al., 2013; Sprung & Rogers, 2020). However, it is still not clear whether the use of ICT for mobile learning has an influence on students' perception of school–life balance. Technology can facilitate the intrusion of one domain into the other, yet also it offers students flexibility over their learning. Given the fact that school–life conflict can have an adverse outcome on students, this study seeks to explore students' perception on technology invasion and examine whether it has an impact on their well-being.

2.11 IT-related fatigue

The phenomenon of fatigue has been widely studied across different disciplines including psychology, medicine, occupational studies and IS research (De Croon et al. 2004; Ravindran, Kuan & Lian, 2014; Eidelman, 1980). Fatigue is a complex concept and several definitions have been proposed in the literature. In medical research, fatigue is defined as a "subjective, unpleasant feeling of tiredness that has multiple dimensions varying in duration, unpleasantness, and intensity" (Piper, Lindsey & Dodd 1987, p. 19). Fatigue is also defined in occupational studies as an adverse reaction of an individual to high demands, workload or stressful situations associated with work (De Croon et al., 2004; Hardy et al., 1997). Fatigue can occur in psychological and physiological forms. Psychological fatigue is described as a state of exhaustion related to decreased motivation and associated with distress and other intense emotional experiences (Shen, Barbera & Shapiro, 2006). Physiological fatigue is a decrease in physiological capacity or a lack of energy in the muscle (Eidelman, 1980). In technostress literature, fatigue associated with IT use has been recognised as a psychological response to techno-stressors (Ayyagari, Grover & Purvis, 2011; Salanova, Llorens, & Cifre, 2013). A large number of studies have investigated fatigue created by ICT use in work and non-work contexts and the negative outcomes of fatigue (Dhir et al., 2019; Lee, Lee & Suh, 2016; Maier, Laumer & Eckhardt, 2015; Yu et al., 2018). Recently, the term 'Zoom fatigue' has emerged as a result of the heavy usage of video-conferencing technology for online meetings in work contexts, specifically during COVID-19 (Bailenson, 2021; Fauville et al., 2021). Research shows that the frequency, duration and intensity of Zoom meetings can lead to a high level of fatigue (Fauville et al., 2021).

Social network (SNS) fatigue is another form of IT-related fatigue experienced by SNS users and associated with social media activities (Ravindran, Kuan & Lian, 2014), which is sometimes referred to as 'Facebook fatigue' (Cramer, Song & Drent, 2016). SNS fatigue can be explained as SNS users' tendency to withdraw from SNS or reduce their usage when they feel overwhelmed by too much content, too many social interactions and connections and an inability to keep up with social media updates (Bright et al., 2015; Zhang et al., 2016). Drawing on the definitions of fatigue in clinical and organisational research, Ravindran, Kuan and Lian (2014) define SNS fatigue as "a subjective, multi-dimensional user experience comprising feelings such as tiredness, annoyance, anger, disappointment, guardedness, loss of interest, or reduced need/motivation associated with various aspects of social media use and interactions" (p. 2317). They indicate that fatigue is a complex, subjective phenomenon and experimental in its nature. They also indicate that the intensity of fatigue experiences among SNS users can vary from a mild feeling of tiredness to a state of exhaustion or burnout. SNS fatigue can have damaging effects on SNS users as well as SNS service operators. Research has shown that SNS fatigue can weaken SNS users' mental and physical well-being and lead to consequences including dissatisfaction with SNS use, regret (Cao & Sun, 2018), and users suffering from anxiety, depression (Dhir et al., 2018) and addiction (Choi & Lim, 2016). Moreover, research has found that fatigue drives individuals to discontinue social media usage (Zhang et al., 2016) and switch to alternative platforms (Maier et al., 2015a). As the experience of fatigue can negatively affect individuals' well-being, research has focused on factors that cause fatigue among users. Factors identified as sources of fatigue can be categorised as technical factors (e.g. system feature overload and complexity) and content-related factors (e.g. information overload) and social factors (e.g. social comparison, social interaction overload and social surveillance) and personal-related factors (e.g. fear of missing out, compulsive SNS use) (Guo et al., 2020; Lee, Son & Kim, 2016; Maier et al., 2015a; Zhang et al., 2020). A summary of existing studies on SNS fatigue is presented in Table 2.2. A majority of technostress studies have addressed fatigue in private use and non-educational use contexts (e.g. Bright et al., 2015; Cao et al., 2019; Maier et al., 2015b; Shin & Shin, 2016). In addition, existing studies focus on voluntary use where individuals can freely stop using SNS when they feel fatigued (Lo, 2019; Luqman, et al., 2017). Although the use of mobile social networking services, such as MIM for learning, might also lead to fatigue, this issue has not received much attention. While some studies have examined the influence of SNS fatigue on academic performance (Dhir et al., 2019; Malik et al., 2020), these studies focus on the personal use context and do not take into account whether students use SNS for learning activities and whether such use contributes to fatigue. Moreover, while the majority of extant studies have focused on the causes and consequences of fatigue, nevertheless, little attention has been given to user coping behaviours, thus different efforts that users can use to reduce fatigue remain undiscovered.

Table 2.2: Summary of prior studies on social media fatigue

Article	Context	Research approach	Factors associated with SNS fatigue	Consequences of SNS fatigue
Maier et al. (2012)	Personal use/ Facebook	Quantitative Online survey of 523 Facebook users in Germany	Social overload	Satisfaction, discontinuous usage intention
Ravindran, Kuan & Lian (2014)	Personal use/ Facebook	Mixed-methods 34 participants (activity analysis over a 100-day period and interviews)	Social dynamic related factors, content-related factors, immersion-related factors, platform-related factors, and community life-cycle related factors	Short breaks in activity, controlled activity, suspended activity
Bright et al. (2015)	Personal use/ Facebook	Quantitative Online survey of 747 SNS users in the US	Social media confidence, social media self-efficacy, privacy concerns, social media helpfulness	-
Cramer, Song & Drent (2016)	Personal use/ Facebook	Quantitative Online survey of 267 students in the US	Social comparison motives (self-destruction, self-enhancement, self-esteem, self-improvement)	-
Lee, Son & Kim (2016)	Personal use/ SNS	Quantitative Survey of 250 SNS users	Information overload, communication overload, system feature overload	-
Shin & Shin (2016)	Personal use/ MIM	Quantitative Survey of 334 Kakao Talk users in Korea	Commercial and non-commercial mobile messenger overload	Mobile communication avoidance

Zhang et al. (2016)	Personal use/ Qzone social networks	Quantitative Online survey of 525 Qzone users	System feature overload, information overload, social overload	Dissatisfaction, discontinuous usage intention
Zheng & Lee (2016)	Personal use/ SNS	Quantitative Survey of 490 mobile SNS users in China	Excessive use, cognitive preoccupation, technology–family conflict, technology–personal conflict, technology–work conflict	-
Luqman et al. (2017)	Personal use/ Facebook	Quantitative Survey of 360 students	Excessive social use, excessive hedonic use, excessive cognitive use	Discontinuance usage intention
van Zoonen, Verhoeven & Vliegenthart (2017)	Organisational use/ SNS	Quantitative Survey of 421 employees	Social media use for work, accessibility, efficient communication, work–life conflict, interruptions	-
Cao & Sun (2018)	Personal use/ SNS	Quantitative Survey of 258 SNS users in China	Information overload, communication overload, social overload	Regret, discontinuous usage intention
Dhir et al. (2018)	Personal use/ SNS	Quantitative Survey of 2698 SNS users in India	Compulsive SNS use, fear of missing out	Depression, anxiety
Yu et al. (2018)	Organisational use/ SNS	Quantitative Online survey study of 230 working professionals in China	Excessive social media use at work, information overload, communication overload, social overload	Job performance
Zhu & Bao (2018)	Personal use/ SNS	Quantitative Online survey of 307 SNS users	Impression management concern, privacy concern, social overload	-

Cao et al. (2019)	Personal use/ SNS	Quantitative Survey of 305 students in China	Social media attachment, depression, anxiety, cyberbullying victimisation	-
Dhir et al. (2019)	Personal use/ WhatsApp and Facebook	Quantitative Survey of 1552 SNS users in India	SNS privacy concerns, SNS self-disclosure, SNS parental encouragement, SNS parental worry, SNS parental monitoring, SNS parental permission	Academic performance decrement due to SNS use
Xiao, Mou & Huang (2019)	Personal use/ SNS	Quantitative Online survey of 424 SNS users in China	Social comparison, social interaction overload, social surveillance, social information overload, system complexity, system pace of change	-
Xiao & Mou (2019)	Personal use/ WeChat	Quantitative Online survey of 426 WeChat users in China	Privacy invasion, invasion of life, social media characteristics (anonymity, flexibility, presenteeism)	-
Lo (2019)	Personal use/ Facebook	Quantitative Online survey of 1285 Facebook users in the US	Social overload, perceiving social support	SNS satisfaction, discontinuous usage intention
Zhang et al. (2020)	Personal use/ WeChat	Qualitative Grounded theory Interviews of WeChat users in China	Fear of missing out, perceived overload, compulsive use, time cost	Avoidance behaviour, withdrawal behaviour, substitution behaviour
Guo et al. (2020)	Personal use/ WeChat	Quantitative Online survey of 341 WeChat users	Information irrelevance, information overload, social overload	Information avoidance behaviour

Fan et al. (2020)	Personal use/ WeChat	Quantitative Online survey of 131 WeChat users in China	Role conflict, privacy concern, self-esteem	Control activities, short breaks, suspend usage intentions
Fu & Li (2020)	Personal use/ Facebook	Quantitative Online survey of 489 SNS users	Perceived technology overload, information overload, social overload	Reduce-usage behaviour, abandoned-usage behaviour
Hwang et al. (2020)	Organisational use/ instant messenger	Quantitative Online survey of 429 employees in Taiwan (LINE) users	Online social anxiety, perceived information overload	Job engagement
Islam, Whelan & Brooks (2020)	Organisational use/ SNS	Quantitative Online survey of 220 professionals	Information overload, communication overload, multitasking, computer self-efficacy	-
Lin et al. (2020)	Personal use/ WeChat	Quantitative Online survey of 502 WeChat users in China	Information overload, communication overload, social overload, flow experience	Discontinuance intentions
Malik et al. (2020)	Personal use/ WhatsApp	Quantitative Online survey of 1870 young-adult students in India	Privacy concerns, social comparisons, self-disclosure, intensity of MIM use, fear of missing out	Academic performance decrement due to MIM use
Whelan, Islam & Brooks (2020b)	Personal use/ SNS	Quantitative Survey of 286 students in Ireland	Boredom proneness, information overload, communication overload. social media use intensity	-
Teng, Liu & Luo (2021)	Personal use/ SNS	Quantitative Survey of 452 WeChat users in China	System function overload, information overload, social overload, privacy concern	Anxiety, negative usage behaviour

2.12 Coping with technostress

Previous sections discussed consequences of technostress at individual levels. As mentioned before, negative outcomes of technostress include physical and psychological fatigue, dissatisfaction with IT use and reduced performance. Considering the potential negative effects of technostress on students' well-being and their academic performance, it becomes important to explore how students cope with fatigue associated with technology use and examine whether such coping behaviours have effects on perceived performance. This topic is relevant in this study for two reasons. First, addressing fatigue induced by academic use and identifying the main causes of fatigue creates a need for understanding coping mechanisms that can be used to deal with stressors and mitigate fatigue. Second, a number of studies have investigated factors causing technology-related fatigue and the negative outcomes of fatigue; however, little research has focused on how IT users cope with fatigue, therefore, this study attempts to bridge this gap. The following sections provide an overview of coping literature in IS research, present a background on the concept of coping and coping theory and then explain the coping model of user adaptation, which provides a foundation to understand how individuals react to IT-related stress.

Prior studies on coping in IS literature

As technostress can have damaging consequences on individuals and organisations, there has been increasing interest in studying coping with IT-related events or stressors in the IS domain (Tarafdar, Cooper & Stich, 2017; Weinert, 2018). Coping with technostress refers to different ways IT users perform to deal with consequences associated with IT use (Beaudry & Pinsonneault, 2005; Bala & Venkatesh, 2016). Generally, coping in IS literature has been studied in three streams of research (Weinert, 2018). The first stream, coping with IT adoption, focuses on how individuals adapt to the implantation of new IT in organisational contexts. For example, Bhattacherjee et al. (2017) investigated IT users' responses to the introduction of a new information system in a workplace in the context of mandatory IT use. Based on primary and secondary appraisals and the level of control over the new IT, Bhattacherjee et al. (2017) suggested four responses: engaged, compliant, reluctant, or deviant. They indicated that individuals who perceived the new IT as an opportunity were more likely to demonstrate engaged or compliant responses, whereas those who viewed the technology as a threat were more likely to engage in reluctant or deviant responses. The second stream, coping with technostress, focuses on individuals' responses to demands created by IT use, such as technology overload, complexity and insecurity. For example, Pirkkalainen et al. (2017) identified two types of coping behaviours: reactive coping (distress venting and distancing from IT) and proactive coping (positive reinterpretation and IT control). They found that both reactive and proactive coping behaviours alleviate the negative effects of IT stressors on IT-enabled productivity. The third stream, coping with IT threats, examines how individuals deal with IT threats, such as malicious IT and online security attacks (Chen & Zahedi, 2016; Liang & Xue, 2010). For example, drawing from coping theories, Liang & Xue (2009) developed the technology threat avoidance theory, which suggests that the perception of IT threat leads to coping appraisal where an individual evaluates whether the IT threat can be avoided. IT threat avoidance is assessed based on three factors: perceived effectiveness, perceived cost of safeguard measures and self-efficacy of taking the safeguard measures. Table 2.3 shows a summary of existing IS research on coping within the three streams.

Overall, IS research on coping enriches our understanding on various ways individuals cope with IT events. A review of the literature shows that several studies have focused on coping strategies in the context of new IT implementations, yet few have investigated coping with IT-related stressors. As a result, there is a lack of understanding on how individuals respond to daily IT stressors. Researchers in the IS field call for more empirical research in this area (Pirkkalainen & Salo, 2016; Tarafdar, Cooper & Stich, 2017; Weinert, 2018). In addition, existing studies on coping and technostress have paid little attention to the effects of coping strategies on IT-related outcomes, such as user performance. Thus, research investigating such effects is needed (Tarafdar, Cooper & Stich, 2017; Weinert, 2018). In addition, most of the existing studies on coping with IT has focused on the organisational/work use and personal use for entertainment, and although technostress can cause serious issues for students and their well-being, there is still a lack of research on how students deal with stress resulting from IT use for learning. This study addresses this issue.

Table 2.3: Summary of IS research on coping

Article	Context	IT events / Stressors	Cognitive appraisal	Coping responses
Beaudry & Pinsonneault (2005)	Organisational/ work ICT use	Implementation of new IT	Primary appraisal: Opportunity, threat Secondary appraisal: Perceived level of control (high, low)	Benefit maximising Benefits satisficing, disturbance handling, self-preservation
Beaudry & Pinsonneault (2010)	Organisational/ work ICT use	Implementation of new IT	Primary appraisal: Opportunity, threat Secondary appraisal: Perceived level of control (high, low)	Task adaptation, seeking social support, seeking instrumental support, venting, psychological distancing
Liang & Xue (2010)	Personal/ leisure ICT use	IT threats	Primary appraisal: Perceived severity, perceived susceptibility Secondary appraisal: Safeguard effectiveness, safeguard cost, self-efficacy	IT-threat avoidance behaviour

Nach & Lejeune (2010)	Organisational/ work ICT use	IT-threatening events to users' identity	-	Acting on the situation, adjusting the self, cathartic practices, distancing
Elie-Dit-Cosaque & Straub (2011)	Organisational/ work ICT use	Implementation of disruptive IT	Primary appraisal: Opportunity, threat Secondary appraisal: Perceived level of control (high, low)	Benefits maximising, benefits satisficing, disturbance handling, self-preservation
D'Arcy, Herath & Shoss (2014)	Organisational/ work ICT use	Security-related stressors (burdensome, complex, and ambiguous information security requirements)	-	Emotion-focused (moral disengagement)
Galluch, Grover & Thatcher (2015)	Organisational/ work ICT use	ICT-enabled interruptions	Primary appraisal: perceptual stress (overload, conflict) Secondary appraisal: Personal control	Timing control, method control, resources control

Salo, Makkonen & Hekkala (2015)	Personal/leisure mobile apps use	Frustrating incidents with mobile applications	-	Problem-focused (switching the app, fixing the application, waiting for updates, adapting to the application) Emotions-focused (downplaying the role of the application, overstating the amount of effort, online/offline venting, blaming the device/oneself, empathising with the application provider)
Bala & Venkatesh (2016)	Organisational/ work ICT use	Implementation of new IT	Primary appraisal: Opportunity, threat Secondary appraisal: Perceived controllability	Exploration-to-innovate, exploitation, exploration-to-revert, avoidance
Chen & Zahedi (2016)	Personal/ leisure ICT use	Online security attacks	Primary appraisal: Perceived susceptibility, perceived severity Secondary appraisal: Perceived security response efficacy, perceived security self-efficacy	Protective actions, seeking help, avoidance

Bhattacherjee et al. (2017)	Organisational/ mandatory use of ICT	Implementation of new IT	Primary appraisal: Opportunity, threat Secondary appraisal: Perceived level of control (high, low)	Engage response, compliant response, reluctant response, deviant response
Pirkkalainen et al. (2017)	Organisational/ work ICT use	Technology-overload, technology-invasion, technology-uncertainty, technology-complexity and technology-insecurity	-	Emotional coping response (distress venting, distancing from IT)
Salo et al. (2017)	Personal/leisure ICT use	Technostress resulting from using IT, such as laptops, mobile phones, SNS, mobile messaging applications.	-	Modification of IT features, modifications of IT-use routine, modification of personal reactions to IT stressors, temporary disengagement from IT, online/offline venting
Chen et al. (2019)	Personal/ leisure mobile gaming use	Problematic use of smartphone games	Primary appraisal: Perceived severity, perceived vulnerability Secondary appraisal: self-efficacy, response efficacy, response cost	Intention to decrease use

Chen, Tran & Nguyen (2019)	Personal use of mobile shopping applications	Perceived information overload and perceived intrusiveness from push notifications	Primary appraisal: Perceived information overload, perceived intrusiveness, perceived reward Secondary appraisal: Perceived information control and self-efficacy	Disturbance handling Self-preservation
Tarafdar et al. (2020)	Personal/ leisure ICT use	SNS stressors (social overload, pattern, invasion, disclosure, complexity and uncertainty)	-	Distraction within SNS, distraction outside SNS
Shwadhin & Gupta (2022)	Educational use of technology-enhanced learning	overload, invasion, uncertainty, complexity and resource sufficiency	Harm appraisal Threat appraisal Positive appraisal Challenge appraisal	Emotion-focused coping (general emotional support, emotional venting, academic disengagement) Problem-focused coping (academic planning, efficacy)

2.13 Coping theory

Coping has been studied in many fields such as psychology, sociology, and medicine (Lazarus & Folkman, 1984). Coping describes the cognitive and behavioural efforts an individual performs to deal with stressful events that occur in their environment (Folkman et al., 1986). In the literature, there are two traditional approaches to coping: the animal model of stress and control, and the psychoanalytic ego psychology model (Folkman & Lazarus, 1988). In the animal model, coping is defined as acting to avoid, escape or overcome dangerous or noxious environmental conditions (Lazarus & Folkman, 1984). The model focuses largely on avoidance and escape behaviours (Lazarus & Folkman, 1984). A limitation of this approach is that it is considered simplistic and does not take into account cognitive and emotional aspects of coping, which are integral components of human functioning (Lazarus & Folkman, 1984). In the psychoanalytic ego psychology model, coping is viewed as thoughts and acts an individual performs to manage person–environment relationships (Folkman & Lazarus, 1988). Shortcomings of such a model include that it focuses more on cognition and treats behaviour as less important (Lazarus & Folkman, 1984). It also views coping as a style or trait that describes how a person usually acts when confronted with stressful situations rather than a process (Lazarus & Folkman, 1984). Coping as a process is defined as "constantly changing cognitive and behavioural efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus and Folkman 1984, p. 141). This definition has been the widely accepted definition of coping in stress and coping literature and technostress research. In the definition, *Cognitive efforts* refer to those efforts that focus on changing the meaning of the situation, such as accepting, avoiding and distancing (Beaudry & Pinsonneault, 2005), whereas *behavioural efforts* refer to acts that aim at changing the situation itself, such as seeking informational support or learning new skills (Beaudry & Pinsonneault, 2005). *External demands* refer to demands placed on individuals by the environment that must be met, such as workload and social pressure, while *internal demands* are personal desires that must be met by the environment (Bhattacherjee et al., 2017), such as an individual's desire to protect their privacy. Individuals' coping responses are determined by the available resources to them, including financial means, social support, problem-solving skills, health and energy (Folkman & Lazarus, 1988). This definition addresses the shortcomings of the traditional approaches. It treats coping as a process (not a style or trait) that an individual goes through when he/she encounters stress (Folkman et al., 1986; O'Driscoll & Cooper, 1994). Coping is viewed as an aim-oriented process in which a person directs cognitive and behavioural efforts towards managing the source of stress (Compas et al., 2001). The definition places emphasis on efforts, which distinguishes coping from automatised adaptive behaviours and thoughts that do not require efforts (Lazarus & Folkman, 1984). It also emphasises efforts to manage stressful demands regardless of whether such efforts are successful or not (Folkman et al., 1986; Lazarus & Folkman, 1984). Defining coping as efforts is important to separate the process of coping from the outcome resulting from it. This means that no specific coping strategy is considered inherently good or bad and the effectiveness of a particular strategy depends on its effects in a specific situation, as well as its long-term effects (Folkman et al., 1986; Lazarus, 1993).

Coping is part of the stress process; according to stress and coping theory, an individual goes through a two-stage process when encountering a stressful event: cognitive appraisal and coping (O'Driscoll & Cooper, 1994). Cognitive appraisal involves the evaluation of the nature of a particular encounter and its relevance to the individual's well-being (primary appraisal), and the evaluation of what can be done to handle the perceived challenge, harm or threat (secondary appraisal) (Folkman et al., 1986). Secondary appraisal involves the assessment of the available coping resources/options, and whether an individual can use a particular coping option effectively (Lazarus & Folkman, 1984). Based on primary and secondary appraisals, an individual enacts a coping response. Coping theory distinguishes between two forms of coping, emotion-focused and problem-focused coping (Carver, Scheier & Weintraub, 1989; Compas et al., 2001). Emotion-focused coping is cognitive effort directed at regulating emotions and lowering emotional distress (Folkman & Lazarus, 1988). It aims at changing the meaning of the stressful situation but not altering the situation itself (Folkman & Lazarus, 1988). Emotion-focused coping is directed only at oneself and includes strategies such as avoidance, distancing, venting anger, and positive comparisons (Folkman et al., 1986). Problem-focused coping, on the other hand, similar to problem-solving strategies aims at managing or altering the situation causing distress or changing oneself, such as learning new skills to deal with the situation (Folkman & Lazarus, 1988; Folkman & Moskowitz, 2000). Individuals can engage in a combination of both emotion-focused and problem-focused coping when encountering a stressful event. In general, individuals tend to engage in emotion-focused coping when they perceive that they have limited control over the situation. On the other hand, they use problem-focused coping when they feel they have the ability and resources to control the situation (Beaudry & Pinsonneault, 2005; Folkman & Lazarus, 1988).

2.14 IT user adaptation behaviours

Technostress and coping literature in the IS field has identified a range of coping strategies. Coping theory suggests that the way individuals deal with technostress is determined by the context and the types of stressors individuals encounter (Cooper, Dewe & O'Driscoll, 2001). Drawing on coping theory, Beaudry and Pinsonneault (2005) developed the coping model of user adaptation (CMUA). They defined technology adaptation as cognitive and behavioural efforts that an individual performs to manage consequences resulting from a significant IT event that occurs in their workplace (e.g. an implementation of new IT). The CMUA is one of the most widely used models for coping with IT. It provides a foundation to understand user reactions to situations or events created by IT. In light of coping theory, the CMUA proposes that an individual's reactions to an IT event are determined by primary and secondary appraisals. During primary appraisal, an individual evaluates a situation created by IT in terms of its personal relevance and its expected consequences. The situation is appraised as an opportunity when its expected consequences are perceived to have positive effects on the individual and their work. On the other hand, the situation is evaluated as a threat when it is perceived to result in negative outcomes. During secondary appraisal, the individual assesses the degree to which they have control over the situation and then evaluates whether they have the required resources to deal with it. The CMUA identifies four adaptation strategies that IT users perform based on primary and secondary appraisals: benefit maximising and benefits satisficing are used when an IT event is appraised as an opportunity, whereas disturbance handling and self-preservation are applied in cases where the perceived consequences of an IT event are appraised as a threat. Given the fact that disturbance handling and self-preservation strategies are used when IT situations are perceived to have negative outcomes, these strategies are relevant to the focus of this study, which seeks to explore students' responses to stressors associated with WhatsApp and its potential adverse consequences on their well-being and performance.

2.14.1 Disturbance handling strategy

According to the CMUA, disturbance handling adaptation strategy is used when a person appraises an IT event as a threat and feels that the situation is under their control (Beaudry & Pinsonneault, 2005). Coping efforts in this strategy are mainly problem-focused directed at dealing with the situation (Elie-Dit-Cosaque & Straub, 2011). In addition, emotion-focused coping is likely to be used in order to minimise the perceived negative consequences associated with the situation and regain emotional stability (Bala & Venkatesh, 2016; Beaudry & Pinsonneault, 2005). Coping efforts can be directed at oneself, for example, adjusting personal habits to meet IT-use requirements, or learning new skills (Beaudry & Pinsonneault, 2005), directed at the technology causing stress, such as modifying IT features (Chen, Tran & Nguyen, 2019; Salo et al., 2017), upgrading or fixing the technology (Salo, Makkonen & Hekkala, 2015) and/or can be directed at the task, such as adapting work procedures to fit with the IT (Beaudry & Pinsonneault, 2005). A disturbance handling strategy is considered effective when it leads to regaining personal emotional stability and the reduction of perceived negative outcomes associated with the stressful situation (Beaudry & Pinsonneault, 2005). In addition, this strategy can help individuals to find ways to improve the situation and benefit from it (Chen, Tran & Nguyen, 2019; Elie-Dit-Cosaque & Straub, 2011).

2.14.2 Self-preservation strategy

Self-preservation strategy is used in situations where an IT event is appraised as a threat and an individual has limited control over the situation (Beaudry & Pinsonneault, 2005). In this strategy, individuals attempt to preserve themselves from potential negative consequences associated with the threatening situation (Elie-Dit-Cosaque & Straub, 2011; Lazarus & Folkman, 1984). Coping efforts will be mainly emotion-focused and directed at managing emotional distress and reducing the perceived negative outcomes of the situations rather than attempting to solve the problem created by IT (Beaudry & Pinsonneault, 2005). Examples of emotion-focused responses include distress venting (Beaudry & Pinsonneault, 2010; Pirkkalainen et al., 2017), avoiding IT use (Bala & Venkatesh, 2016; Chen & Zahedi, 2016; Liang & Xue, 2010), withdrawing from IT use (Beaudry & Pinsonneault, 2005; Maier et al., 2015a) and distancing (Beaudry & Pinsonneault, 2010; Nach & Lejeune, 2010). Research has found that when individuals encounter IT-related stressors, they tend to disengage from IT use (Galluch, Grover & Thatcher, 2015; Salo et al., 2017). Self-preservation strategy could lead to negative outcomes, such as when it is used in situations where the problem should be addressed instead (Folkman et al., 1986; Folkman & Lazarus, 1988). On the other hand, it might be adaptive in circumstances where there is nothing to be done to manage stress (Folkman et al., 1986). Beaudry & Pinsonneault (2005) indicate that when the self-preservation strategy is successful, emotional stability will be regained; however, there will be little or no effect on IT user performance.

2.15 Chapter Summary

This chapter provided background on the theoretical base and key concepts forming the premise of this study. The chapter focused on three areas. First, it discussed the role of WhatsApp in mobile learning and highlighted the advantages that WhatsApp can offer students. Despite the fact that the mobile-learning literature has shown that WhatsApp has the potential to enhance learning, the effectiveness of WhatsApp in learning is still inconclusive. The review of the literature suggests a need for exploring the negative effect of WhatsApp on students' well-being and their performance. Next, the chapter explained the concept of technostress and the transactional model of stress to establish the theoretical bases of the study. In addition, it gave an overview of extant research on technostress and identified gaps within IS research. To develop an in-depth understanding of the causes of technostress, factors identified in the literature as techno-stressors were reviewed, namely the concepts of technology overload, information overload, communication overload and technology invasion were discussed. In addition, to build a better understanding of the phenomenon of fatigue in the context of WhatsApp, the chapter reviewed the concept of social media fatigue and presented a summary of existing studies on this topic. The third topic the chapter focused on was coping with technostress. Coping with IT-related stress has become an important topic, given the detrimental effects of technostress on individuals and organisations. Nevertheless, the review of extant research on technostress has suggested that limited research has been done on this issue. To understand coping in the context of WhatsApp, the current chapter provided an overview of the concept of coping and then reviewed coping in the context of IT use. Following that, the coping model of user adaptation was explained in order to build a theoretical foundation to understand students' responses to fatigue and stressors related to WhatsApp use. Having established the theoretical foundation of the current study, the next chapter explains and provides justifications for methodological choices and philosophical underpinnings of the current study and discusses in detail the data collection and analysis methods used.

Chapter 3: Methodology

3.1 Chapter overview

This chapter discusses the research paradigm and the philosophical assumptions that underpin the current study and provides justification for the research design and the chosen methods for data collection and data analysis. The chapter starts with an overview of the main research paradigms that are used in IS research then explains and justifies the use of pragmatism as a philosophical framework to guide the current study. The current study adopts a mixed-methods approach in order to gain insights and an in-depth understanding of fatigue and coping behaviours in the context of academic use as well as to examine the proposed conceptual model. More detail on the rationale behind using a mixed-methods approach is provided in this chapter. The study used a two-stage mixed-methods design, beginning with a qualitative study and concluding with a quantitative one. The aim of the qualitative phase was to explore techno-stressors associated with WhatsApp and understand coping behaviours, and then develop the conceptual research model based on the qualitative findings. The data in this phase were collected using semi-structured interviews and analysed using template analysis. In the second phase, the proposed research model was validated using data collected via online questionnaires. Structural equation modelling was used to analyse the quantitative data. The data collection methods used in both phases and the methods used for data analysis are explained in this chapter. Moreover, the study target population, sampling techniques and sample sizes in both qualitative and quantitative phases are explained and justified. The chapter discusses validation in mixed methods research and explains validity assessment in the qualitative and quantitative phases. The chapter ends with an explanation of the relevant ethical considerations that were followed in this study.

3.2 Research paradigms

Any social science research has philosophical assumptions that guide the research process. This includes assumptions about reality, how knowledge is obtained and the methods of gaining knowledge (Creswell & Creswell, 2018). Researchers need to be aware of these philosophical underpinnings since they have a significant impact on how the research is designed and conducted (Saunders, Lewis & Thornhill, 2016). The terms ‘paradigm’ (Guba & Lincoln, 1994) or ‘worldview’ (Creswell & Clark, 2007) are used by researchers to describe a set of beliefs or assumptions about the world that influence what should be studied, how research should be carried out and how findings should be interpreted in a particular discipline (Bryman, 2012; Collis & Hussey, 2014, Morgan, 2007). A research paradigm is a philosophical framework that involves assumptions about the nature of social reality (ontology), assumptions about knowledge and what constitutes acceptable and scientific knowledge (epistemology), and the process of research (methodology) (Creswell & Clark, 2007; Mingers, 2001; Saunders, Lewis & Thornhill, 2016). The choice of an appropriate research paradigm is crucial as it shapes the research process, from research design to data collection to interpreting results. In social sciences, there are several different paradigms proposed, which are distinguished from each other based on key concepts, namely ontology, epistemology and methodology. *Ontology* is concerned with the nature of reality. It focuses on the nature or essence of the social phenomenon under investigation. Ontological assumptions are concerned with whether the social phenomenon has a reality external and independent from the investigator or whether the social phenomenon is socially constructed (Bryman, 2012). *Epistemology* refers to assumptions about knowledge and what constructs valid, acceptable, and legitimate knowledge (Saunders, Lewis & Thornhill, 2016). It is concerned with how an investigator is aiming to uncover knowledge to reach reality. It is then about the relationship between the researcher and what is being investigated (Creswell & Clark, 2007). When objective reality is assumed, the researcher tends to distance themselves from the phenomenon under study (Collis & Hussey, 2014). In addition, knowledge is obtained from objective data about observable and measurable phenomena. On the other hand, when subjective reality is assumed, researchers tend to minimise the distance between them and what is being researched (Collis & Hussey, 2014). Knowledge is obtained from subjective evidence from individuals.

Different paradigms have different ontological and epistemological assumptions. Understanding different philosophical assumptions and how they inform methodology enables the selection of the best-fit research paradigm. Generally speaking, the main paradigms in the IS field are positivism and interpretivism, which represent two extremes of a continuum of paradigms (Collis & Hussey, 2014). Pragmatism falls within this continuum, which is another paradigm associated with mixed-methods research and is used in IS research (Goldkuhl, 2012; Goles & Hirschheim, 2000; Mingers, 2011). The following sections discuss three paradigms: positivism, interpretivism and pragmatism, and explain which one is appropriate for this study.

Positivism, based on the philosophical stance of natural sciences, argues that a single and objective reality exists independently of social actors (Bryman 2012; Saunders, Lewis & Thornhill, 2016). The researcher has no influence on the social reality as they remain detached from what is being studied and their role is to discover knowledge through observation and experiment (Bryman, 2012). Positivist researchers believe that knowledge can be acquired only from observable and measurable phenomena, which leads to the production of generalisable results (Saunders, Lewis & Thornhill, 2016). Positivist research adopts a deductive approach that begins with theory and develops hypotheses, which then can be tested with quantitative data (Bryman, 2012; Collis & Hussy, 2014).

Interpretivism, on the other hand, emerged as a critique of positivism and emphasises that social phenomena are fundamentally different from those of the natural sciences, thus they cannot be studied in the same way as physical phenomena (Bryman, 2012). Interpretivists believe that social reality is highly subjective and constructed by how people perceive their world (Bryman, 2012; Collis & Hussy, 2014). Knowledge about social reality is acquired by interpretation of human behaviours; therefore, interpretive research emphasises understanding human behaviours rather than explaining them (Bryman, 2012). Interpretivist researchers interact with phenomena under study and their role is to elicit the subjective meaning of social actions (Bryman, 2012). Since researchers cannot separate themselves from what is being observed, their interpretation of research data is influenced by their perception and values (Saunders, Lewis & Thornhill, 2016). Interpretive research adopts an inductive approach, which uses qualitative methods to explore social phenomena and develop theories (Bryman, 2012; Collis & Hussy, 2014).

Positivist and interpretivist paradigms have distinct ontological and epistemological assumptions; therefore, they employ different research methods. Positivism is often associated with quantitative methods in which the researcher tests a theory by identifying a set of hypotheses and then collects data to support or reject them (Collis & Hussy, 2014). Quantitative methods are considered appropriate for testing hypotheses, verifying theories and generalising results (Johnson & Onwuegbuzie, 2004), for example, surveys and experiments, which are often employed to examine causal relationships among multiple concepts and provide explanation for such relationships. Quantitative methods allow the researcher to establish the reliability and validity of research measurement and thereby allow the production of reliable and generalisable results (Bryman, 2012). However, quantitative methods also have disadvantages and criticisms. They have been criticised for being inadequate in providing rich information about complex phenomena (Johnson & Onwuegbuzie, 2004). In addition, relying on quantitative methods to collect data from respondents can prevent the connection between research and everyday life (Bryman, 2012). For instance, in self-completion questionnaires, respondents' answers may differ from their actual behaviour. Moreover, quantitative methods have received criticism on the way concepts are measured. Using self-reported measures may not accurately capture concepts. It is possible that a question (a measure of a concept) has a different meaning for different respondents, which could affect the validity and reliability of findings (Bryman, 2012).

The interpretivist paradigm, on the other hand, uses qualitative methods such as interviews, in which the researcher seeks to explore the meaning of a social phenomenon through the perspectives of the participants. Unlike quantitative research, which maintains a distance between the researcher and the subjects of the study, qualitative approaches allow the researcher to interpret the social world from the view of the individuals being studied (Creswell & Creswell, 2018). Thus, qualitative approaches are considered ideal for developing an in-depth understanding of human behaviours (Bryman, 2012). Like with quantitative methods, qualitative approaches also have weaknesses and criticisms. Qualitative research has been criticised for being too subjective in the sense that qualitative findings depend on what researchers view as significant and important (Bryman, 2012). The interpretation of findings can be affected by the subjective bias of a researcher (Johnson & Onwuegbuzie, 2004). In addition, qualitative research is difficult to replicate because the researcher is the instrument of data collection, and he/she chooses what is important and what to focus on; what one researcher views as significant may not be important for another (Bryman, 2012). Another issue with qualitative methods is that they often focus on a small number of participants, therefore the findings cannot be generalised to other settings or other people (Johnson & Onwuegbuzie, 2004).

Instead of being restricted to a particular method (i.e., quantitative or qualitative), the current study uses a mixed-methods approach in order to draw from the strengths and minimise the weaknesses of both methods (Johnson & Onwuegbuzie, 2004). Consequently, it adopts neither a purely positivist nor a purely interpretive position, as will be discussed later.

There has been an ongoing debate over mixing qualitative and quantitative methods. The paradigm incompatibility argument asserts that quantitative and qualitative methods are associated with different epistemological positions; therefore, combining them in a single study entails mixing conflicting paradigms (Bryman, 2008; Creswell & Clark, 2007; Onwuegbuzie & Leech, 2005). According to this view, mixed-methods research is not possible or even desirable (Smith & Heshusius, 1986). The problem of this argument is that it tends to treat research methods as epistemological stances (Bryman, 2012). However, researchers argue that methods can be separated from a paradigm and used within a context that holds different assumptions (Johnson, Onwuegbuzie & Turner, 2007; Mingers, 2001). Mixed-methods research advocates argue that both quantitative and qualitative methods can be employed in a single study and researchers should not be forced to choose between positivism and interpretivism (Tashakkori & Teddlie, 2003). Researchers can draw on more than one paradigm (Creswell & Clark, 2007). Moreover, Mingers (2001) argues that each paradigm (i.e., positivism or interpretivism) focuses its attention on different aspects of the world and selecting one paradigm over the other could limit our knowledge of reality, therefore, the use of multiple paradigms contributes to a better understanding of the phenomenon under investigation. Johnson, Onwuegbuzie and Turner (2007) recognise that "variation in particular philosophical commitments should be welcome in mixed-methods research" and these differences should be embraced as an important part of the mixed-methods research paradigm (p.125). Advocates of mixed-methods research within the IS field suggest that the paradigm should not prevent researchers from conducting mixed-methods research and that researchers can mix their paradigmatic views and at the same time conduct rigorous mixed-methods research (Venkatesh, Brown & Bala, 2013).

3.3 Pragmatism

Pragmatism is viewed as the appropriate philosophical position for mixed-methods research (Morgan, 2007; Tashakkori & Teddlie, 2003). This section discusses pragmatism as a paradigm of mixed-methods research and the philosophical assumptions underpinning the current study. Pragmatism has its origin in the late nineteenth and early twentieth centuries in the work of philosophers William James and John Dewey (Saunders, Lewis & Thornhill, 2016). Pragmatism has been suggested by researchers to be a new alternative paradigm that overcomes incompatibility issues and serves as a foundation for mixed-methods research (Biesta, 2010; Creswell & Creswell, 2018; Morgan, 2007). It can provide epistemological and logical justifications for combining qualitative and qualitative methods (Johnson, Onwuegbuzie & Turner, 2007). Pragmatism does not commit to any particular philosophical stance or assumption about reality (Creswell & Creswell, 2018). Pragmatist researchers believe that objective reality exists independently from the individual. However, this reality is embedded in the environment and the experience of the individual (Goles & Hirschheim, 2000). For pragmatists, reality is the practical consequences of ideas, and the truth is 'what works' at the time (Creswell & Creswell, 2018; Tashakkori & Teddlie, 2003). Pragmatist researchers agree that objectivity is important but also believe that researchers cannot be separate from what is being studied; therefore, the researcher cannot be a pure objectivist. This view is different from positivism, which suggests that researchers should only be objective (Goles & Hirschheim, 2000). Practically, the subjectivity of researchers is embedded within the research process. Researchers select what they perceive as important to study; therefore, they never can be completely objective (Morgan, 2007; Onwuegbuzie & Leech, 2005). Pragmatists adopt both objectivity and subjectivity in order to be able to understand the phenomenon from different perspectives (Goles & Hirschheim, 2000). They place a great emphasis on the research problem and question and employ all methods available to understand it (Creswell & Creswell, 2018; Goles & Hirschheim, 2000). The focus is on the appropriateness of research methods for answering questions, rather than on philosophical assumptions (Bryman, 2008). Researchers have freedom to choose 'what works'; thus, they can use both quantitative and qualitative methods in a single study to address the research problem (Creswell & Clark, 2007; Onwuegbuzie & Leech, 2005). In the IS field, pragmatism has been accepted by researchers as an alternative paradigm and an opportunity to improve the rigour and relevance of research (Goles & Hirschheim, 2000; Venkatesh, Brown & Bala, 2013; Venkatesh, Brown & Sullivan, 2016).

This study embraces pragmatism as it fits best with mixed-methods research. Adopting a pragmatic approach in this study allows the researcher to be free and not restrained by a forced choice between positivism and interpretivism (Creswell & Clark, 2007; Goles & Hirschheim, 2000; Venkatesh, Brown & Bala, 2013). This study argues that the experience of fatigue and technology overload is a complex phenomenon and can be affected by the context in which it emerges, which, in this study, is educational use. In addition, the subjects of this study are students in Saudi Arabia. Adopting a positivist approach entails using existing theories of technostress to explain fatigue experienced due to educational use of technology. However, existing research provides little knowledge about fatigue in the context of mobile learning. It may not be reasonable to explain this phenomenon based on existing research on technostress without considering how individuals in a different context (educational use) and from a different cultural background (Saudi culture) perceive it. The experience of fatigue and overload also might not be fully understood by considering the views and perspective of a few students as in interpretivist research. The adoption of a single paradigm limits the range of methods that can be used to answer the research questions (Mingers, 2001). Therefore, taking a pragmatic approach allows focusing on the research problem and using whatever methods are appropriate to address it (Bryman, 2012; Goles & Hirschheim, 2000). Pragmatism enables the researcher to be flexible in selecting research methods that address various research questions (Johnson & Onwuegbuzie, 2004). In addition, in order to draw a strong inference on the consequences of educational use of WhatsApp on students' well-being and provide practical implications for universities, educators and policy makers, there is a need for both understanding students' views on the phenomenon and providing generalisable evidence. A pragmatic approach thus allows the collection of different types of data and evidence, which can provide a holistic view of the phenomenon under study (Johnson & Onwuegbuzie, 2004).

Generally, there are two approaches to theory development: deductive and inductive reasoning. In *deductive reasoning*, the conclusion is derived logically from a set of assumptions (Saunders, Lewis & Thornhill, 2016). The conclusion is considered true as long as all the assumptions are true. Typically, research that follows a deductive approach begins with a set of hypotheses about relationships between concepts based on existing theory, then quantitative data are collected to test the hypotheses. If the results of the analysis are not consistent with the hypotheses, the theory is false, and is rejected or modified (Saunders, Lewis & Thornhill, 2016). On the other hand, in *inductive reasoning*, a generalisable inference is drawn from specific observations (Bryman, 2012). Research using an inductive approach starts by collecting data to explore a phenomenon and then uses the data to draw conclusions.

Pragmatism is often associated with abductive reasoning, which moves back and forth between induction and deduction (Morgan, 2007; Venkatesh, Brown & Bala, 2013). Practically, research cannot be completely deductive or inductive because the process of moving between theory and data never works in one direction; researchers need to move back and forth between theory and data when conducting research (Morgan, 2007). According to pragmatists, mixed-methods research can use both deductive and inductive reasoning within a study (Tashakkori & Teddlie, 2003). An inductive approach was used in this study to collect qualitative data from a small sample of participants regarding their experience with fatigue and technology overload, and to develop a conceptual framework based on the collected data. A deductive approach was also used to test the conceptual model, which was developed using technostress theories and research as well as the data collected from the interviews, and to allow the generalisability of results. The mixed-methods design used in this study is discussed in detail in the following sections.

Table 3.1: Comparison between the philosophical assumptions of three paradigms (adapted from Saunders, Lewis & Thornhill (2016))

Paradigm	**Positivism**	**Interpretivism**	**Pragmatism**
Ontology (The nature of reality)	Singular reality. Social reality is objective and external to the researcher.	Multiple realities. Social reality is subjective and socially constructed.	Singular and multiple reality. Social reality is objective and external to the individual and also it is grounded in the environment and experience of each individual (Goles & Hirschheim, 2000).
Epistemology (what constitutes valid and	Knowledge is created by objective data.	Knowledge is created by subjective data.	'True' theory and knowledge are those

acceptable knowledge)	Social phenomenon is observable and measurable. The researcher is independent from the phenomenon under investigation.	Social phenomenon is interpreted. The researcher interacts with phenomenon under investigation.	that enable successful action. The researcher collects data by 'what works' to solve research problems.
Methodology (the process of the research)	Deductive research approach.	Inductive research approach.	Abductive research approach.
Methods (techniques for data collection and analysis)	Quantitative methods: Surveys, experiments.	Qualitative methods: Interviews, focus group, narrative.	Mixed, multiple, quantitative, qualitative methods. Action research.

3.4 Mixed methods

Mixed-methods research has been recognised as the third methodological movement or paradigm in social sciences (Johnson & Onwuegbuzie, 2004). Mixed-methods research is defined as "an approach to knowledge (theory and practice) that attempts to consider multiple viewpoints, perspectives, positions, and standpoints, including the standpoints of qualitative and quantitative research" (Johnson, Onwuegbuzie & Turner, 2007, p.113). Mixed-methods is a research design that employs multiple methods or more than one research paradigm in the same research project (Creswell & Creswell, 2018). It involves collecting, analysing, and combining both quantitative and qualitative data within a single study (Creswell & Clark, 2007). Mixed-methods research is different from multimethod research, which uses one or more research methods within the same research paradigm (e.g. two different quantitative methods), whereas mixed-methods research combines research methods from different paradigms (Johnson, Onwuegbuzie & Turner, 2007). Researchers have identified three strengths of mixed-methods research (Venkatesh, Brown & Bala, 2013): (1) combining quantitative and qualitative methods enables researchers to address both exploratory and confirmatory research questions. In exploratory research, qualitative methods can be used to

have a better understanding of a phenomenon and to gain a theoretical insight. On the other hand, in confirmatory research, quantitative methods are used for theory testing. In mixed-methods research, both exploratory and confirmatory approaches can be combined.
(2) The use of mixed-methods research enables researchers to draw stronger conclusions than the use of a single method. (3) Mixed-methods research can produce diverse and complementary views on the phenomenon of interest. The value of mixed-methods research in the IS field has been recognised as an opportunity to advance the field and provide novel theoretical perspectives (Venkatesh, Brown & Sullivan, 2016). Given the complexity of IS phenomena, a single method may not be able to address all its various aspects (Mingers, 2001). Thus, researchers encourage the use of mixed-methods research in the IS field to provide a richer understanding of different aspects of IS phenomena (Venkatesh, Brown & Bala, 2013).
There are various purposes of using a mixed-methods approach (Tashakkori & Teddlie, 2003; Venkatesh, Brown & Bala, 2013), which can be summarised as follows. Complementarity (the results of one method are used to seek elaboration, illustration, clarification and enhancement of the results of the other method), completeness (mixed-methods designs are used to gain a complete view of the phenomenon of interest), developmental (the results of one method are used to help develop the other method), expansion (mixed methods are used to extend prior studies and provide deeper understanding of the phenomenon under study), corroboration/conformation (one approach is used to confirm the results obtained from the other approach), compensation (mixed methods are used to offset the weaknesses of one method by the other) and diversity (mixed methods are used to gain divergent perspectives of the same phenomenon). The reasons for choosing a mixed-methods approach and the purpose of using it are discussed in the next section.

3.4.1 Rationales for selecting a mixed-methods approach

Given the objectives of this study, which attempt to understand factors that create fatigue and overload among students using WhatsApp, a mixed-methods approach was chosen as an appropriate method for the study for the following reasons. First, fatigue in the context of educational use reflects individuals' subjective evaluation of their experience with WhatsApp. Quantitative methods can be used to examine techno-stressors that lead to fatigue; however, using only quantitative data may not be adequate to develop a deep understanding of such a complex phenomenon (Creswell & Clark, 2007). Qualitative methods can offer rich and detailed information about the phenomenon under study. Yet, qualitative methods may not be able to provide a comprehensive view of the research problem, as they consider the views and experiences of few individuals, thus findings cannot be generalised to a large number of people (Johnson & Onwuegbuzie, 2004). Each method enables us to view the phenomenon from one aspect; combining both quantitative and qualitative methods can provide a more complete view of the phenomenon. Using a mixed-methods approach enables the researcher to obtain a greater understanding of the phenomenon from participants’ perspectives as well as producing generalisable results (Creswell & Clark, 2007; Mingers, 2001). Further, each method has its strengths and limitations: the use of a mixed-methods approach can leverage the strength and minimise the limitations of both quantitative and qualitative methods (Creswell & Clark, 2007; Johnson & Onwuegbuzie, 2004). Second, extant research on technostress often focuses on non-academic use as discussed in the literature review chapter. Given the lack of theoretical frameworks that explain fatigue and technology overload in educational-use contexts, a qualitative method was used to explore this topic in the Saudi context and to develop a conceptual research model. A quantitative method was also used to confirm findings obtained from the qualitative study and to allow the generalisation of the results. Third, instead of using a single method, combining both qualitative and quantitative data can provide greater confidence in the conclusion and produce better results (Creswell & Clark, 2007; Johnson, Onwuegbuzie & Turner, 2007). Fourth, Mingers (2001) argues that research is not a single event but a process that includes different phases and activities. For each phase or activity there are certain research methods which tend to be more useful in some phases than in others. Combining research methods can produce more comprehensive findings. In this study, the phenomena of fatigue and technology overload were investigated through multiple stages. Each stage (i.e. qualitative, quantitative) had different objectives and attempted to address a particular research question, and thereby used a different method. A combination of qualitative and quantitative methods was used with the aim to achieve a more comprehensive research outcome. The next section describes the research design and the different stages of the study.

3.4.2 Mixed-methods research design

A research design or strategy is a plan for collecting, analysing, interpreting, and reporting data (Bryman, 2012; Creswell & Clark, 2007). In mixed-methods research, there are many ways in which qualitative and quantitative methods can be combined in a single study. The choice of the appropriate mixed-methods research design is made in accordance with three decisions: timing, weighting, and mixing (Creswell & Clark, 2007). The *timing* decision determines the order in which the collected data are analysed and used within a study. The implementation of qualitative and quantitative methods can be concurrent or sequential. In concurrent design, both methods are conducted in a single phase, while in sequential design the researcher implements quantitative and qualitative methods in two different phases of the study. For example, the qualitative method is implemented and is then followed by the quantitative method. The *weighting* decision determines the relative importance of the quantitative and qualitative methods with regards to answering the research questions. Both methods can have an equal priority, or one method can have a greater priority. The relative importance of each method is determined by the research objectives and questions (Creswell & Clark, 2007). The *mixing* decision identifies how the quantitative and qualitative methods will be combined. In this regard, data collected from quantitative and qualitative methods can be merged, connected or one data set can be embedded within the other. Any combination of timing, weighing and mixing decisions can be used to design mixed-methods research. The four major types of mixed-methods designs are triangulation, embedded, explanatory, and exploratory (Creswell & Clark, 2007; Creswell & Creswell, 2018). The *triangulation design* is a single-phase design in which quantitative and qualitative methods are implemented at about the same time. The purpose of this design is to use the data from one method to complement the data obtained from the other method. In the *embedded design*, one type of data is embedded within the other type. For example, quantitative data are included within a largely qualitative study. In this design, the use of one type of data is intended to provide support for the other type. The *explanatory design* is a two-phase design in which quantitative data are collected and analysed in the first phase, followed by qualitative data collection. The purpose of collecting qualitative data is to explain the results obtained from the quantitative phase. The *exploratory design*, like the explanatory design, is two-phased; however, the qualitative data are collected and analysed in the first phase, then the results of the qualitative method are used to develop a quantitative method in the subsequent phase (Creswell & Clark, 2007). The exploratory design is used when there is a lack of measures or instruments or when existing theoretical frameworks are not sufficient to explain the phenomenon under investigation (Creswell & Clark, 2007; Venkatesh, Brown & Bala, 2013). Given the exploratory nature of this study, the used design was the exploratory sequential mixed-methods design (see Table 3.2). This design was appropriate for this study because it begins with a qualitative method to explore a phenomenon in depth and develop a better understanding of the research problem (Saunders, Lewis & Thornhill, 2016).

In addition, exploratory design is useful in case there is a need to develop a research instrument and then test it using quantitative data (Creswell & Clark, 2007). Considering the fact that qualitative findings may not be generalised to other people or contexts (Johnson & Onwuegbuzie, 2004), the sequential design can be used to address this limitation. It enables the results of a qualitative method to be generalised to different groups (Creswell & Clark, 2007). The sequential design was chosen to leverage the findings from the qualitative method and to develop the quantitative study in the next phase (Venkatesh, Brown & Bala, 2013).

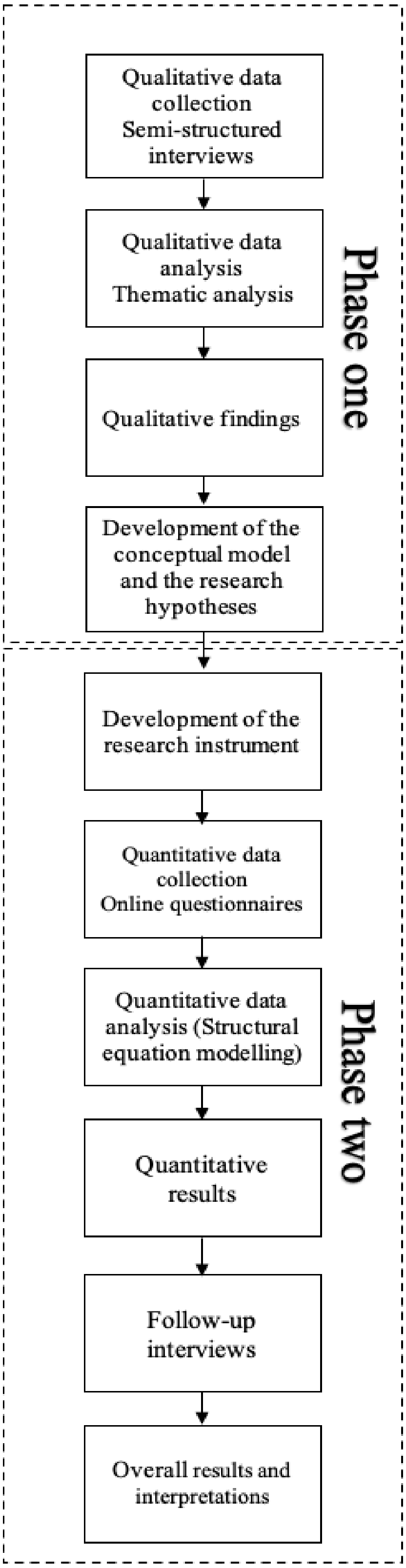

Figure 3.1: Research design

The mixed-methods design of the current study is a two-phase design (see Figure 3.1). In the first phase, a qualitative study was conducted. The data were collected from participants through semi-structured interviews. The purpose of this phase was to develop a better understanding of fatigue and technology overload in the context of educational use. The interviews were carried out to identify key techno-stressors that create fatigue from participants' perspectives and explore students' coping strategies to reduce WhatsApp fatigue. The findings of the qualitative phase were used to develop the research conceptual model and hypotheses. In the second phase, a cross-sectional survey approach was used to collect data from a large sample. the phase started with a development of the study instrument, which was an online questionnaire. The aim of this phase was to validate the research framework and test the research hypotheses. In addition, the results of the quantitative study were used to confirm the findings of the qualitative phase. Due to the fact that online surveys were distributed during the shift to remote learning during the COVID-19 lockdown, additional information was needed to understand how this shift might influence the academic use of WhatsApp. Consequently, follow-up interviews with students who participated in the main interviews were conducted to obtain the needed information. The results of the follow-up interviews were used to provide interpretation to the survey results.

In this exploratory sequential design, the findings of the qualitative phase were used to inform the design of the quantitative phase, thereby the qualitative and quantitative data were connected through the development of the research instrument (Creswell & Creswell, 2018). The qualitative and quantitative phases had an equal priority in addressing the research problem and answering research questions.

Table 3.2: Mixed-methods design decision (Creswell & Clark, 2007)

Design decision	Description	Design choices	The study choice
Timing	The order in which quantitative and qualitative methods are conducted.	*Concurrent timing:* quantitative and qualitative data are collected and analysed simultaneously. *Sequential timing:* One type of data is collected and analysed followed by the other type of data.	The sequential design. Qualitative data were collected and analysed in the first phase, followed by quantitative data collection in the next phase.
Weighting	The priority of the quantitative or qualitative method in answering the research questions.	*Equal weight*: both methods have equal priority. *Unequal weight*: one method is more important than another.	Both methods had an equal weight with regards to addressing the research questions.
Mixing	This determines how quantitative and qualitative data will be mixed.	Quantitative and qualitative data can be merged, embedded, or connected.	The qualitative data were connected to the quantitative phase through the development of the research instrument.

3.5 Data collection methods

3.5.1 Interviews

Research interviews are a common method for data collection and widely employed in qualitative research (Bryman, 2012). In simple terms, the research interview is a purposeful conversation between two or more individuals in which interviewees are asked questions about topics of interest (Saunders, Lewis & Thornhill, 2016). In qualitative research, interviews are employed to explore participants' subjective opinions, feelings and experience of particular topics (Collis & Hussy, 2014). Unlike questionnaires, interviews allow participants to express their opinions and attitudes while at the same time enabling the interviewer to develop further questions based on participants' answers. Therefore, rich information can be gathered from the conversation (Collis & Hussy, 2014).

There are three types of interviews: structured, semi-structured and unstructured interviews. *Structured interviews* involve asking participants a prepared and standardised set of questions. All participants are asked exactly the same questions and in the same order (Bryman, 2012). Structured interviews are used to collect quantifiable data, therefore they are often employed in quantitative research (Saunders, Lewis & Thornhill, 2016). On the other hand, semi-structured and unstructured interviews are considered non-standardised and known as qualitative research interviews (Saunders, Lewis & Thornhill, 2016). *Semi-structured interviews* are more flexible in comparison with structured interviews, allowing the researcher to prepare a list of questions in advance and develop further questions during the interview (Collis & Hussy, 2014). *Unstructured interviews* are used to explore a topic of interest in depth. Questions are not prepared in advance but emerge during the conversation (Saunders, Lewis & Thornhill, 2016). The interviewer asks only a few open-ended questions, and the interviewee is allowed to talk freely about events, opinions and behaviour with regard to the research topic (Bryman, 2012). This type of interview is considered very time-consuming. In addition, controlling conversations and recording questions and answers during unstructured interviews can be a challenge (Collis & Hussy, 2014). Moreover, unstructured interviews can produce a large amount of qualitative information on a range of topics, which makes analysing the data a difficult task (Collis & Hussy, 2014). In this study, a semi-structured interview was chosen as the method for qualitative data collection as explained in the following sections.

3.5.2 Semi-structured interviews

The aim of the qualitative phase was to explore fatigue associated with educational use of WhatsApp and to understand coping behaviours. In order to achieve the research objectives and develop a deep understanding of the research topic, semi-structured interviews were used to collect data from students. Semi-structured interviews are considered a flexible data collection method that enables interviewees to express their feelings and opinions about the research topic while at the same time allowing the researcher to guide the conversation and ask a list of predetermined open-ended questions (Collis & Hussy, 2014; Saunders, Lewis & Thornhill, 2016). It also allows the researcher to ask further questions based on interviewees' responses and ask for clarification on specific issues raised during the conversation, which could lead to the exploration of areas that have not been considered (Bryman, 2012). Semi-structured interviews were used with the aim to generate rich and detailed information about the research problem and build understanding of techno-stressors and coping responses associated with WhatsApp use in the Saudi context. Specifically, interviews were conducted to explore how students use WhatsApp for academic purposes and how this usage leads to fatigue and technology overload from their perspective, and to explore how students usually respond to fatigue triggers. The process of conducting the interviews is described in the following sections.

3.5.3 Preparing for the semi-structured interview

The interview guide. Prior to conducting the interview, an interview guide was developed, which is a set of questions to be asked or issues to be addressed during the interview (Bryman, 2012). Designing an interview guide helps the interviewer to clearly understand the interview questions as well as the purpose of including these questions (Magnusson & Marecek, 2015). The interview guide was used in this study as a reminder of key areas that needed to be explored, to ensure that important areas were covered and detailed information about the research topic was obtained from the participants. The interview guide was designed using the steps in Figure 3.2. The questions were developed based on the research questions and to cover the main areas in the research framework (see Figure 2.2). The questions were formulated as open-ended in order to obtain information about participants' views and experiences with WhatsApp. Open-ended questions would allow the participants to describe events or situations in which they experienced fatigue due to the educational use of WhatsApp and to describe their feelings and reactions in such situations (Saunders, Lewis & Thornhill, 2016). Besides open-ended questions, the interview guide included closed-ended questions, such as questions used to capture personal information and other specific questions that do not require detailed information. For example, the amount of time participants spent on the app per day and numbers of WhatsApp groups participants had joined. The questions were formulated in a simple and easily understood language that did not include theoretical concepts or specific terminology. The questions were translated by the researcher into Arabic, in order to be understood by the participants, and revised by two postgraduate students in the business school in University of Nottingham who speak both English and Arabic very well. The questions were developed to follow a logical order starting from general questions about WhatsApp usage and educational use in general, moving to more specific questions about techno-stressors that might cause fatigue. The order of questions would be altered during the interview based on interviewees' answers. In general, the participants were asked all the questions using similar wording, in order to ensure consistency and reliability (Bryman, 2012). Follow-up questions, such as probing questions, were used as necessary to ask for clarification or to elicit more detailed answers from participants (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). The guide was reviewed and tested by pilot interviews in order to examine the clarity and flow of the questions and to gain some experience before conducting the main interviewees. The interview guide is presented in Appendix A.

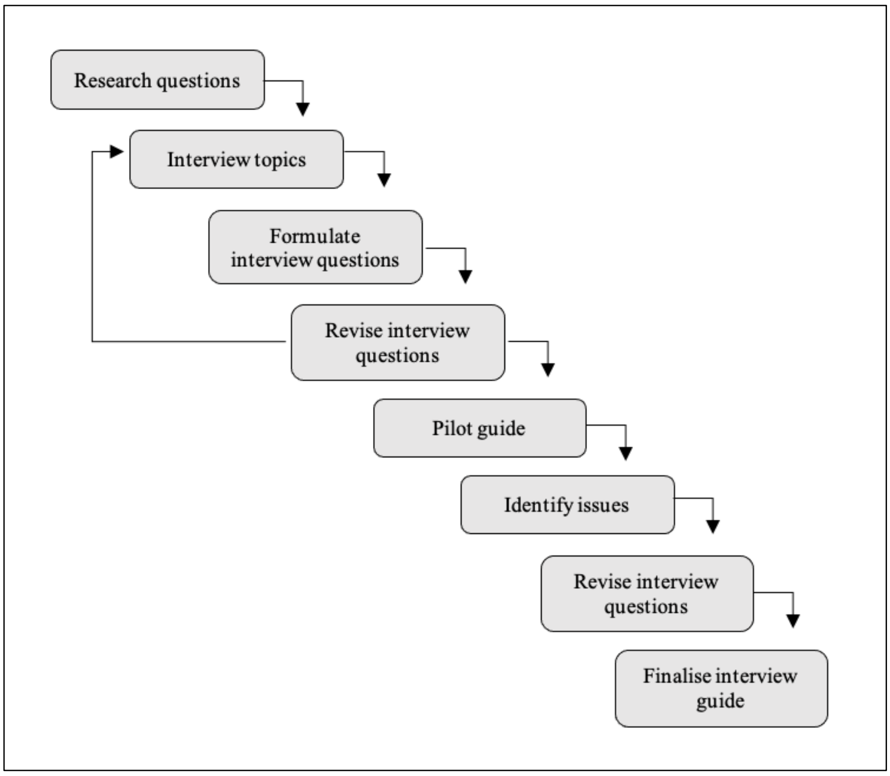

Figure 3.2: Designing an interview guide (adapted from Bryman (2012))

Pilot interview. A pilot test of the interview guide is an important step prior to carrying out interviews (Magnusson & Marecek, 2015). The purpose of performing a pilot test is to assess the interview guide and to allow the interviewer to examine the clarity of the questions and eliminate any ambiguity. It helps the researcher gain experience and skills in conducting interviews and asking follow-up questions (Bryman, 2012). In addition, it is an opportunity to examine what questions or topics are likely to require the most time during the interview and estimate the interview duration (Magnusson & Marecek, 2015).

Pilot interviews were conducted with five students, who were WhatsApp users and whose characteristics were like those of the intended participants (i.e., age, culture, language). The participants in the pilot interviews were not included in the main study. The participants gave their permission to take part in the pilot interview. The interviews were conducted face-to-face in public places as well as online via video conferencing and lasted about 30 minutes. The pilot interviews were used to check the wording and accuracy of the questions and to examine whether the questions were clear, understandable and valid for answering the research questions. They were helpful in building confidence and gaining some experience around conducting interviews and guiding the conversation. The interview guide was revised and adjusted with the help of the participants' feedback and comments. Accordingly, some questions were deleted, and new questions were added to the guide.

3.5.4 Conducting semi-structured interviews

Prior to the interview, a brief description of key topics and main questions to be asked during the interview were given to the participants. This step was important to inform the interviewees about the information that the interview would focus on, to give them an opportunity to prepare for the interview and to enhance its validity (Saunders, Lewis & Thornhill, 2016). In order to build trust and confidence, the participants were informed about their right to withdraw from the study and were reassured that their interview would remain confidential and that transcripts would be anonymised. The participants were informed about the nature of the study's outputs and what would happen to the data collected during the study and after it was done. In addition, a summary of interview findings would be provided to them if they requested it. Within the first few minutes of each interview, the participant was thanked for agreeing to take part in the study and attending the meeting. An explanation of the purpose of the study and the importance of participating were briefly outlined.

The interview started with general questions about the participant (e.g. academic level, school and academic discipline) and WhatsApp usage (e.g. How long have you been using WhatsApp? Why do you use WhatsApp?). General questions helped to initiate the conversation, to make interviewees feel comfortable and to build a rapport with them. The interview guide was used during the interview to direct the conversation and to ensure that key areas were covered. Three main themes were covered during the interview: 1) the educational use of WhatsApp (e.g., How do you use WhatsApp for learning?). This part of the interview was important to understand how participants used WhatsApp for educational activities and to explore their perception towards using WhatsApp for learning; 2) factors that create fatigue when students use WhatsApp; and 3) the participants' responses to fatigue and fatigue creators. Questions focused on factors that might create fatigue, such as information overload and the perception of technology invasion. Whenever the participant mentioned situations where they felt annoyed or fatigued or mentioned stressors, they were asked how they would cope with these stressors. For example, if a participant mentions receiving lots of messages from study groups as a stressor, he/she would be asked how he/she would deal with this stressor. In addition, participants were asked to describe events or situations where they felt annoyed or stressed by WhatsApp use and explain why they felt stressed and how they dealt with such experiences. Participants also mentioned situations that happened to other students. This question helped to discover various techno-stressors that create fatigue, which might not have been addressed in the literature.

The interviews were conducted between July and November 2019. Due to limitations pertaining to travelling costs and the locations of participants, face-to-face interviews were not applicable; interviews were therefore carried out online via a video communication app (Zoom[2]). Interviews ranged in duration from 40 to 90 minutes, averaging approximately 60 minutes, and were tape-recorded with the participants' permission and transcribed.

3.5.5 Surveys

A survey is among the most-used data collection methods in quantitative research. It is a method of gathering data from a sample with the intention of analysing the data statistically and generalising the results to a population (Collis & Hussy, 2014). The survey research design

[2] https://zoom.us/

is often associated with a deductive research approach, in which research is designed to test theories (Saunders, Lewis & Thornhill, 2016). From a methodological perspective, data collection methods should be chosen based on the research objectives. The purpose of the quantitative phase in the current study was to validate the proposed research model by examining the relationships among different constructs in the conceptual mode. Thus, to achieve this objective, the survey was chosen as the quantitative data collection method. In particular, a cross-sectional survey design was used where the data were collected at one point in time (Creswell & Creswell, 2018). A survey method was appropriate because it allowed collecting quantitative data from a large sample and statistically analysing this data to test the research hypotheses (Saunders, Lewis & Thornhill, 2016). The data collected via online questionnaires were used to provide an explanation for the relationships between techno-stressors and fatigue and the association between fatigue and coping responses.

Questionnaires are the main data collection instruments used within a survey design (Bryman, 2012). There are many forms of questionnaire, each of which differs based on how it is delivered, returned or collected and the amount of contact the researcher has with the respondents (Saunders, Lewis & Thornhill, 2016). Self-completed questionnaires, also known as self-administrated questionnaires, do not require the presence of the investigator and can be delivered to respondents by hand, mail (postal or mail questionnaires) or distributed via the internet (online questionnaires) (Saunders, Lewis & Thornhill, 2016). On the other hand, interviewer-completed questionnaires are recorded by the interviewer based on respondents' answers and can be conducted via telephone (telephone questionnaires) or in person (face-to-face questionnaires) (Collis & Hussy, 2014). In this study, online self-completed questionnaires were used to collect data from respondents. Among other forms of questionnaires, online surveys have many advantages. In contrast to interviewer-completed questionnaires or structured interviews, which can be expensive and time-consuming, online questionnaires are considered the most effective means for collecting a large number of responses at a low cost (Bryman, 2012; Dillman Smyth & Christian, 2014). Online surveys can be sent easily and quickly via email or social media to a large number of participants at the same time (Bryman, 2012). Great numbers of online questionnaires can be completed within a short period of time and the results can be available immediately for review and analysis (Dillman Smyth & Christian, 2014). In interviewer-completed questionnaires, the presence of the interviewer might result in social desirability bias; that is the tendency of respondents to answer questions in a way that is viewed favourably by others. On the other hand, in self-completed questionnaires respondents are relatively less likely to be influenced by social desirability bias due to the absence of the investigator (Dillman Smyth & Christian, 2014). Online questionnaires allow the anonymity of participants and maintain a higher level of privacy (Saunders, Lewis & Thornhill, 2016). They are considered more convenient for respondents as they can fill in a questionnaire at their convenience (Bryman, 2012). Given the fact that people have become more familiar with doing various daily activities online (e.g. shopping, learning) and with the increasing use of smartphones and tablets, it has become much easier for respondents to access and complete online surveys (Dillman Smyth & Christian, 2014). Unlike other types of questionnaires, the design of an online questionnaire can include a variety of interactive features, such as pop-up instructions, dropdown lists, audio, videos, photos and other features for navigation (e.g. skip) (Dillman & Christian, 2005). Online questionnaires can be designed by online survey tools (e.g. SmartSurvey, SurveyMonkey), in which data are captured and saved automatically (Collis & Hussy, 2014). Sophisticated survey tools provide real-time analysis, which enables the researcher to track the progress of the questionnaires. Considering the advantages of online questionnaires, this tool was chosen in this study for the quantitative data collection. In addition, the quantitative data were collected during the spread of the COVID-19 pandemic. Due to lockdowns and social-distance measures, paper-based questionnaires were not possible. Therefore, online questionnaires were the most appropriate data collection tool for the quantitative study.

3.5.6 Issues with online questionnaires

This section addresses issues often associated with online questionnaires and explains how such issues were addressed in the current study. One of the issues of collecting data through an online questionnaire is that it could produce a low response rate (Saunders, Lewis & Thornhill, 2016). Low response rates could influence the statistical power of the data collected and affect the reliability of the results (Bryman, 2012). In addition, a high non-response rate could increase the risk of non-response bias in the findings and consequently undermine the ability of researchers to generalise the results to a population (Bryman, 2012; Tourangeau & Plewes, 2013). Given the importance of response rate, many steps were implemented to increase it. First, a brief description about the study and its purposes, and an explanation of the importance of participation, was provided, as well as confirmation of anonymity and confidentiality (Bryman, 2012). In addition, follow-up emails and reminders via Twitter and WhatsApp were sent to respondents in order to motivate them to complete the questionnaire (Virtanen, Sirkiä & Jokiranta, 2007). Non-response bias occurs when non-responders significantly differ from respondents to the questionnaire (Bryman, 2012). Non-response bias was assessed, and the results showed that non-response bias was not an issue in this study, as will be discussed later in Chapter 7. The issue of non-response also can arise due to the length of the questionnaire (Czaja & Blair, 2005). Long questionnaires may lead to respondent fatigue and result in incomplete answers (Bryman, 2012). In order to avoid this issue, the questionnaire was designed to be simple and did not require much effort from respondents (taking no longer than 15 minutes to complete) (Bryman, 2012; Czaja & Blair, 2005). Non-responses could also occur at the item level, when some items in the questionnaire are not completed (Czaja & Blair, 2005). Item non-response also contributes to non-response bias and can affect the quality of the results (Czaja & Blair, 2005). To reduce the problem of missing data and eliminate item non-response, the items on the questionnaire were all required to be completed (Ayyagari, Grover & Purvis, 2011). A weakness of online questionnaires is that they are self-completed, meaning there is no interviewer who can explain confusing questions or instructions (Czaja & Blair, 2005). Respondents cannot get help when they do not understand questions or have difficulty answering them (Bryman, 2012). To reduce the issue of the absence of the researcher, the questions were formed in simple language and without any technical words. The questionnaire was translated and pre-tested with a number of participants to ensure that the questions were clear and understandable, as will be explained later in Chapter 6. Another issue with using online questionnaires is that dependency on others to fill in a questionnaire can delay data-analysis stages (Saunders, Lewis & Thornhill, 2016). Although online questionnaires can be sent to a large number of participants in a fast and easy way, it may take some time to get enough responses from participants, which then leads to a delay in the data analysis process. To address this issue, enough time was allocated to the data collection stage.

3.6 Mixed-methods sampling

Sampling is one of the most important stages in research design (Venkatesh, Brown & Sullivan, 2016). A well-defined sampling strategy is important as it determines the quality of research findings (Collins, Onwuegbuzie & Jiao, 2006; Saunders, Lewis & Thornhill, 2016). Sampling is the process of selecting a sample from the target population using sampling techniques (Bryman, 2012). In many cases, it is impossible to collect data from the entire population, therefore sampling techniques enable the selection of a subset of a target population (Saunders, Lewis & Thornhill, 2016). In both quantitative and qualitative research, researchers need to decide on what sampling technique should be used based on the research objectives and approach. Although the sampling process may not be an easy task in either qualitative or quantitative research, it can be more complicated in mixed-methods research because different research approaches (i.e. quantitative and qualitative) need different sampling techniques (Collins, Onwuegbuzie & Jiao, 2006). In mixed-methods research, sampling decisions should be made according to the design of the study and whether it is a concurrent or a sequential design (Creswell & Clark, 2007; Collins, Onwuegbuzie & Jiao, 2006). In this regard, the same sample should be selected for both the qualitative and quantitative phases, or each phase should have a different sample (Collins, Onwuegbuzie & Jiao, 2006). In exploratory mixed-methods design, the purpose of the qualitative phase is to develop a research instrument to collect quantitative data in the subsequent phase, therefore participants in the qualitative phase should not be included in the quantitative phase (Creswell & Clark, 2007; Creswell & Creswell, 2018). Accordingly, a different sample for each phase was used.

3.7 Research target population

The subjects of this study are university students in Saudi Arabia. In Saudi Arabia, there are 43 universities (29 public and 14 private) and 19 private colleges[3]. It was not possible to include students from all these universities in the target population due to time and cost constraints, and difficulties associated with gaining access. Therefore, among these universities, Immam Abdurahman Bin Fisal University[4] (IAU) was chosen to be the site of the current study. The study was conducted in one university in order to gain rich and detailed contextual information that would help to answer the research questions. IAU was chosen because it is one of the largest and best universities in Saudi Arabia. When the study was conducted, it had around 32,000 students. In addition, the researcher is a faculty member at the university, thus it was easy to gain access to participants.

[3] https://moe.gov.sa/en/education/highereducation/Pages/UniversitiesList.aspx

[4] https://www.iau.edu.sa/en

Population refers to a full set of cases or units from which a sample is to be selected (Saunders, Lewis & Thornhill, 2016). Before discussing sampling techniques used in the study, it is important to clearly define the research's target population. The target population was all undergraduate students in IAU. When the data were collected, the university had about 24,000 undergraduate students, 75% of which were female and 25% of which were male. With the help of university administration, it was possible to have access to a list of student email addresses, which facilitated recruiting participants and selecting the study samples.

3.8 Qualitative phase sampling

Generally, sampling techniques can be classified into two categories: probability and non-probability sampling (or non-random sampling) (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). Probability sampling is commonly used in quantitative research and aims to produce a representative sample (Saunders, Lewis & Thornhill, 2016). In this technique, each unit in the target population has an equal chance of being selected (Bryman, 2012). On the other hand, non-probability sampling is often used in qualitative research, and the probability of each unit being selected is not known. Non-probability sampling is not concerned with the selection of a representative sample but rather the most appropriate sample for the study (Saunders, Lewis & Thornhill, 2016). Several non-probability-sampling techniques are used in qualitative research, the most popular technique being purposive sampling, which is also known as judgemental sampling (Saunders, Lewis & Thornhill, 2016). In this technique, participants are selected based on specific criteria that enable researchers to answer the research questions (Bryman, 2012; Creswell & Clark, 2007). In the qualitative study, purposive sampling was used. Given the fact that the purpose of the qualitative phase was to gain an in-depth understanding of students' experience and usage of WhatsApp for educational purposes, purposive sampling would enable the selection of participants who would provide this type of rich information about the research topic. The selection of a sample was undertaken based on the researcher's judgement and knowledge (Bryman, 2012). In the qualitative phase, the selection of participants was made based on the following inclusion criteria:

- The participants should be undergraduate students at IAU and should have completed at least one semester at the university. This condition was important to ensure that the participants were relevant to the research objectives, which focus on undergraduate students.

- The participants should be active WhatsApp users and use the app for educational purposes. As students voluntarily adopt WhatsApp for learning, it was important to ensure that the selected participants used WhatsApp for learning and joined study groups. This condition was made to ensure that the participants were familiar with mobile learning via WhatsApp so that rich information about their experience with WhatsApp would be obtained. To meet this criterion, potential participants were asked screening questions that determined whether they used WhatsApp for learning and whether they had study groups.

In addition to these criteria, maximum variation sampling was used to select participants. In maximum variation sampling, the researcher ensures that there is a wide variety in the sample by selecting participants with diverse characteristics, thus different perspectives on the research topic can be obtained (Bryman, 2012). The criteria for maximising variation are identified based on the research objectives and may include race, gender, age, level of education or any set of criteria that differentiates individuals (Creswell & Clark, 2007). To ensure variation within the sample, participants with different academic levels and from different schools were chosen. Considering the fact that each school in IAU had its rules and approach with regards to using mobile learning, students from different schools would have different experiences with using WhatsApp for learning. Therefore, interviewing students from different schools and departments would help to obtain different views on the research topic.

Potential participants were recruited through university email and via WhatsApp with the help of a staff member in the deanship of student affairs at IAU, who facilitated the access to the potential participants. Invitations to the study were sent to potential participants, which included a description of the study and its purposes as well as the researcher's contact details. Participants who agreed to take part in the study were asked screening questions to ensure that they met the identified criteria. Participants who met the criteria received the information sheet and informed-consent form before the interview.

3.8.1 Sample size

The decision upon a sample size is one of the issues that researchers face when conducting qualitative studies. In non-probability sampling, there is no defined rule about what sample size is appropriate for a study as researchers usually select a number of cases that are assumed to be sufficient to answer research questions (Saunders, Lewis & Thornhill, 2016). A small number of participants can provide detailed information about the phenomenon of interest (Saunders, Lewis & Thornhill, 2016). Unlike quantitative research, wherein sample sizes should be large enough for statistical techniques to be used and for research results to be generalisable, qualitative research uses small sample sizes as this type of research does not aim at generalising the results (Creswell & Clark, 2007). In addition, large sample sizes are more likely to produce a large amount of data, which can be difficult to analyse (Robinson, 2014).

In qualitative research, there is no clear answer to the question of how many individuals should be interviewed in a single study (Saunders & Townsend, 2018). Qualitative researchers suggest that data collection should be conducted until data saturation or information redundancy is achieved (Saunders, Lewis & Thornhill, 2016). The notion of saturation, derived from grounded theory, describes a process in which the researcher continues conducting interviews until the additional data collected produces little or no new information (Bryman, 2012). There are different suggestions regarding the number of participants likely to be sufficient to reach saturation. Numbers are suggested based on the research objectives and the type of qualitative approach used (Onwuegbuzie & Leech, 2007). For example, qualitative researchers suggest a sample size of one to two individuals for a narrative study, 50 to 60 participants for grounded-theory research and a small number of participants, such as 4 to 10, for case-study research (Creswell & Clark, 2007). Marshall et al. (2013) propose between 20 and 30 participants for grounded theory and between 15 to 20 participants for single case-study research. Other researchers provide a range for the acceptable number of interviews in general regardless of research types. For instance, Bertaux (1981) advises that 15 is the smallest acceptable number of participants in qualitative research. Adler and Adler (2012) propose between 12 and 60 participants, whereas Brinkmann and Kvale (2015) suggest 5 to 25 interviews. Saunders and Townsend (2018) recommend a general rule of between 15 and 60 participants. As general advice, Onwuegbuzie and Leech (2007) recommend that sample sizes should not be too small, such that it is difficult to reach data saturation and at the same time, not too large so that in-depth analysis becomes difficult. Researchers also suggest sample sizes based on the homogeneity/heterogeneity of the target population and the participants to be chosen. In this regards, Kuzel (1992) recommends that for a homogeneous population, 6 to 8 participants are likely to be adequate while when the sample is selected from a heterogeneous population, 12 to 20 participants are more likely to be needed. Guest, Bunce and Johnson (2006) note that between 6 to 12 in-depth interviews should be sufficient when the sample is drawn from a relatively homogenous group. Similarly, Saunders (2012) suggests a range of 4 to 12 participants for homogeneous populations, and 12 to 30 participants for heterogeneous populations.

In this study, the data were collected until a sufficient level of saturation was reached and no new information was gained from participants. The sample size of the qualitative study was 21 participants. The sample was selected from a relatively homogenous group, as the target population was undergraduate students aged between 18 to 25 studying at the same university and from the same cultural background. Drawing on the above recommendations regarding sample sizes, 21 participants was considered sufficient for this study. In addition, this number of interviews was adequate to collect in-depth information about the research topic and to answer the research questions.

3.9 Quantitative phase sampling

Probability sampling is a commonly used technique in survey research strategies. The intent of using this technique is to produce a representative sample so that the results can be generalised for a population (Bryman, 2012). Random choice of individuals based on probability sampling means that each person in the population has an equal chance of being included in the sample (Creswell & Clark, 2007). To select individuals using probability sampling, it is essential to have a defined sample frame that is a complete list of all the units in the population from which a sample will be taken (Saunders, Lewis & Thornhill, 2016). Without a sample frame, probability sampling is not possible. Random sampling involves selecting cases from a sample frame at random. In this technique, each case in the sample frame is given a unique number, then cases are selected using random numbers until the needed sample size is reached (Saunders, Lewis & Thornhill, 2016). In this study, it was not possible to have full access to student contacts. A complete list of all registered undergraduate students at the university along with their email addresses was not provided to the researcher. Access to student email addresses was facilitated through the university administration. Specifically, an invitation to the questionnaire was sent to the manager of the public relations and media office at IAU who sent the questionnaire to a list of student email addresses. Due to the difficulties in obtaining a sample frame, random-sampling techniques were not applicable and thus non-random sampling was used to select a sample for the quantitative study. To achieve representativeness, maximum variation sampling was used (Teddlie & Tashakkori, 2009). In this method, wherever possible, participants with diverse characteristics relating to their gender, academic year, school, and discipline were included in the sample (Creswell & Clark, 2007; Saunders, Lewis & Thornhill, 2016). The purpose of using this sampling method was to select as representative a sample as possible (Teddlie & Tashakkori, 2009) and thus to minimise the sample's bias. Accordingly, the questionnaire was sent to a list of student email addresses. The list contained around 6,000 students from different schools/departments and different academic years. To satisfy sample-frame requirements, screening questions were added to the questionnaire. Specifically, respondents were included in the sample based on three conditions. They should be current and undergraduate students at IAU and use WhatsApp for learning purposes.

3.9.1 Sample size

In contrast to qualitative research, there is a set of rules or guidelines that can be used to estimate the sample size needed in quantitative research. Sample sizes are determined by factors, such as the level of confidence that the sample selected would be representative of the target population, the margin of error that can be tolerated, the size of the target population and the types of statistical analysis that will be used (Saunders, Lewis & Thornhill, 2016). Generally speaking, sample sizes need to be large enough so that errors in generalising to the target population are minimised (Bryman, 2012). The sample size is crucial for data analysis techniques. It has great influence on the statistical power of significance testing (Hair et al., 2014a). A sufficient sample size is needed to ensure that the results of the statistical technique have enough statistical power (Hair et al., 2017a). With an inadequate sample size, statistical techniques may fail to detect a significant effect that exists in the population (Hair et al., 2017a). Typically, each statistical analysis method has technical requirements with regards to the minimum sample size (Hair et al., 2014a). Such requirements should be met in order for statistical analysis methods to work effectively and produce accurate results. Structural equation modelling (SEM), the data analysis method used in this study, has its minimum sample size requirements. In SEM, the complexity of the structural model and the number of variables within the model have an effect on the sample size required to obtain robust parameter estimates (Hair et al., 2017a). As a rule of thumb, the sample size should be 10 times larger than the number of variables included in a structural model (Hair et al., 2014a). Others suggest collecting at least five cases per indicator (variable) (Bentler & Chou, 1987). For the partial least squares (PLS-SEM) approach, an often-cited minimum sample rule is the 10-times rule, which indicates that the sample size should be at least 10 times the maximum number of incoming paths to a construct in the structural model (Barclay, Higgins & Thompson, 1995). However, although Hair et al. (2017a) suggest that the 10-times rule provides a general guideline for the minimum size requirements, they warn that such a rule does not take into consideration the number of indicators and statistical power, such as effect size, therefore it can be misleading. The 10-times rule may not be applicable when the structural model has many indicators, in this case, other minimum sample rules for SEM can be used (e.g. n > 150, or 10 cases per indicator) (Urbach & Ahlemann, 2010). In this study, the number of indicators in the structural model is 46. Thus, based on Hair et al.'s (2014a) suggestion of 10 cases per indicator, the sample size should be 460. In addition, power analysis (Cohen, 1988) was performed to determine the minimum required sample size to achieve adequate power as recommended by Hair et al. (2017a) and Goodhue, Lewis and Thompson (2012). The sample size was estimated with the use of a-priori sample-size calculator for SEM software (Soper, 2021). Given the number of latent variables (12) and observed variables (46) in the model, the anticipated effect size (0.3), the desired probability (0.05) and desired statistical power level (0.8), the minimum recommended sample size for the structural model is 200. The usable collected responses in this study came to 1,188 in total, which was a large enough sample size for conducting PLS-SEM analysis.

3.10 Data analysis methods

3.10.1 Qualitative data analysis: Thematic analysis

There are different types of qualitative data analysis methods. The main types include thematic analysis, interpretative phenomenological analysis, grounded theory and pattern-based discourse analysis (Braun & Clarke, 2013). This section focuses on thematic analysis as it is the qualitative data analysis method used in the qualitative phase.

Thematic analysis is one of the most commonly used qualitative analytic methods (Braun & Clarke, 2006; Bryman, 2012). Qualitative research produces a large volume of non-structured data. Analysing such data is not a simple task and is considered time-consuming. Thematic analysis offers a means for organising and managing such large amounts of data so that they can be better understood (Lapadat, 2010). Thematic analysis can be defined as “a method for identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79). Thematic analysis is often described as a method or technique for data analysis that can be applied to various types of qualitative research (King, Brooks & Tabari, 2018). In contrast to other types of qualitative analytic approaches, such as grounded theory and interpretative phenomenological analysis, which are guided by specific philosophical assumptions, thematic analysis is not tied to any particular philosophical position (Brooks et al., 2015). In addition, thematic analysis is not a single method and is better understood as an umbrella term that encompasses various approaches (Braun et al., 2019). Different types of thematic analysis are underpinned by different philosophical assumptions and vary in the way themes are defined and organised (King, Brooks & Tabari, 2018). Yet, the focus of all thematic analysis approaches is on identifying, organising and interpreting themes within qualitative data. Thematic analysis as a tool or technique unbounded by theoretical commitments provides researchers with flexibility (Saunders, Lewis & Thornhill, 2016). It can be used to answer any research question and can be employed across a range of research paradigms (Braun & Clarke, 2006).

There are two main approaches to identify themes within data in thematic analysis: an inductive or ‘bottom-up’ approach and a deductive or ‘top-down’ approach (Braun et al., 2019; Saunders, Lewis & Thornhill, 2016). In an inductive approach to coding, themes are not identified in advance but are developed from the data. This type of thematic analysis is described as data-driven because identified themes are linked to the data themselves (Braun & Clarke, 2006). In contrast, a ‘top-down’ approach to coding is more likely to be used within a deductive form of reasoning, wherein themes are determined in advance and driven by the researcher’s theoretical interest in the research topic (Braun & Clarke, 2006). Types of thematic analysis vary in the degree to which they employ ‘top-down’ or ‘bottom-up’ approaches, with some types of thematic analysis using a combination of both approaches (e.g. template analysis) (King, Brooks & Tabari, 2018).

3.10.2 Template analysis

Template analysis is a form of thematic analysis commonly used in organisational, business and management research (Brooks et al., 2015). It employs hierarchical coding to analyse textual data and provides researchers with flexibility to adapt the process of the analysis to the requirements of their research (King & Brooks, 2017). Template analysis can be applied to any form of textual data including interview transcripts, diary entries and data obtained from open-ended survey questions (King, Brooks & Tabari, 2018). In this method, a coding template is developed, which includes a set of themes identified by the researcher as important in the data. The template is created using a subset of the data, which is then applied to further data, refined, revised and reused (Brooks et al., 2015). The method is flexible in terms of the design and format of the coding template and does not suggest a fixed number of levels of themes. A researcher can develop as many levels as needed to capture the richest aspects of the data (King, & Brooks, 2017).

Template analysis was used in the current study to analyse the qualitative data. This method was appropriate for this study for many reasons. It is a flexible method that is not bound to any epistemological or methodological underpinnings, which provides the researcher with flexibility to adapt the technique to the needs of their study and its philosophical assumptions (Brooks et al., 2015). Template analysis lies between 'top-down' and 'bottom-up' approaches (King, Brooks & Tabari, 2018). It enables the use of extant theories to build a coding template, while at the same time allowing the researcher to develop new themes on the basis of the data. Thereby, it employs both inductive and deductive approaches. In this respect, template analysis is compatible with a mixed-methods approach. In this study, a 'top-down' approach to coding was used, in which *a priori* themes were identified prior to the analysis. *A priori* themes included techno-stressors, in particular information and communication overload and technology invasion, which were identified based upon existing technostress studies as discussed in the previous chapter. 'Bottom-up' coding was also used during the coding process. In this approach, factors associated with fatigue, such as distraction, invasion of privacy as well as coping responses, were identified on the basis of the data. In addition to its flexibility, template analysis is considered simple, relatively easy to apply and does not require prior knowledge or experience with qualitative data analysis (Braun & Clarke, 2013).

Template analysis can be applied to interview transcripts as in the following steps (Brooks et al., 2015; King & Brooks, 2017):

1. Familiarisation with the data: the researcher starts the process of the analysis by reading and re-reading the data to familiarise themself with the transcripts. In a relatively small study, the researcher may read through the entire data set at least once or they may select a subset of the transcripts to start with if the data set is large.

2. Preliminary coding: the analysis begins with some *a priori* themes identified in advance, which are likely to be relevant and useful in understanding the research topic. The use of *a priori* themes in the template analysis is permitted, although not compulsory. These themes are identified based on theoretical ideas that inform the research. The researcher can use pre-determined themes when the relevance of a particular issue with regards to the research questions is well documented. *A priori* themes can be redefined or removed when they do not appear to be useful, relevant, or meaningful to the analysis. Once *a priori* themes are identified, preliminary coding is conducted in which the researcher reads through the data to label any ‘chunks’ of data that appear to be relevant to the research questions. Such chunks of data are coded using *a priori* themes; alternatively, when they do not fit *a priori* themes, new themes are developed and included in an initial template.

3. Clustering: the identified themes are organised into meaningful clusters. This step involves identifying themes and the possible relationships between them and organising them in hierarchical levels.

4. Developing the initial template: once clustering is done, an initial version of the coding template is developed often based on a subset of the data. For example, the researcher may conduct preliminary coding and clustering on five interview transcripts, then start developing an initial template.

5. Applying and developing the template: the initial template is then applied to the entire dataset and adjusted as necessary. In this step, existing themes may be redefined or removed from the template, and new themes may be included. The process of modifying and trying the template continues until a final version template is produced.

6. Using the template to interpret the data: once a final template is defined, it is used to provide interpretation and illustration of the data and is used to write up the findings. The process of implementing template analysis in the current study will be described in Chapter 4.

3.10.3 Quantitative data analysis: Structural equation modelling

Structural equation modelling (SEM) is a multivariant statistical analysis technique that is used to estimate relationships among variables (Hair et al., 2014a). SEM is considered a second-generation method of multivariant analysis (Bagozzi & Fornell, 1982). Unlike first-generation methods, such as multiple regression and bivariate correlations that can test one relationship at a time, SEM is able to simultaneously test and estimate multiple relationships among dependent and independent constructs (Gefen et al., 2000; Urbach & Ahlemann, 2010). There are two types of variables in SEM: latent variables (LVs) and indicators. LVs (also called constructs) represent unobserved variables that cannot be measured directly and hence are measured by one or more indicators (Hair et al., 2014a; Schumacker & Lomax, 2016). Indicators (also called items) are observed variables used to measure constructs (Hair et al., 2014a; Schumacker & Lomax, 2016). An example of a path model in SEM is shown in Figure 3.3. The path model consists of different sub-models, namely the structural model and the measurement models. The structural model, which is also referred to as a causal model, represents the relationships between different constructs (i.e. LVs) (the grey box in Figure 3.3). Each construct in Figure 3.3 is measured by more than one item. There are two types of constructs in the model: exogenous and endogenous. Exogenous constructs (LV1 and LV2 in Figure 3.3) act as independent variables. Endogenous constructs (LV3 and LV4 in Figure 3.3) are explained by other constructs (LV1 and LV2). While endogenous constructs often act as dependent variable (e.g. LV4), they can also be considered independent variables when they lie between two constructs (e.g. LV3). Each construct has a measurement model. The measurement models show the relationships between a construct and its items (the dash boxes in Figure 3.3). One of the characteristics that makes SEM different from other methods is that it enables the researcher to both examine measurement properties and test the hypothesised causal paths using one technique (Gefen, Rigdon & Straub, 2011; Hair et al., 2014a).

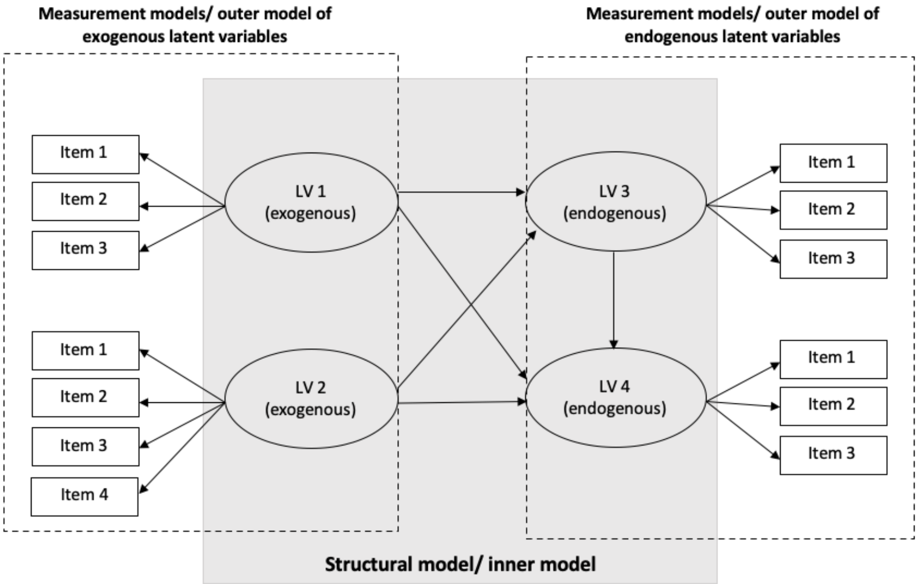

Figure 3.3: Example of a path model in SEM (adapted from Hair et al. (2014b))

3.10.4 Partial least squares and Covariance-based SEM

There are two main SEM methods: covariance-based SEM (CB-SEM) and partial least squares SEM **(**PLS-SEM) (Gefen, Straub & Boudreau, 2000). While such methods share the same objective, which is to estimate relationships between constructs and indicators in a structural equation model, they differ in their underlying philosophy, distributional assumptions, and estimation objective (Gefen, Rigdon & Straub, 2011; Hair et al., 2017a).

A key difference between the two methods is associated with the way each method estimates latent constructs included in the model. In CB-SEM, constructs are considered common factors that explain covariance between its associated indicators, whereas in PLS-SEM the constructs represent weighted composites of indicator variables (Hair et al., 2017a; Hair & Sarstedt, 2019). In other words, CB-SEM uses common variance when estimating constructs while PLS-SEM uses total variance (Sarstedt et al., 2016). The decision between CB-SEM and PLS-SEM depends on the assumptions and objectives of each method (Hair, Ringle & Sarstedt, 2011). CB-SEM is used to confirm or reject theories (Hair et al., 2017a). Since CB-SEM relies on the overall model fit, it requires a strong theoretical foundation and well-developed measures (Barroso, Carrión & Roldán, 2010; Hair et al., 2017b). Therefore, CB-SEM is more appropriate for theory testing and confirmation (Barroso, Carrión & Roldán, 2010; Hair, Ringle & Sarstedt, 2011). In addition, it works with structural models of low to medium complexity such as those including five or fewer constructs and 50 or fewer indicators (Hair et al., 2017b; Urbach & Ahlemann, 2010). CB-SEM has many assumptions which should be met, such as large sample sizes and the normality of the data: any violation of these assumptions can lead to inaccurate results (Hair, Ringle & Sarstedt, 2011).

On the other hand, the aim of PLS-SEM is theory development and exploration (Hair et al., 2017a). PLS-SEM is more appropriate than CB-SEM when the objective of the research is prediction, although it can also be used for theory confirmation (Barroso, Carrión & Roldán, 2010; Hair et al., 2017b). In addition, PLS-SEM can work effectively with small sample sizes and does not require normally distributed data (Hair et al., 2017a). Moreover, PLS-SEM can handle complex models that include many constructs and indicators (Ringle, Sarstedt & Straub, 2012). The key differences between CB-SEM and PLS-ESM and their strengths and limitations are summarised in Table 3.3.

Table 3.3: Comparison between PLS-SEM and CB-SEM

(Hair et al., 2017b; Hair et al., 2021)

	PLS-SEM	**CB-SEM**
Features	- Considered a composite-based SEM method - Constructs are weighted composites of indicator variables - Uses total variance and combines indicators to form composite variables - Aims at maximising the amount of unexplained variance in the dependent variables - Used for theory building and explanation of variance	- Considered a common factor-based SEM method - Constructs are common factors that explain the covariance between their associated indicators - Uses only common variance when estimating the model - Aims at minimising the discrepancy between the theoretical covariance and the estimated covariance matrix - Used for theory testing and confirmation

Strengths	- Handles highly complex models with many constructs and indicators - Can achieve high statistical power with small sample sizes - Works with non-normal data	- Works with structural models that contain circular relationships between constructs - A precise method to empirically measure theoretical concepts - Allows assessment of model fit using goodness-of-ft measures
Limitations	- Cannot be applied when structural models include circular relationships - Its use for theory testing and confirmation is limited because it does not use goodness-of-ft measures as CB-SEM	- Requires normally distributed data - Requires large sample sizes - Handles models with few constructs and indicators - Less effective in estimating complex mediation models

3.10.5 Justifications for using PLS-SEM

CB-SEM and PLS-SEM are the most widely used SEM methods in IS literature (Benitez et al., 2020; Gefen et al., 2012; Hair et al., 2017b; Ringle, Sarstedt & Straub, 2012; Urbach & Ahlemann, 2010). Researchers tend to prefer using the CB-SEM approach; however, Hair and Sarstedt (2019) argue that such preference for CB-SEM over PLS-SEM 'is not justified'. In fact, neither of these methods is superior to the other and each has its advantages and limitations (Hair, Ringle & Sarstedt, 2011; Hair et al., 2017a). Therefore, making a general recommendation for a specific method is neither possible nor reasonable (Urbach & Ahlemann, 2010) as neither of them is suitable for all situations (Hair et al., 2017a). There have been cases where CB-SEM and PLS-SEM produce convergent estimates, particularly when sample sizes are large (Barroso, Carrión & Roldán, 2010; Hair, Ringle & Sarstedt, 2011; Urbach & Ahlemann, 2010). Hence, researchers should select the SEM method that is appropriate for their research objectives, taking into account the characteristics of the data and the structural model (Hair et al., 2017a). Consequently, PLS-SEM was selected in this study for the following reasons. First, the objective of the study is to explore the technostress phenomenon in the academic context and identify key drivers of fatigue. The study is considered exploratory since it used the qualitative method to generate hypotheses to be tested in an unexplored context (Hair et al., 2017b). In addition, technostress theories are still developing and have not been fully explored in the academic context. Moreover, although the measures used in this study were derived from the literature, they were translated into Arabic and considered newly developed in the context of academic use. Therefore, PLS-SEM was the most suitable method because it is less strict and does not require strong theories or well-developed measures (Gefen, Rigdon & Straub, 2011; Urbach & Ahlemann, 2010). PLS-SEM is an alternative method when the aim of the research is theory building and testing (Hair, Ringle & Sarstedt, 2011). It can produce more accurate results compared to CB-SEM when the research is an exploratory phase and the measurement is less developed (Gefen, Rigdon & Straub, 2011). Second, the results of the normality test suggested that some of the variables were not normally distributed (see Chapter 5). While CB-SEM requires multivariate normality, PLS-SEM does not, thus PLS-SEM is the preferred method when distributional assumptions cannot be fulfilled (Hair, Ringle & Sarstedt, 2011; Urbach & Ahlemann, 2010). In addition, the study used a large sample size, and PLS-SEM can provide accurate estimates with large sample sizes (Goodhue, Lewis & Thompson 2012). Third, the structural model in this study included many constructs with many indicators, which made it complex. PLS-SEM was more appropriate for estimating the structural model due to its ability to deal with complex models and achieve a high degree of statistical power (Goodhue, Lewis & Thompson, 2012; Hair, Ringle & Sarstedt, 2011; Hair et al., 2017b; Urbach & Ahlemann, 2010).

3.11 Validation in mixed-methods research

Validation in social sciences is key to indicate research quality and rigour (Venkatesh, Brown & Bala, 2013), with different validation criteria and processes often applied to quantitative and qualitative studies (Bryman, 2012). While there is common agreement among researchers with regards to validation standards and techniques in quantitative research, there is no consensus as to the most appropriate criteria or approaches to assess the quality of qualitative research (Braun & Clarke, 2006; Creswell & Clark, 2007). This section discusses the quality criteria for both quantitative and qualitative research. This is important for mixed-methods research as data quality here is determined by the validity and credibility of the quantitative and qualitative data (Venkatesh, Brown & Bala, 2013). If the qualitative and quantitative data used within a mixed-methods study are proven to be credible and valid, the study is considered to contain high-quality data (Teddlie & Tashakkori, 2009). Validity in mixed-methods research is a particular challenge because two different sets of criteria should be used to evaluate data quality: one for quantitative methods and the other for qualitative (Venkatesh, Brown & Bala, 2013). Moreover, the quality of inferences that are produced on the basis of collected qualitative and qualitative data in mixed-methods research should be evaluated (Teddlie & Tashakkori, 2009), as will be explained later.

3.11.1 Quality criteria in quantitative research

The quality of quantitative research is often assessed by the reliability and validity of results. Reliability refers to the degree to which consistent results are produced when the same measures are used across different research projects (Bryman, 2012). A measure is considered reliable if researchers replicate the research design, use the same method of measurement, and generate the same results. The use of reliable measures is fundamental for the validity of a quantitative study. Indeed, reliability is a precondition for validity in quantitative research, which means that a study that fails to fulfil its reliability criteria is considered invalid (Saunders, Lewis & Thornhill, 2016). Validity refers to the appropriateness of the measures used, the accuracy of the results, and the generalisability of the findings (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). While reliability is important, it is not sufficient to fully ensure research quality; validity is also required.

Validity in quantitative research comprises measurement validity, internal validity and external validity (Bryman, 2012). *Measurement validity*, also known as construct validity, is concerned with whether a measure being used in a study to capture a concept actually reflects the concept that is supposed to be measured (Saunders, Lewis & Thornhill, 2016). There are different types of measurement validity. These include content validity, convergent validity and discriminant validity. *Internal validity* refers to the causal relationships between variables. In other words, whether the effects identified are actually caused by the variables under investigation and not by other confounding factors (Bryman, 2012). *External validity* refers to whether the findings of a study can be generalised to other settings or groups (Bryman, 2012). To establish reliability, measures from past research that have been proven to be reliable and valid should be used. Furthermore, the researcher should assess the reliability of the measures used based on the collected data (Creswell & Clark, 2007). To assess the reliability of measures, internal consistency can be used, which refers to the correlation between a set of items of the same test (Saunders, Lewis & Thornhill, 2016). Validity in quantitative research is assessed using a variety of different methods and statistical tests, which are discussed in detail in Chapters 6 and 7.

3.11.2 Quality criteria in qualitative research

Reliability and validity refer to the replicability of the results, the accuracy of measures, the soundness of the results that specify a causal relationship, and the generalisability of the results. These are all important considerations in quantitative research. That said, their suitability for application to qualitative research is contested (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). Certain researchers apply the concept of reliability and validity to qualitative research while other researchers argue that qualitative research should be evaluated according to different criteria from those used by quantitative researchers (Bryman, 2012). A commonly used alternative to reliability and validity in qualitative research is Lincoln and Guba's (1986) proposed term, *trustworthiness*. The concept of trustworthiness includes four criteria that relate directly to the previously discussed terms of reliability, internal validity and external validity:
Dependability, (parallel to reliability) refers to the degree to which the process of a research study is dependable (Teddlie & Tashakkori, 2009). The establishment of dependability requires the use of an *auditing* technique, in which the researcher keep complete records of all phases of the research process, including selection of participants, interview transcripts, data analysis and the changes that occur in the study settings (Teddlie & Tashakkori, 2009).

Credibility, (equivalent to internal validity) refers to whether results are credible and believable. In other words, it establishes whether the findings of a qualitative study actually represent what participants intended (Venkatesh, Brown & Bala, 2013). To determine the credibility of findings, the researcher should ensure that the qualitative study is conducted according to the standards of good practice (Bryman, 2012). Furthermore, the researcher can submit the findings to participants for confirmation. This technique is referred to as member validation or *member checking* (Bryman, 2012).

Transferability, (similar to external validity or generalisability) refers to the extent to which the results of a qualitative study can be transferred to other groups of people and contexts (Saunders, Lewis & Thornhill, 2016). Transferability can be established by what is termed *thick description*, which means providing detailed descriptions of the study's questions, context, design, findings and interpretations so that other researchers can evaluate the transferability of the study to other contexts in which they are interested (Bryman, 2012).

Confirmability, (similar to objectivity) refers to the extent to which the findings can be confirmed or corroborated by other researchers (Venkatesh, Brown & Bala, 2013). Although complete objectivity is difficult to achieve in social science research, confirmability ensures that the researcher, to the greatest extent possible, does not allow their personal values to influence the conduct of the research (Bryman, 2012). Confirmability can be assessed via a *confirmability audit* technique, which enables auditors to examine the whole process of the research and its outcomes to assess whether the interpretations are supported by the findings (Teddlie & Tashakkori, 2009).

In qualitative research, there are many validation techniques that can be used to establish the quality of a qualitative study. The most popular techniques are member checking and triangulation (Braun & Clarke, 2006; Creswell & Clark, 2007), as detailed below:

Member checking, also known as member validation, is a commonly used technique. It refers to the practice of checking the study's results with its participants. This approach involves sending or taking summaries of the results (e.g. major themes, theoretical models) in a written report or oral presentation to key participants in the study and asking them to comment on them, assessing whether the findings are accurate and represent their experiences (Braun & Clarke, 2006; Creswell & Clark, 2007). The purpose of this technique is to avoid misrepresenting the views of the participants and to attempt to ensure that the interpretations of the participants' experiences match their actual understanding of their experiences (Braun & Clarke, 2006). It is a form of 'credibility check' that aims to determine whether the findings are credible and dependable from the perspective of the participants (Braun & Clarke, 2006). Member checking, despite being a powerful technique for assessing the credibility of the research findings, involves certain challenges such as participants being reluctant to engage in the validation process (Braun & Clarke, 2006; Saunders, Lewis & Thornhill, 2016). Thus, in order to increase participant engagement in the validation, it can be helpful to inform the participants before conducting interviews that the verification process is incorporated in the study and explain why it is important (Braun & Clarke, 2006).

Triangulation is another validity technique that refers to the use of two or more sources of data or methods of data collection to confirm the credibility and validity of research data, and its analysis and interpretation (Creswell & Clark, 2007). Triangulation involves using a multi-method quantitative study, a multi-method qualitative study or a mixed-methods study (Saunders, Lewis & Thornhill, 2016). The rationale of using triangulation is that it increases the confidence and credibility of the findings when different methods generate the same results. Triangulation is used in qualitative research to receive multiple views and so develop a fuller picture of the topic under study (Braun & Clarke).

3.11.3 Inference quality in mixed-methods research

Combining qualitative and quantitative methods creates additional potential issues concerning the validity of a mixed-methods study (Creswell & Clark, 2007). Among such issues is the question of how validity should be conceptualised and evaluated, and whether traditional validation standards of qualitative and quantitative research should be followed (Creswell & Clark, 2007). As mentioned previously, researchers have suggested that quantitative and qualitative methods used in a mixed-methods study should be assessed based on traditional validity principles used within both quantitative and qualitative research (Creswell & Clark, 2007; Teddlie & Tashakkori, 2009; Venkatesh, Brown & Bala, 2013). In terms of the validity of mixed methods research, Creswell and Clark (2007) define it as “the ability of the researcher to draw meaningful and accurate conclusions from all of the data in the study” (p.146). Teddlie and Tashakkori (2009) suggested the use of the term ‘inference quality’ to refer to validity of conclusions and interpretations produced on the grounds of collected quantitative and qualitative data in a mixed-methods study. Supplementing this definition, Venkatesh, Brown and Bala (2013) describe inference quality as the accuracy of deductively and inductively generated conclusions in mixed-methods research. They developed an integrative framework for evaluating inference quality in mixed-methods research. This integrative framework includes two main dimensions of inference quality: design quality and explanation quality. *Design quality* focuses on the appropriateness of methods selected and the research design chosen to answer the research questions. Furthermore, it assesses whether the design selected for both quantitative and qualitative aspects of data collection methods, sampling and data analysis procedures is adequate. *Explanation quality* focuses on the credibility of inferences that have been produced on the basis of results. It is concerned with the quality of interpretations from the quantitative and qualitative analysis. Explanation quality also focuses on the quality of meta-inferences (i.e. overall results of mixed-methods research). Specifically, it assesses whether inferences from each quantitative and qualitative aspect are effectively integrated into meta-inference (*integrative efficacy*), whether meta-inferences are generalised or transferred to other contexts (*inference transferability*), and the extent to which meta-inferences fulfil the purposes of following a mixed-methods research approach (*integrative correspondence*).

3.12 Assessing the quality of mixed-methods research

To address the validity of mixed-methods research, the current study follows Creswell and Clark's (2007) guidelines, which are as follows: (1) report and discuss quality criteria within the context of both qualitative and quantitative research in a mixed-methods study. This is because both types of data are collected, analysed and interpreted, meaning that traditional validation standards and approaches should be applied; (2) use of the term 'validity' or 'inference quality' to refer to validation processes in mixed methods; (3) discussion of the quality of mixed methods findings or meta-inferences; (4) discussion of research quality in terms of the overall mixed methods design used in a study; (5) addressing potential threats to the validity of mixed-methods research.

3.12.1 Validity in the qualitative phase

In the qualitative study, the validity of qualitative data and results were established based on the aforementioned criteria of trustworthiness; namely dependability, credibility, transferability and confirmability. To enhance dependability and confirmability, the processes of the qualitative study (i.e. the sampling method used, the selection of participants, the process of developing the interview guide and conducting semi-structured interviews) and the procedures followed in analysing qualitative data were described and reported in detail in the current chapter. By providing detailed information on the study process, other researchers may use the study's design in the future. Prior to data collection, an interview guide was designed and pre-tested using pilot interviews. This guide was used during interviews to maintain consistency and direction. To establish credibility, the key themes were shared with participants during follow-up interviews. The main findings were presented and the participants were asked to provide their comments on the findings. This method helped ensure the accuracy of interpretations and conclusions (Teddlie & Tashakkori, 2009). In addition, the findings of the qualitative study were confirmed through analysis of the quantitative data. The use of the triangulation method in the current study through the collection of different types of data on the same research topic has enhanced the validity and credibility of the qualitative data and interpretations. To promote the transferability of the study results, purposeful sampling was used. Participants were selected from different schools and departments and in different academic years. This approach enabled the gathering of different views and experiences on the academic use of WhatsApp and the experience of fatigue. Moreover, a detailed description of the study's context, setting, design, participants, findings and interpretation was provided so that future research can assess the findings and interpretations of the study in similar contexts (Saunders, Lewis & Thornhill, 2016).

3.12.2 Validity in the quantitative phase

In the quantitative phase, reliability and validity were established using different validation techniques, pilot tests and statistical analysis. The procedures followed in assessing the credibility and validity of the study measurements are discussed in detail in Chapters 6 and 7. In brief, to ensure reliability, existing measures from prior studies were used. In addition, before distributing the main questionnaire, pilot tests were conducted to assess the internal reliability, construct validity and content validity of the study measures. To reduce sampling bias, data were collected from a large sample size. Moreover, non-response bias was addressed, and the results showed that non-response bias was not a concern in this study (Section 7.5.1). Statistical conclusion validity was enhanced through appropriate data analysis techniques and by the selection of a large enough sample size to ensure sufficient statistical power (Hair et al., 2014a; Teddlie & Tashakkori, 2009). Furthermore, the collected data were examined to ensure that no assumptions of the data analysis tests were violated. The final questionnaire was analysed using PLS-SEM. The results of measurement model assessment indicate that the collected data meet the criteria of reliability and validity (Section 7.8.1).

3.12.3 Quality of mixed-methods meta-inferences

Having discussed the validity of qualitative and quantitative phases of the current study, the quality of mixed-methods inferences that were produced on the basis of qualitative and quantitative data were evaluated. Venkatesh, Brown and Bala's (2013) framework were used to ensure the quality of the inferences, as explained previously. The assessment of the quality of inferences is presented in Table 3.4 below.

Table 3.4: Assessment of the quality of inferences in this study

Quality aspects	Indicators
Design quality	This study used an exploratory sequential mixed-methods design (see Section 3.4.2). This began with the qualitative phase to address the first, second and third research questions; namely, to identify key techno-stressors that create fatigue, to identify factors that contribute to information and communication overload, and to explore students' coping strategies. The qualitative findings were used to develop the conceptual model and study instruments for the study. In the quantitative phase, a survey approach was used to empirically test the proposed model and to address the fourth research question: examination of the effects of fatigue and coping strategies on performance. The use of a sequential mixed-methods approach was appropriate to address the research questions and to achieve the research objectives. Overall, the design components of both the qualitative and quantitative phases, including sampling, data collection methods and data analysis techniques, were appropriate to address the research questions and objectives.
Explanation quality	
Integrative efficacy	The results of the qualitative phase were connected to the quantitative phase through the development of the study instrument. The results of the quantitative phase confirmed the qualitative phase findings. As

	mentioned previously, follow-up interviews were conducted to account for the changes that occurred in the academic use of WhatsApp due to the spread of COVID-19 during the implementation of the quantitative phase. The follow-up interviews were important to address any changes that might have influenced students' responses in the quantitative phase, enhancing the validity of the overall findings of the study. The meta-inferences or overall findings of both phases, as well as the inconsistent results, are explained in Chapter 8.
Inference transferability	Overall, the inferences were consistent with prior technostress research. That said, there are limitations in the generalisability of the findings, as fully explained in Section 8.6. In brief, the findings might be generalised to other students and universities in Saudi Arabia, but cannot be confidently generalised to other countries. In addition, while this study focuses on the educational use of WhatsApp, the findings might not be applicable to other technologies.
Integrative correspondence	The inferences in the qualitative and quantitative phases have clearly addressed the research questions (see Section 8.3). The meta-inferences have met the purposes of a mixed-methods approach. The qualitative phase identified techno-stressors and coping strategies, leading to the development of the study instrument. The quantitative study tested the proposed conceptual model and confirmed the results of the qualitative study.

3.12.4 Addressing potential threats to inference quality and remedies

The validity of mixed-methods research can be enhanced by addressing possible threats to validity that can arise during data collection and analysis. Table 3.5 identifies the potential threats to the validity of the current study’s design and explains how they have been minimised.

Table 3.5: Potential threats to validity and their mitigation within this study

Area	Threats	Minimizing the threat
Data collection	- Selecting the same individuals for the qualitative and quantitative data collection. - Using the same sample sizes for the qualitative and quantitative data collection. - Not testing for the reliability and validity of the study instrument.	- Different participants were selected for qualitative and quantitative phases. - A small sample was used in the qualitative phase and a larger sample was used in the quantitative phase. - A pilot study was conducted to test the reliability and validity of the measures.
Data analysis	- Choosing weak qualitative results that provide a poor base for follow-up quantitative research. - Not addressing validity issues.	- In the qualitative phase, the key themes were used to develop the conceptual model and hypotheses. - The validity of both phases were addressed and discussed.

3.13 Ethical considerations

Research ethics refer to a set of principles that guide the manner in which research involving interaction or intervention between the researcher and humans or human data is designed, managed and conducted (Saunders, Lewis & Thornhill, 2016; Collis & Hussy, 2014). Generally, ethical principles focus on certain issues (Bryman, 2012; Collis & Hussy, 2014; Saunders, Lewis & Thornhill, 2016). The main issues can be summarised as follows. *Avoidance of harm:* the research should be conducted in a way that does not cause any harm to either the participants or the researcher including physical, emotional and mental harm. *Voluntary participation and the right to withdraw:* this includes the right not to answer a question or set of questions, not to give information requested and not to participate in a part of the study. *Informed consent:* participants should be given sufficient information about taking part in a research project so that they can freely make an informed decision about whether or not to participate. *Privacy*: participants' privacy should be protected, and invasions of privacy should be avoided. *Anonymity and confidentiality:* the identities of participants should remain anonymous and records of individuals should be maintained as confidential.

To ensure the current study was conducted in accordance with ethical standards, certain practices were followed. First, in order to adhere to the University of Nottingham's code of research conduct and research ethics, ethical approval was sought from the Research Ethics Committee (REC) at the university and obtained before the commencement of data collection. In both the qualitative and qualitative phases, prospective participants were informed about the ethical principles and code of conduct followed in the study. Prospective participants were provided with sufficient information about the nature of the study, its purposes and the requirements of taking part. In addition, participants were informed that their participation was voluntary, and that they had the right to not participate, to decline to answer any question and to withdraw from participation without consequence. Moreover, participants were assured that their identities would remain anonymous as they would not be named in the study and that the data they provided would be kept confidential and used only for research purposes. The information sheet was supplemented with an informed-consent form (see Appendix B) and both were translated into the participants' language (Arabic) to ensure that participants were fully informed of the nature of the study and the implications of their participation as well as to obtain informed consent.

During the data collection process, efforts were made to ensure that confidentiality of the data collected and the anonymity of the participants were maintained. In the qualitative study, efforts were undertaken to ensure that the participants could not be identified. The anonymity of the interviewees was maintained by using coded numbers to refer to the participants in the study findings. Personal and sensitive information was not collected during the interview. Moreover, interview tapes, transcripts and participants' contact details were stored separately. To maintain confidentiality, the recorded interviews were transcribed by the researcher herself. In addition, efforts were made to ensure that the collected data were protected. Interview recordings, notes and transcripts were held in a secure and safe location and accessed only by the researcher. The recorded interviews and participants' data will be destroyed upon completion of the study.

In the quantitative study, similar practices were also followed to ensure the confidentiality and anonymity of questionnaire respondents and to protect their data. Before distributing the questionnaire, permission was sought and obtained from IAU to send the online survey via student university email addresses. A description of the study and its purposes, along with informed consent and participants' rights, as discussed above, were attached with the questionnaire. Moreover, the research contact details were provided in case further clarification was needed. To maintain anonymity of responders, identifiers, such as names, addresses and emails, were not collected. The questionnaire did not include any personal information or data that would allow respondents to be identified. In addition, to ensure the protection of respondents' data, questionnaires were collected using SmartSurvey[5], which is a secure survey software fully compliant with EU Privacy Laws and the Data Protection Act and stores all data on UK/EU-based servers. The downloaded responses were coded and held in protected files on a password-protected computer and were accessed only by the researcher.

3.14 Chapter summary

The purpose of this chapter was to provide the rationale and methodological details for the current study. It explained and discussed the philosophical underpinning of the research and described the mixed-methods approach used in this study. A two-phase design starting with an exploratory study and concluding with a confirmatory study was explained. Using an exploratory mixed-methods design was appropriate for the study, which aims to explore the phenomenon of fatigue and technology overload in the context of academic use. The chapter provided an overview of the used data collection methods in the qualitative and quantitative phases and the data analysis techniques, and provided justifications for selecting such methods. The next chapter focuses on the qualitative phase. It describes the procedure followed in semi-structured interviews and explains the process of data analysis undertaken in the qualitative phase. It then discusses the findings of the qualitative study.

[5] https://www.smartsurvey.co.uk/

Chapter 4: Qualitative data analysis and results

4.1 Chapter overview

The previous chapter explained the two-phase mixed-methods design followed in this study. The first phase involved implementing a qualitative study. The process of conducting semi-statured interviews to collect the qualitative data was described in the previous chapter. This chapter describes the procedure of data analysis followed in the qualitative phase, presents the results and provides an overall discussion of the qualitative findings. The aim of the qualitative phase is to explore the academic use of WhatsApp and how this usage can create fatigue among students. Specifically, it investigates reasons for the experience of fatigue among students and explores their coping responses to fatigue creators. The qualitative phase is important not only because it offers detailed information about students' experience with academic use but it also provides guidance for developing a research instrument in the subsequent quantitative phase. To fulfil this phase's objectives, the data were collected from 21 participants through semi-structured interviews. The interview transcripts were coded and analysed using template analysis. Semi-structured interviews and template analysis were explained in the previous chapter. This chapter provides a description of the study participants. It then explains the procedures followed to analyse the data, and presents the findings. The findings section begins with a description of the academic use and non-academic use of WhatsApp and discusses students' perception of WhatsApp in relation to their learning. Then it discusses in detail the experience of fatigue and coping behaviours. The chapter ends with a thorough discussion of the qualitative findings.

4.2 Participants

The participants were 21 undergraduate students at IAU university in Saudi Arabia. An invitation to the study, including a description of it and its purposes, was sent to students via email. The process of recruiting participants, the sampling technique and the criteria used to select participants were explained in Chapter 3. Nine of the participants were male and 12 were female, and all were aged between 18 and 24, in different academic years and from different schools, as presented in Table 4.1.

Table 4.1: Demographics of the interviewees

Participant	Gender	Age	Academic year	School
P1	Female	24	5	Medicine
P2	Female	22	3	Art
P3	Male	23	5	Medicine
P4	Male	21	3	Applied studies and community service
P5	Female	24	4	Art
P6	Male	23	5	Architecture and planning
P7	Female	21	3	Art
P8	Female	24	4	Computer science and information technology
P9	Male	23	4	Architecture and planning
P10	Female	21	3	Business administration
P11	Female	24	4	Art
P12	Male	19	1	Business administration
P13	Male	24	4	Engineering
P14	Female	23	5	Design
P15	Male	18	1	Engineering
P16	Male	22	3	Business administration
P17	Female	24	4	Art
P18	Male	22	5	Computer science and information technology
P19	Female	21	3	Applied studies and community service
P20	Female	21	4	Education
P21	Female	22	4	Education

4.3 Qualitative data analysis

The interview transcripts were analysed using the template analysis and following the procedures recommended by King and Brooks (2017), as explained previously in Chapter 3. The unit of analysis was the individual student's perception of fatigue relating to academic use of WhatsApp and their emotional and behavioural reactions to fatigue creators. The coding process started by identifying and searching for patterns that would provide an explanation for the experience of fatigue. Words, phrases or narratives that indicated the experience of negative feelings, such as annoyance, anger and mental and physical tiredness, were coded as fatigue experiences and the corresponding sources of such feelings were coded and classified as fatigue creators. Pre-identified themes were also used during preliminary coding. Drawing on existing literature and theory on technostress, information overload, communication overload and technology invasion were identified in advance as themes. In addition to identifying sources of fatigue, participants' different reactions to stressors were coded and further categorised, based on the coping model of user adaptation into two main adaptation strategies: disturbance handling and self-preservation. In the next step, the identified themes were grouped and organised in hierarchical levels as the main themes and subthemes. In this step, an initial template was developed based on a subgroup of the interviews, which were conducted in the early stage of the data collection. The process of coding continued using further interview data, and the initial template was developed and modified accordingly. The process of developing and modifying the template continued throughout the analysis process until the final template, which provided a rich and detailed representation of the data, was produced. After the analysis of 21 interview transcripts and the development of several versions of the template, the final template was finalised as shown in Table 4.2. The template includes five key themes representing stressors, and two main themes reflecting coping responses.

The analysis was performed using MAXQDA 2020, which is one of the best-known and most widely used software packages for qualitative data analysis and mixed-methods research[6]. MAXQDA facilitated sorting, structuring and analysing the data. One of the features of MAXQDA is that it supports different languages, including Arabic, thus it helped analyse the transcripts that were written in Arabic.

[6] https://www.maxqda.com/

Table 4.2: Summary of key themes and subthemes

	Themes	**Sub-themes**
Stressors	1. Communication overload	1.1 Too many messages in group chats 1.2 Piling up of messages 1.3 Message notifications are annoying 1.4 Too many direct messages 1.5 Spending lots of time on the app 1.6 Feeling pressured to respond
	2. Distraction	2.1 Distraction while studying 2.2 Distraction while in class 2.3 Group conversations cause distraction 2.4 Constant checking of the app 2.5 Notifications trigger constant checking
	3. Information overload	3.1 Quantity of information 3.1.1 Too many conversations 3.1.2 Difficult to read group posts 3.1.3 Too many posts in study groups 3.1.4 Losing important information 3.2 Quality of information 3.2.1 Redundant information 3.2.2 Unreliable information 3.2.3 Negative posts 3.2.4 Irrelevant conversations 3.3 Study group characteristics 3.3.1 Group size 3.3.2 Number of groups 3.3.3 Group rules for participation 3.4 The technology 3.4.1 Lacking prioritising content 3.4.2 Lacking information management tool 3.5 The individual
	4. Invasion of personal life	4.1 Constant connectivity with study groups 4.2 Staying connected during the weekend

		4.3 Difficult to separate work and personal time
	5. Invasion of privacy	5.1 Discomfort around being monitored 5.2 Pressured to quickly respond due to ‘online status’ and ‘read receipt’ 5.3 Online status creates expectations of availability
Coping responses	1. Disturbance handling	1.1 Temporarily turn off notifications 1.2 Modifications of privacy settings 1.3 Disable unnecessary notifications 1.4 Modifying WhatsApp use
	2. Self-preservation	2.1 Temporary disengagement from WhatsApp or study groups 2.2 Temporarily leaving study groups 2.3 Permanently leaving WhatsApp groups 2.4 Leaving groups results in losing important things 2.5 Using an alternative app

4.4 Findings

4.4.1 Non-academic use of WhatsApp

Participants used WhatsApp for academic and non-academic purposes. Given the fact that WhatsApp is a messaging app and not designed specifically for e-learning, participants mainly used the app for personal communication, to connect with family, friends and other people. All participants were members of at least one WhatsApp group that included family members. In addition, apart from two outliers, all joined at least one friend group on WhatsApp. Besides these groups, the students were also members of WhatsApp groups that had been created to share information related to other personal interests, such as sports, films and job advertisements. Considering the focus of this study, which is the academic use of WhatsApp, non-academic use, though it might have influence on the experience of fatigue, is beyond the scope of this study. Thus, the following sections focus on the academic use of WhatsApp and its relation to fatigue.

4.4.2 Academic use of WhatsApp

WhatsApp was not a formal communication channel at IAU. The main channel for communication was university email and Blackboard (virtual learning environment). Owing to the accessibility of WhatsApp and its widespread use among the student body, participants noted their heavy use of the platform for various academic activities. In general, participants perceived WhatsApp to be a useful and instrumental tool in enhancing mobile learning. They expressed various ways through which WhatsApp could facilitate learning and help them to achieve better learning outcomes. Specifically, participants noted that WhatsApp was very useful for sharing learning materials as well as news and announcements concerning their study. It helped students stay updated and access important information more quickly. Participants mentioned that instead of checking their emails or Blackboard, they would get any announcements or updates faster via WhatsApp, as other students would share it. Announcements of any changes to the timetable, such as lecture cancellations, rescheduling or changes in location, would be sent to student emails and posted on Blackboard. However, participants noted that not all students would check their emails regularly, and only a few students who tended to check their emails regularly would share such announcements once they received the email. Therefore, for most of them, WhatsApp was the main channel through which announcements and study-related news were received. Moreover, collaborative learning was coordinated and carried out via WhatsApp. This included organising and coordinating group work, engaging in group discussions, and participating in knowledge exchange. A small number of participants mentioned using WhatsApp to contact faculty members; however, the majority used email to communicate with university staff members.

4.4.3 WhatsApp study groups

Students benefited from using WhatsApp for learning purposes by creating and joining study groups. The participants reported joining a significant number – between 10 and 25 – of such groups, the main purposes of which were information sharing and collaboration. Moreover, participants reported that WhatsApp groups were very helpful during exam preparation. They mentioned that they would join groups created to help students prepare for exams. In these groups, students engage in discussions, exchange study summaries and learning materials and help each other with difficult questions. Generally, study groups can be classified into two types: *main groups*, which last throughout the academic year; these included year groups, groups for students studying the same major, and larger faculty groups. The second type were *temporary groups*, which were created for specific purposes, such as group projects, which students temporarily would join then leave once the work is completed, and course-related groups, which would be created for each module in a semester. The number of groups a student joined during a semester was determined by the number of modules they were studying, in addition to the main study groups they had joined. As a side note, most study groups were administrated by the students themselves.

4.4.4 Fatigue associated with the educational use of WhatsApp

The findings revealed that the use of WhatsApp for academic purposes created fatigue among participants. The participants reported the experience of a variety of feelings, such as annoyance, anger, boredom and mental exhaustion, associated with the use of WhatsApp. These feelings were evidence of the experience of psychological fatigue. In addition, among the 21 participants, five reported experiences of symptoms such as headache, sleep problems and eye fatigue, indicating physical fatigue. According to the data, students suffered from fatigue due to five main factors or stressors: (1) communication overload; (2) distraction; (3) information overload; (4) invasion of personal life; and (5) invasion of privacy. The following sections discuss these factors in detail and analyse how and why students encountered such stressors.

4.4.4.1 Communication overload

Communication overload was one of the key reasons for students experiencing fatigue. Participants reported using WhatsApp as the main tool for communication and information sharing, and this was mainly due to the accessibility and convenience of the app. Some participants mentioned using it to contact teaching staff. However, heavy reliance on the app as the main communication channel led students to feel overloaded by the WhatsApp messages and notifications they received on a daily basis. The majority of participants reported receiving too many messages and notifications through the app. One participant attributed receiving too many direct messages to general reliance of students on the app:

> *I receive too many direct messages. Actually, everyone uses WhatsApp. Instead of using phone calls which cost money, I would rather use WhatsApp to text or call people and save money. If I need to contact someone, would I call him [phone call] or text him on WhatsApp? Definitely, I would text him via WhatsApp, not Snapchat or Instagram, for sure I would use WhatsApp.* – P15

The inability to respond to WhatsApp messages, particularly direct messages, was another issue raised by some participants. A participant (P7), who was a group leader and an organiser of multiple group projects, indicated that she would often be unable to respond in a timely manner to other people or may forget to respond due to being part of too many conversations. This caused her to feel the additional pressure of often feeling blame from others because of her late responses.

In addition to direct messages, participants noted that the major source of increased incoming messages was group chats, as the following comment highlights:

> *What I do not like about study groups is too many messages. Actually, I am not the kind of person who likes to read a lot or listen [to voice notes] a lot. Once I have left the app for three hours, I could find more than 200 new messages in the group.* – P15

The number of incoming messages was increasing in study groups because of chatting and irrelevant posts, which wasted students' time and resulted in negative feelings such as annoyance and anger:

> *Sometimes, I would receive 700 messages from a study group in a day, most of which are just chatting and nothing important.* – P7

> *Sometimes, group members would talk about unrelated topics. It is annoying that I get notifications from the group thinking it is important information, an announcement or a reminder, but I find it is just chatting and not important. Sometimes, group chats become annoying in the morning; I would receive three or four hundred messages, but nothing is really important.* – P19

> *Something that I do not like about WhatsApp groups is the piling up of messages. In work or study groups especially, messages get piled up because someone started a conversation that is unrelated to the purpose of the group. This wastes my time. For example, I open the group chat expecting important things, but I find posts irrelevant to the discussion. This is very irritating.* – P20

Piling up of messages is an indication of communication overload, as mentioned in the above comments. With the increased interaction and participation in groups, students were often faced with a vast backlog of messages. This made it difficult for participants to read or listen to all of the messages and to know which were important. Some participants perceived that reading group conversations immediately once they had received the messages was less difficult than reading them later, as a delay in reading them caused the number of messages to be read to become almost unmanageable:

> *When I receive lots of messages, it could be hard to read them all. If I read them immediately once I receive them it would not be difficult, but if I was asleep, for example, and I woke up and found one or two hundred new messages in the group chat, that would be annoying.* – P6

Some participants stated that they had to read all group messages, especially when doing a group project, in order to be informed about anything related to their work. To avoid the piling up of messages, students tended to constantly check and read messages.

> *At home, I keep WhatsApp open on my laptop while I am sitting with my family. I constantly look at the screen and read incoming messages. I do not like messages piling up. Once I receive a message, I read it immediately. I do not leave them. Now, [during the interview], I have received twenty-five new messages. Students [in study groups] talk a lot.* – P14

The above two comments suggest that being present in the conversation and immediately reading incoming messages may lead to a reduced feeling of overload. Furthermore, piling up of messages is more likely to cause fatigue, especially when there is a perceived need to read all incoming messages to stay informed. On the other hand, being constantly available online could lead to consequences, such as increasing the time a student spends on the app and may ultimately result in technostress.

Participants noted that communication overload was an issue particularly during exam days, as students would generally use WhatsApp a lot for exam preparation.

> *Students often would use WhatsApp the most during midterm and final exams. Almost all students would participate in the study group, even those who usually would not. WhatsApp at these times [exam days] was stressful, when all students in a group chat were talking at the same time. Sometimes, the app would freeze, and messages could disappear or be deleted.* – P19

The findings suggest that communication overload can occur when a person has less control over their ICT usage. This is evidenced by some participants reporting that they spent considerable time on the app texting or chatting, and they felt unable to reduce their usage. As one participant expressed:

> *Generally, social media, including WhatsApp, are a major waste of people's time. Sometimes, I control my usage to not spend too much time on the app. I used to text my friends a lot, particularly during exam times, so I was wasting a lot of study time on the app.* – P12

Overall, the findings indicated that the key manifestations of communication overload were receiving too many messages and notifications, the piling up of messages in study groups and spending a lot of time on the app. The interviews also suggest that feeling obligated to respond was another factor contributing to communication overload.
Communication overload occurred due to the increased number of messages students received. Such messages did not necessarily require a response, especially in group chat. That said, many participants noted feeling a personal responsibility to respond to others, such as answering or replying to other students' queries in study groups, even though answering such questions required time and effort. This is highlighted by the following comments:

> *If someone asks a question in WhatsApp groups, I feel responsible to answer. I have a strong sense of responsibility. Not only do I feel responsible, but sometimes, I get*

> *excited. I may be busy with some work I have to finish now, but inside me, I feel I have to find an answer to the question [asked on a WhatsApp group]. I do not like to say I do not know. I can do a little research and help others.* – P5

> *If someone asks and I know the answer, I have to respond. I am not the type of person who reads a question and knows the answer but does not reply. If I have the information other people ask for, I feel I have to give them the answer.* – P12

A student who was experiencing an increasing number of messages during the semester explained:

> *I do not like to keep information and not share it with others. Many students were facing study-related issues and needed help. Previously, I had experienced the same issues they were facing. So students would contact me and ask how to deal with these issues. I helped them to get better grades. Actually, they finished the course and got good grades and thanked me. Most of direct messages that I would receive were from students who needed information or help with something . Most of them from students I did not even know.* – P13

The above comments indicate that the reason for students feeling overwhelmed by the number of messages might be their perception of the importance of being responsive and always available to help others. This perception could lead them to spend more time on the app and exert effort in order to provide support to others.

4.4.4.2 Distraction

Distraction, which is closely related to communication overload, was another issue mentioned by participants. The data suggested that distraction and interruption attributable to incoming messages and notifications was a factor that created fatigue. Many participants perceived WhatsApp to be a source of distraction. For example, participants indicated that receiving messages and notifications while in class led them to constantly check the app and immediately read incoming messages.

> *Between 8:00 to 3:00 [school hours] I open the app many times. I cannot tell you exactly how many times I check the app. I constantly receive messages from my class group, and I check them immediately. In an hour, I get too many messages. More than I can count.* – P12

Participants also mentioned receiving messages from their family or other WhatsApp groups while in class, which could reduce their focus and interrupt their attention.

> *During lectures, I text my family and check if they need anything. Even when the lecturer is teaching, I would quickly send a message. As a football player in the university team, I also would get messages from my team regarding training times. So, I would constantly check WhatsApp during lectures to see the time and date for training.* – P15

The participant further reported leaving class to check the app or respond to messages. He described how vibrations of message notifications would interrupt his focus in class:

> *In class, once I feel vibrations from message notifications, I automatically have to check the message. I may leave the class to do that. I feel I have to check the message, otherwise I would not be able to focus in the class and my thoughts go far away.* – P15

Although joining study groups was perceived as useful for exam preparation, students using WhatsApp while studying could get distracted. Students tended to engage in study-related discussions or information exchanges that could help them with exam preparation. However, a disadvantage of using the app while studying was that students reported being distracted by incoming messages and irrelevant chatting. As some of the participants stated, they would switch between studying and checking group messages in order not to miss important information:

> *This often happens during exam days. For example, while I am studying, I receive a notification from the study group of the module that I am studying, so I stop studying and immediately check the group messages because I do not want to miss important discussions or information. Actually, this is considered a distraction and it could be*

> *irrelevant conversations that interrupted my studying. But, you know, any notification I get, I would check the message immediately.* – P6

In addition to switching attention between two tasks such as studying and checking WhatsApp, or listening to the lecturer and texting, the increased amount of communication could require students to engage in multiple conversations at the same time. Students mentioned that they would join many conversations at once, particularly when they had to work with different group projects, as highlighted in the following comments:

> *Having so many groups can be annoying, especially when members in more than one group chat are texting at the same time. For example, members of a group project are texting at the same time as asking about something else. This makes me distracted and unable to focus. It is something that makes students feel discomfort.* – P18

> *Using WhatsApp can negatively affect concentration. Often, I have more than one thing important to do and I need to focus on these, such as when I have two projects that both have to be done by the same date. Each project has to be done in a certain way, so I feel really distracted. Every time I open WhatsApp, I get confused between the two groups.* – P7

The above comments suggest that multitasking can lead to difficulties focusing on the task at hand and feeling distracted. Given the fact that concentration is necessary for students working on a project, switching attention between multiple conversations could reduce the quality of their work and cause them to feel overwhelmed.

4.4.4.3 Information overload

Another stressor associated with fatigue was the exposure to the vast amounts of information exchanged in study groups. WhatsApp allows the sharing of different types of information such as study-related announcements and learning materials in the forms of documents, videos, pictures or voice notes. Students also reported using the app to coordinate and organise group projects, which involved exchanging ideas, opinions and materials relevant to projects. Aside from study groups, students stated that they received information that was not relevant to their study from other WhatsApp groups comprising friends, family members and hobbyists. That said, this present section focuses on responses related to information overload caused by study groups, as they were revealed as the main cause.

As participants indicated that they would rely largely on WhatsApp for information sharing, they would receive a large amount of information through the app on a daily basis. Students experienced information overload when they felt that the amount of information exceeded their information-processing abilities. This is highlighted by the following comment:

> *A group that I have joined specialises in the medical field. Although the group members share much interesting and useful information relevant to my study, sometimes, when the group members share too many posts it becomes annoying because I want to read all posts but I cannot. I wish they could share once or twice a week or the group admin would organise the participation so that I feel motivated to read their posts. Unfortunately, they send too much information. Instead of reading some posts shared, I become unable to read and less excited to do so.* – P1

In addition, with the increased number of messages students received, it was sometimes difficult for them to find relevant information. Furthermore, important information could become lost due to the volume of irrelevant messages. Many participants pointed out this issue, as in the following comments:

> *One disadvantage of the study groups was too much talk. There were too many useful posts, which could be hard to follow. I would often feel lost with the amount of information being shared, especially during exam days. In addition to useful information, there was too much irrelevant talk that would make me confused and lose important points. For example, a student sent twenty PDF files. I wanted to check them as they might be useful, but at the same time, there were other resources I had to study from.* – P8

> *Because of group chats, I could miss useful information or important news.* – P2

> *When group members move away from study-related topics and started unrelated chatting, this can cause distraction. For example, information was sent at the beginning*

> *of the conversation followed by too many messages [unrelated to the initial post]. I could enter the group and leave without noticing such information. I could lose it because of the number of messages.* – P6

The above comments indicate that the quality of information in terms of relevance can also contribute to information overload. Participants felt they had to read all messages, even though they may be trivial, in order to note relevant information and stay updated. However, many of the participants indicated that they felt unable to do so and thus missed important information. In addition to information relevance, the participants reported receiving redundant information, such as when a student (P19) received the same posts from two groups, or when the same question had been asked and answered many times by members in a group. Some participants also indicated that information students would share could be inaccurate and thus not relied upon, particularly if its source was the students themselves, instead of more reliable sources such as teachers or literature. A participant explained why she felt study groups created tension during final exams and why she would not rely on study groups for exam preparation:

> *Information shared in WhatsApp groups could be unreliable. You do not know the person who is sharing the information. The group included ninety students and I do not know all of them. I do not know whether the person who shares the information is reliable. I do not know their academic performance level and whether the information has been forwarded from the professor. This causes confusion and disruption.* – P18

Since WhatsApp was not adopted by the university as a formal communication channel, some participants felt that news and announcements shared through the app might not be trustworthy.

> *Although WhatsApp can help in spreading useful information to a large number of people, it also can facilitate spreading rumours and misinformation to as many people as possible. Students would use it to cancel a lecture where the doctor did not cancel it.* – P9

> *From my personal experiences in the university, I noted students dropped a semester because of WhatsApp groups and I noted students dropped some modules because three or four students in a WhatsApp group talked negatively about the teacher.*

> *WhatsApp, as it facilitates sharing study materials, it also facilitates spreading negativity.* – P9

> *WhatsApp groups are not a formal source of information I can rely on. I can send a message to the student and lie to them saying today lectures have been cancelled. For me, I do not consider WhatsApp as a formal channel, unless I trust the person who sends the message and I can rely on the information.* – P13

In summary, the findings indicated that information overload can be caused by two factors related to the information: the quantity of information, and its quality in terms of relevance, redundancy and reliability. The interviews revealed other factors which contributed either directly or indirectly to information overload in study groups. These factors are discussed below.

4.4.4.4 Additional factors contributing to information overload

Number of groups

The number of study groups of which a participant was a member was a factor noted to lead to information overload. As mentioned previously, most participants were members of multiple groups, and as this number increased, so did the amount of information received from multiple sources, thereby increasing the likelihood of information duplication. As one participant (P19) indicated, she was receiving the same information from two different groups; therefore, she decided to leave the non-essential group. Other participants also reported leaving groups as a way to reduce overload.

Size of groups

Another factor associated with information overload connected to study groups is the size of groups. WhatsApp allows up to 250 participants in a group and many participants cited having a large group with the maximum number of participants. Such large groups are more likely to produce a large amount of information and create too many conversations that could potentially veer away from study topics. A student explained the reason for too many posts in a group:

> *When the group becomes large, such as with 200 members, it becomes difficult to manage, even when there is a group leader.* – P2

Another participant expressed her opinion regarding the relationship between the number of group members and the increased volume of irrelevant conversations:

> *The more members join a group, the more diverse viewpoints and different ways of thinking exist among the group.* – P17

One participant (P13) mentioned that due to more students having joined a group, there was an increase in daily participation. On the other hand, another participant (P6) explained that it is not necessarily the number of group members that causes overload, because some groups have only a few members, but that these members may engage in a long conversation for hours. Altogether, the findings suggest that the group size along with the level of participation in a group contribute to information overload.

Group rules for participation

Group rules for participation are a set of rules or policies put in place to regulate the participation in the group. Such rules can be set explicitly by group admins or commonly agreed upon by group members. The rules can then be written in a group description to be viewed by its members. The interviewees indicated that there were participation rules in some groups, which helped manage the flow of information and the participation in the group. In addition, they were effective in preventing the spread of irrelevant content or unnecessary conversations in the group.

An example of participation policies cited by some of the participants was that group members should share only relevant content and that the group admin would remove any member who broke this policy. Sometimes, stricter policies for participation were applied in groups, such as when group admins prevented any direct participation from the members, meaning that the content could only be shared by group admins. According to the interviewees, this policy helped significantly in eliminating unnecessary content in the group and managing the flow of information. However, the participants felt that restricting participation was often inappropriate when students needed a flexible communication channel to exchange information and knowledge, such as when they needed an immediate response to a query from group participants. In addition, such policies require more effort on the part of group admins to manage the participation; therefore, not all study groups were managed by admins. In the cases in which groups had no admins, some participants indicated that they could intervene to manage the situation when other members veered away from study topics or shared inappropriate or irrelevant content.

Aside from group admins, some participants (P6, P9, P11) mentioned that the presence of the instructor could regulate participation in the group. Usually, study groups were administrated by students, but sometimes instructors joined groups. The participants perceived that the presence of instructors in WhatsApp groups effectively helped with preventing inappropriate participation, increasing the reliability of shared information, and reducing the level of interaction between group members, as participants tended to share less. This then reduced information overload.

Type of technology

Technological design can also contribute to information overload. As mentioned in a previous section, WhatsApp is not a platform designed for e-learning purposes; thus, it lacks features that can facilitate information management and storage. For example, participants mentioned that the app lacks features that enable the storage and organisation of important messages. A student (P1) mentioned that she would add posts to her ‘favourites’ in order to save important posts. However, she found this method ineffective because it combined all the saved messages in the same place and did not allow for more refined organisation. She therefore created groups with no members other than herself and sent any messages she wanted to save to this group. Another participant (P19) mentioned that she would send any messages she needed to save to her sister, so that she could quickly retrieve them.

Another issue related to WhatsApp groups is that there is no feature to organise conversations according to their topic. For example, a student (P8) suggested that adding a ‘hashtag’ feature to WhatsApp could help in organising posts and easily finding related information or discussions. In addition, the app lacks features that enable the sender to prioritise messages. Given the number of messages students received, they pointed out difficulties in finding relevant information. One participant (P14) wished that there could be a feature that enables prioritising messages according to their content using colours; for example, red indicating that the message is important and white indicating the message is trivial. She explained such a feature would help her to notice important information in study groups.

The individual

Information overload generally occurs due to the limitations in individuals' information-processing abilities. This is dependent on the individual themselves, as each person possesses different levels of ability and different personal skills to deal with information. The findings from this research suggest that the differing reactions of students towards information overload could then be attributed to these varying abilities and personal skills. In short, information overload was felt by many participants, whereas some of them seemed confident in their ability to deal with the amount of information they were receiving. For example, a student (P9) who was an active member of 50 groups was confident about his ability to manage information and communication overload because he used a time-management strategy. Although he used to receive many messages every day, he was able to read all messages and information in study groups and separate what was relevant from what was not. Another participant (P10) mentioned that dealing with too much information in study groups depends on the person. She explained that she would use the app for exam preparation and could spend two to four hours engaging in discussions with other students while some of the group members would leave the group and re-join when the discussions had ended. Students' attitude towards study groups also influenced their perceptions of information overload. The data shows that participants who perceived study groups as useful were also able to find ways to save and sort group messages. For example, some participants reported adding important messages in a favourite list to return to later when they needed them and deleting unnecessary group chats.

> *The last update of WhatsApp allows us to delete the entire group chat and conversations except messages that I marked as favourites. I often do not need all group conversations, only messages in my 'favourite list'. So, I would often mark any useful information or anything that I would need later as favourite. Then I would delete the group chat except favourite messages.* – P13

In addition, two participants (P1 and P17) reported creating a group without members, so the only member in the group was the student who created it. Such a group was used to save and sort important information.

4.4.4.5 Invasion of personal life

Invasion of personal life was another reason why students felt stressed by the use of the platform. The findings reveal that the use of WhatsApp for study-related activities could create a conflict between academic life and students' personal lives. School work, such as collaborative work, requires students to stay constantly connected, even outside of school hours. A student expressed the disadvantage of using the app for study-related work:

> *The negative effect of WhatsApp on students is that it wastes a lot of my time. How many hours do we spend on the app, whether sending, responding to messages or doing online meetings? It is a negative thing that I have to be connected even during out of school time. For many people, work stops when they leave workplaces, but for us, work continues via the app. In general, all social media apps waste our time, but we can leave them anytime, while in the case of WhatsApp, the conversations can keep going until the other person ends the conversation or the work is done.* - P20

In addition, as students relied on the app as a main communication channel, they perceived that they had to constantly be connected as they may receive important announcements or information, even during the night. A group leader expressed her feeling of being stressed due to imposed constant connectivity even during inappropriate times:

> *I use the app currently for study-related purposes such as group projects, assignments, organizing group works and contacting teaching staff. Teachers contact me to pass information to other students. They rely on me too much. I can get a message from a teacher in the morning or late at night. I feel really nervous that I may not be able to see their message on time and then I would not be able to pass it to students. Therefore, I have to always be connected to the app.* – P7

Given the fact that the use of WhatsApp may create expectations of constant availability, students can be reached at any time, and they may feel responsible to respond even when the timing is not appropriate. The participant felt pressure to respond to others while spending time with her family, especially if she was contacted by teachers:

> *Even during family time, I have to stay connected. When a teacher contacts me while I am sitting with my family, I feel it is inappropriate to say I am spending time with my family right now. So I have to finish the conversation with the teacher and then join my family.* – P7

Another participant who used to receive a lot of messages from study groups described her usage of the app during her family time:

> *While I am sitting with my family I leave the app open so that I can read messages as soon as they are delivered.* – P14

While the weekend can be a relaxing time for students, in which they can have a rest from studying, some participants noted that during the weekend they had to be connected to study groups and sometimes would spend extra time on the app working on group assignments.

> *We use the app during the weekend with the same intensity as during school days and sometimes we use it more in the weekend such as when we have group work.* – P14

Interviewees expressed that the use of WhatsApp invaded their personal lives, and that they wanted to separate their personal time from schoolwork. The conflict that the app created between personal time and work could be attributed to the fact that students used the app for both personal communication as well as for study-related communication, therefore, it may be hard to separate time spent on the app for chatting with friends from time spent on study-related conversations. A participant explained this issue:

> *It bothers me when I have finished my work and I feel mentally drained, so I want to have a chat with my friend. I open the app to text my friend; then, because my online status is visible to others, someone texts me asking about my work and I have to send*

> *the work, so I am forced to interrupt my break to send the work. It is mentally stressful: I do not like it.* –P8

Some participants expressed their preference to use an alternative platform for academic use as a way to separate their personal communications from study-related ones, as a student suggested:

> *WhatsApp is formal and personal, and I use it to contact my family. I do not like to merge my personal life with work. I feel annoyed by WhatsApp groups but I have to join them; there is no other means for communication.* – P17

4.4.4.6 Invasion of privacy

Another issue frequently cited by participants that caused discomfort and anger was the lack of privacy. WhatsApp affords features that enable user activity on the app to be visible. For example, the app allows contacts to recognise the presence of a user by displaying the 'online status' of the user. In addition, the app offers 'last seen' information, which enables contacts to see when a user last used the app. The app also provides 'read receipts', which inform the sender whether the message has been delivered and read by the recipient. These features may be important to increase the visibility of communication between users. For example, online status and last seen can improve online communication and create awareness of the user's presence, which is an essential element in face-to-face communication. Read-receipt information can provide the sender feedback on the status of his message and inform him when the recipient has received and read it. Such a feature could be useful for students working on a group assignment, as a group leader indicated:

> *This feature [read receipts] is useful, especially for group work, as it can ensure that all team members have received my message so I do not need to be worried about that.* – P7

However, enabling users' activity to be visible may not always be desirable for the user, as such visibility can come at the cost of losing privacy. It is worth noting that the app provides some level of control to protect user privacy; for instance, it enables the user to disable 'last seen' information. Yet, there is no way that the user can hide their online status. In addition, the user can partially disable read receipts but these cannot be disabled in group chats, as the sender in a group can know if the message has been delivered, who has read it, and who has not.

The interviewees expressed their feeling of discomfort because the app allows others to monitor their usage activities. For instance, signalling the presence of the user and displaying the last time he/she used the app can promote monitoring. Participants cited instances when they were under surveillance. A student (P20) mentioned that she could not disable 'last seen' information although she wanted to do so, because her mother asked her to enable this feature in order to check if she was online and when she last accessed the app. Another student expressed that:

> *'Online status' can cause a problem with other people, for example, it happened to me that a person contacted me on Snapchat and I was not able to respond. [At the same time] he opened WhatsApp and found me online. He asked, why you did not reply to my message on Snapchat?* – P12

This comment suggests that showing the presence of users on WhatsApp enables tracking their activities and can create expectations around their availability. In addition, it creates an unspoken norm that people are expected to respond quickly. Most of the participants referred to this issue and described it as annoying, and that it sometimes caused pressure, as highlighted in the following comments:

> *I think the app is important for communication, but people can make it mentally stressful, like when they ask why you read my message but did not reply. I am not always in the mood to reply. These things make the use of the app irritating.* – P5

> *'Online status' – I do not like it. I would prefer if such a feature did not exist. If someone sees me online, he would think I should reply but I think it is up to me if I want to respond right now or not. It happened to me that my family texted me and I did not reply. They said we saw you online, why did not you reply?* – P15

The visibility of user presence could also make users more reachable and exposed to an increased amount of communication. This issue was cited by some participants, who used the app to organise group work.

> *What is annoying about WhatsApp is when I am online and I have some work to do with a group, and at the same time, other people are texting me and want an immediate reply. I feel it is irritating that the app shows that I am online, but I cannot reply. Sometimes, I get understood wrong that I do not want to reply, or I am late in responding while actually I am busy.* – P7

This comment indicates that signalling the user's presence could lead to misunderstanding their behaviour when they are not able to respond. Another student (P2) explained that some WhatsApp features could cause interpersonal issues, such as when it shows that the person has read the message but then, for instance, their internet suddenly becomes disconnected, meaning that he/she is unable to respond immediately yet it leads others to think that he/she does not want to respond.

As previously mentioned, some of these features can be disabled; however, for some participants, this was not always possible. For example, a student (P20) mentioned that her family asked her to enable 'last seen'. Another student felt disabling such features was not appropriate, as she explained:

> *The problem is not the app but the way individuals are using it and you cannot control people. You can disable read receipts but I feel it is not nice to do that to prevent the other person from seeing if you have read the message or not. The person would not contact you if they did not really need help. I feel it is not polite to keep him worried about whether you have read his message or not. So the person should put himself in others' places.* – P17

In order to deal with this issue, some of the participants reported trying to become invisible when they felt pressure to respond. For example, a student (P8) mentioned that she used to avoid opening the app and read messages from the pop-up notifications displayed on the lock screen of her mobile. Doing so enabled her to read incoming messages, mark them as read and reply to others while she was still invisible to the contacts.

4.4.4.7 Coping responses to WhatsApp fatigue

The previous sections discussed the main stressors students encountered when using the app. In order to deal with such stressors or alleviate the negative feelings resulting from unpleasant situations, participants tended to engage in coping behaviours. The previous section on information overload referred to some approaches that students as a group would implement in order to manage the flow of information and group chats, for example, implementing rules for participation in the group. The following sections discuss students’ different ways to deal with fatigue and stressors. They focus on how students individually, not as a group, would usually respond to the stressful situations they encountered. The data showed that the main coping behaviours that participants often used were disturbance handling and self-preservation.

4.4.4.8 Disturbance handling

The majority of the participants indicated that they would tackle stressful situations, such as annoyance or mental exhaustion caused by an ongoing flow of notifications and messages, by adjusting the app features. In addition, some participants were able to reduce stressors by modifying their usage of WhatsApp and minimising their time spent on the app. The disturbance handling approach was a form of problem-focused coping, which aimed at directly addressing the issues. Participants noted that adjusting the technology settings was applied when the disturbing situations were perceived as manageable, and they felt they were able to handle them. They reported using this approach to deal with different types of stressors, such as mental exhaustion caused by receiving too many messages and notifications, distraction, constant connectivity and availability, and invasion of privacy, as will be explained later.

Disturbance handling focused on preventing the exposure to stressors or reducing their consequences. For instance, a student (P10) indicated that once she joined a WhatsApp group, she would immediately mute the group notifications, even before she received any messages from the group, because she believed that there would be unnecessary posts and conversations. In this example, the student was able to address the problem by avoiding the exposure to stressors. Participants also mentioned modifying the app features or reducing their WhatsApp use to mitigate unpleasant situations that had already occurred. For instance, a student (P14) indicated that at the beginning of her study at the college, she used to enable all group and message notifications. She would continually get too many messages and notifications appearing on her phone screen, and as a result suffered from anxiety. She indicated that disabling notifications helped her feel less stressed. The student expressed her feelings since she had turned off notifications:

> *I feel very relieved beyond description that I see new messages only when I open the app, so if I sit with my family or join my friends at the weekend, I am not annoyed by notifications. Some people keep texting all the time, even during the weekend. For me, I do not want study time to extend into my personal life. There is time for study and time for my family, and I do not want to merge them. I need time for myself, so when I disabled notifications, I felt relaxed. I can get my mind off work.* – P14

This comment suggests that disabling the app notifications and taking breaks from the app during personal times, such as family gatherings or time with friends, could help students separate their personal lives from study time, particularly those who suffered from being constantly connected to their study groups.

Adjusting notifications was applied to reduce distraction. As mentioned previously, push notifications were one of the most common stressors distracting students' attention, particularly while engaging in learning activities. The majority of the participants turned notifications off when they felt they caused distraction.

> *I disabled group and message notifications because they often would distract me. Every time I opened my mobile phone, I used to be bothered by too many notifications displaying on my screen. For me personally, WhatsApp is the most distracting app, so I turned all group notifications off. Usually, group messages are not that important and not urgent, so I do not need to enable group notifications.* – P5

> *In class, when I feel distracted by the app notifications, I put my phone on 'Do not disturb' mode so that I do not receive notifications from the app.* – P4

Other participants noted that turning off all notifications was not convenient, particularly in the case of things that require an urgent response. Thus, some participants mentioned turning off only unnecessary notifications such as those they receive from non-study groups.

> *Hobby groups that I have joined for entertainment I muted their notifications because I know once I get notifications from these groups I would immediately check them, thus I muted group notifications to avoid receiving any notification from these groups, and I check them only in my free time.* – P9

Adjusting notification settings was not only effective in minimising distractions and annoyance but also helped limit the state of constant connectivity and the habit of frequent checking. The above comment demonstrated that disabling notifications helped the student overcome compulsive checking behaviour.

Participants would constantly check the app, possibly because of push notifications. Thus, for some participants disabling the app notifications including group chat and direct message was a way to eliminate unnecessary frequent checking, as a participant stated:

> *Previously, I used to spend a lot of time on WhatsApp. I used to constantly check WhatsApp messages because I had a fear of missing important things or forgetting to reply to people's messages. Now, I have disabled all types of notifications; sounds, banners and the number of new messages, which appear on the screen. I do not receive any notifications from WhatsApp. I have realised that if there would be an urgent thing the person would directly call me. I feel this is a very useful way. I have not missed any important things since then.* – P3

In addition to the previously mentioned reasons for adjusting the app features, participants attempted to cope with unwanted monitoring by adjusting privacy settings and disabling features that enable others to monitor their presence. A student described how she dealt with being pressured by others to respond quickly:

> *Since I disabled [read-receipt] information, I have a happy life. Previously, people would ask me if I read their message, but could not reply quickly. But now no one asks. I used to leave WhatsApp open on my phone screen while doing other work on my computer. Sometimes when I got messages from someone, it showed that I had read the messages, but I did not. People accused me of not replying quickly to their messages. It was really annoying, but once I disabled the two blue ticks, my life became easier.* – P1

Some participants reported dealing with stressors by modifying their usage of WhatsApp and managing their time on the app. For example, a participant (P9) who used WhatsApp as their main communication app confessed that previously he had experienced health issues including headaches and sleep problems because he was always connected and available on the app. He suffered from communication overload, as he described: "*some groups if I had not check them for two days I would find a thousand new messages".* To overcome this issue, he decided to manage his usage and take daily breaks from WhatsApp. He indicated that managing time spent on the app became a routine that helped him deal with communication overload and reducing fatigue.

Similarly, another participant cited that in the past, he felt SNS including WhatsApp negatively affected his concentration. To improve his concentration, he therefore decided to practise a new routine for a period of time where he would avoid using SNS during weekdays. He admitted this experience helped him stay focused on his work. Moreover, although he stopped this practice, he become able to control his usage of SNS:

> *Now, I am often thinking that if I spend time on my smartphone now I will not have enough sleep, I will wake up tired, I will not be able to go to football exercise and I will not be able to go to the university. Once I began thinking this way, I would leave my phone and go to sleep if it was sleep time, or study if it was study time.* – P16

4.4.4.9 Self-preservation

The previous section discussed how modifications of WhatsApp's technological features were used to reduce the negative outcomes of stressors, especially when such stressors were perceived as manageable. However, the findings suggest that this approach was not always sufficient to reduce strain. Therefore, in cases where participants were not able to reduce stressors or adapt to them, they attempted to minimise strain by applying other approaches, such as distancing themselves from the situations, temporally disengaging from the app and leaving study groups. In contrast to the disturbance handling approach, which aimed at addressing the problem causing the stress, self-preservation was a type of emotion-focused approach used to mitigate technostress by regulating emotional strain without changing the stressful situation.

Disengaging from the app

Students reported disengaging from the technology to avoid being overloaded by information and communication. For instance, students tended to share a high volume of information in different forms (e.g., lecture notes, PDF files, photos, videos, etc.) during exam days to get the most benefit from study groups. Participants expressed that they could not effectively process such information given the lack of time. Therefore, in order to avoid exposure to too much information that could lead to cognitive overload, participants tended to disengage from study groups during exam days. Some participants indicated that they avoid study groups not only because of group chats, which caused information overload, but also due to the content of group conversations, which included too many expressions of anxiety and stress associated with exams.

> *During exam weeks, I got stressed out and the conversation in the group made me more nervous. Students talked about how the module was difficult. Other students expressed how they felt worried. Such conversations made me really anxious. So, to be safe, I would stay away from the app until exams were finished.* – P5

Students reported disengaging from the app or study groups in situations where group chats became annoying and involved irrelevant discussions or arguments that led to tension in the group. In such situations, students tended to temporarily distance themselves and avoid participating in the group conversation:

> *I do not like side conversations in WhatsApp groups; particularly in large groups. People have different points of view. Sometimes, students would argue on some irrelevant points. They might spend two hours on the discussion. For me personally, this is really annoying. When the discussion would get intense, I would exit the app. From my experience, I could guess if such discussions would last long or not, so if I felt it would take a while, I would leave my mobile aside and do another activity to keep myself busy until the students had ended their discussion. Then I would open WhatsApp, but I would not read any messages.* – P17

Temporarily leaving WhatsApp groups

Distancing from the app while studying was perceived as effective in reducing distractions. Students reported temporarily withdrawing from WhatsApp groups that were perceived to cause distraction or information overload. For example, some interviewees cited that they temporarily left groups when they felt distracted. As a student mentioned:

> *[During exam days] I would leave study groups because I got distracted by their chats. Students in these groups kept talking and laughing, so I may not have been able to control myself and I would join them to escape from studying. Therefore, I had to temporarily leave these groups and asked the group admin to add me later on [once exams had finished].* – P1

> *[During exam preparation,] we would spend two to four hours in group discussion so when we start the discussion, some students would leave the group and re-join when we end the conversation.* – P10

However, disengaging from or leaving study groups was not without consequences. As WhatsApp could enhance learning through facilitating collaboration and knowledge exchange, students who would disengage from the technology or leave study groups during exam preparation might be at the risk of missing important information. In study groups, students tended to help each other with answering past exam papers. They would share useful materials such as summaries of important topics which could help with exam revision, therefore students who tended to avoid accessing study groups could miss such useful content. For example, a participant (P7) reported that it happened to her that a student shared a summary of important points in the course, but she was not able to get this summary as she had left the group. She said these points were in the exam, but she missed them. Another student expressed her feeling of regret for not checking the study group:

> *I would often wish that I had opened the group and read what students had shared. It happened many times that students pointed out important things, but I missed it because I was not in the group.* – P20

The participant also pointed out the fact that in the study group she felt the sense of closeness and belonging; thus, she would lose this feeling if she left the group. On the other hand, some participants were prepared to take the risk of losing important things for the sake of their mental health, as a student confessed:

> *When I stay away from the app, I feel worried that I could miss important information, but I do what makes me mentally comfortable. Sometimes, the app makes me really nervous. I would ask my friend to text me via SMS and inform me if there were important things shared in the group.* – P5

Permanently leaving WhatsApp groups

The participants reported leaving WhatsApp groups in situations other than those that occurred during exam days. For example, students stated that they would permanently leave WhatsApp groups including friends' groups and unnecessary study groups when they felt annoyed and overloaded by their posts.

> *When trivial topics dominated the group, I would immediately leave the group because I knew I would read the message and a thousand trivial messages would come afterwards. So, I would prefer to leave the group if I noticed the content being shared in the group was trivial and getting more trivial. I would say to the group members, "Sorry, the content is not relevant to me" and would leave.* – P9

Some participants mentioned situations in which other students left or were forced to leave study groups because they were bullied by some group members, or because they got into a fight with others. This issue would negatively influence students, as one participant expressed:

> *There was a lot of news being shared in the group as it was the formal group of the module. Students who left the group or removed by a group admin would lose essential things and might lose some knowledge. – P9*

Using an alternative mobile messaging app

Participants also cited a lack of privacy as a reason for avoiding WhatsApp. For example, an interviewee (P13) indicated that he tended to keep away from WhatsApp as much as he could and use another app. He also mentioned that because most people use WhatsApp, he could not switch totally to other mobile messaging apps. Some students cited using other apps when they wanted to contact their friends. For example, a student (P20) mentioned that to avoid being visible online she contacted her friends via Snapchat, as it does not show a user’s online status. Another participant explained why she preferred to use another app:

> *I prefer to use iMessage because it does not show ‘online status’. It protects user privacy. People would blame me when I open WhatsApp and do not reply. I informed people who are close to me such as family and close friends to contact me via iMessage instead of WhatsApp.* – P17

4.5 Discussion of qualitative findings

The aim of the qualitative study was to explore and identify the main stressors that led to the experience of fatigue. In addition, the study explored how students individually attempted to cope with stressors in order to mitigate fatigue. The following sections discuss the main findings of the qualitative study.

4.5.1 Communication overload

Research has demonstrated that communication overload is a key dimension of technology overload (Karr-Wisniewski & Lu, 2010) and users who experience communication overload could suffer from fatigue (Lee, Son & Kim, 2016; Cao & Sun, 2018). Consistent with prior studies, the findings of this study showed that communication overload was one of key stressors facing students who use WhatsApp. The findings suggest that the increased dependence on the app for daily communication led to the issue of communication overload. As students used WhatsApp for learning and non-learning purposes, they would receive too many messages and notifications from family, friends, students and others. Consequently, they tended to spend significant amounts of time on the app texting and responding to others. The issue of communication overload has been described as conversational overload, when a person receives too many messages to the extent that he/she becomes unable to respond (Jones, Ravid & Rafaeli, 2004). Stephens et al. (2017) suggest that communication overload occurs due to factors including message quality, piling up of messages, having a lot of distractions, feeling obligated to respond to others, and feeling overloaded with information. The findings of this study also showed that the main reasons students suffered from communication overload were receiving too many messages and notifications, especially from group chats; moreover, not only the quantity of incoming messages but also the content of such messages, which contained unnecessary posts or conversations unrelated to the purpose of the group. In addition, the interviews suggest that heavy reliance on WhatsApp could be another factor contributing to this issue. The term 'technology dependence' has been described as the extent to which a user depends on information and communication technology to complete their work (Shu, Tu, & Wang, 2011). Research suggests that an individual with higher reliance on technology is more likely to experience technostress (Shu, Tu, and Wang, 2011; Salo, Pirkkalainen & Koskelainen, 2019). The findings showed that students relied on WhatsApp to a great extent. This overreliance in WhatsApp increased the students' exposure to communication overload.

Another factor giving rise to this issue was feeling pressured to respond. The findings showed that students tended to be responsive and provide help and support other students in study groups. They might tend to do that because being responsive and helping others is encouraged and appreciated in Saudi culture. However, providing so much social support could lead to adverse consequences such as social overload and exhaustion (Maier et al., 2015a). In work contexts, researchers refer to this issue as collaborative overload, when employees exert more effort and energy to support their colleagues (Lansmann & Klein, 2018). Hence, in addition to feeling fatigued by the large amount of communication, students who are always available and responsive might be at the risk of experiencing social or collaborative overload.

4.5.2 Distraction

Distraction was another issue closely related to communication overload and leading to fatigue. Karr-Wisniewski and Lu (2010) indicate that communication overload arises when information technology, such as email, instant messaging and mobile devices, create too many interruptions in employees' work, making them less productive. The findings showed that using WhatsApp while learning was perceived by participants to be a source of distraction. Specifically, message notifications and group chats were found to be interruptive, leading students to frequently check the app and interrupt their learning activities. Prior studies have found that the use of mobile messaging in class during lectures, or outside of class while studying or doing coursework, can create multitasking and off-task switching leading to distraction (Chen & Yan, 2016; May & Elder, 2018). Multitasking is described as the execution of two or more activities at the same time (Wood et al., 2012). In the context of learning, multitasking is defined as having one's attention divided and performing off-task switching (Junco, 2012). Researchers distinguish between two types of multitasking: concurrent multitasking, in which tasks are performed simultaneously (e.g., listening and texting) and sequential multitasking, where switching from one task to another occurs in sequential order (Salvucci, Taatgen & Borst, 2009). Both types of multitasking behaviour were found in the data. Using WhatsApp during lectures to read or respond to messages was a form of concurrent multitasking. In addition, interrupting learning activities to check WhatsApp demonstrated sequential multitasking. The findings indicated that students would constantly check WhatsApp even during lectures or while studying. Similarly, Rosen, Carrier and Cheever (2013) found that students interrupted a learning task every six minutes and switched their attention to distracting tasks, such as texting and using social media. Further they found that students who accessed Facebook many times during studying had lower grades than those who did not access it. Likewise, empirical studies found that checking social media while attending a lecture is associated with lowered academic achievement (Junco, 2012; May & Elder, 2018; Wood et al., 2012). In addition, texting while listening to a lecture has been found to weaken students' ability to retain learned information. For example, Rosen et al. (2011) examined the effect of text-message interruptions during a class lecture on recall memory. They found that students in the high-texting group, who received more than 16 texts in the space of 30 minutes, performed significantly worse on a recall test than those in a no-texting group. Moreover, students who tended to respond quickly to incoming messages performed significantly worse than those who chose to wait five minutes before reading and responding.

The negative effects of using mobile phones or instant messaging while engaging in learning activities are not restricted to in-class learning (May & Elder, 2018). Multitasking outside of class, while doing homework or studying, can also reduce efficiency when performing learning activities and lead to a lower academic performance (Junco & Cotton, 2012). Similarly, the findings of this study indicated that WhatsApp was regarded as distracting not only during class, but also outside class while studying for exams. Although study groups helped students in exam preparation and course revision, participants also perceived the app to be distracting on exam days, affecting their concentration. Studies also found that outside of class, the use of instant messaging while carrying out an academic task, such as reading, can reduce students' ability to focus attention on the academic task in-depth (Levine, Waite & Bowman, 2007). Moreover, it can increase the time required to complete the task (Fox, Rosen & Crawford, 2009).

In summary, while WhatsApp can promote learning, the findings indicated that the use of WhatsApp during class or outside classrooms while studying led to multitasking and created distraction. The above discussion suggests that using WhatsApp while attending to lectures or doing learning tasks can decrease students' information-processing ability due to the division of attention, and thus negatively affects learning.

4.5.3 Information overload in study groups

Research has suggested that online learning environments such as WhatsApp study groups offer many educational benefits for students, such as enhancing collaborative learning, facilitating knowledge exchange and information sharing, and ultimately enhancing academic performance (Gikas & Grant, 2013; Lampe et al., 2011; Pimmer et al., 2019; Tang & Hew, 2017). However, the findings of this study suggest that a drawback of WhatsApp study groups was the problem of information overload. The findings showed that students tended to share information, news and learning materials in WhatsApp study groups. In addition, they used WhatsApp groups to engage in academic discussion and collaborative learning. The app was intensively used by students during exam days for exam preparation and temporary study groups were created for studying and exam-revision purposes. The data revealed that students faced information overload due to the exchange of too much information and too many course materials and conversations in study groups, to the extent that it was difficult sometimes to find relevant information and important posts might be missed. Information overload was an issue particularly during exam days due to high levels of interaction in study groups and students sharing high volumes of study-related content. For many participants, reading all posts and making use of what was being shared while studying for exams was difficult, if not impossible. These findings are consistent with information processing theory indicating that individuals have limited cognitive capacity to process information; when a person is presented with too much information, his/her ability to process and assimilate this information is decreased (Eppler & Mengis, 2004; Sweller, Van Merrienboer & Paas, 1998). The difficulty in finding relevant information, making sense of it and becoming selective might be an indication of the experience of information overload (Eppler & Mengis, 2004).

Prior studies have examined the problem of information overload that face SNS users (e.g. Cao & Sun, 2018; Gao et al., 2018; Yu et al., 2018; Matthes et al., 2020). They have found that the use of SNS including MIM leads to perceived information overload. Moreover, there is an association between information overload and the experience of SNS fatigue. Information overload has been attributed to factors including the large amounts of information on SNS, information equivocality, the excessive use of SNS, and the number of friends (Lee, Son & Kim, 2016; Laumer, Maier & Weinert, 2013; Sasaki, Kawai & Kitamura, 2016; Yu et al., 2018). Studies also investigate the effect of information overload in the context of SNS use on students' academic performance (Whelan, Islam & Brook, 2020a; Yu, Shi & Cao, 2019). However, these studies mainly focus on non-educational uses of social media and do not take into account how the educational use of MIM applications affect students' perception of information overload. In addition, although these studies examine the impact of information overload on SNS users, little attention has been given to the causes of information overload, resulting in a lack of understanding of factors influencing perceived information overload. Studies often explain the phenomenon in terms of the amount of information on social media and tend to ignore other factors that can contribute to this issue. The findings of this study extend existing literature by showing that information overload in terms of WhatsApp use for learning was influenced by many factors, which are categorised into four main areas: information-related, group-related, technology-related and individual-related factors.

Information in terms of quantity and quality. Quantity of information is considered an intrinsic factor that directly influences information overload, whereas quality of information is an extraneous factor indirectly contributing to information overload (Jackson & Farzaneh, 2012; Roetzel, 2019). Consistent with information overload literature (Eppler & Mengis, 2004; Eppler, 2015), the major cause of information overload was the amount of information and number of messages in study groups as discussed previously. In addition to the quantity of information, the results indicated that the quality of message content was a key factor contributing to this issue. Quality of content was identified in terms of relevancy of posts and conversations. Unrelated discussion and chatting were found to hinder students from finding relevant and important messages and resulted in useful content being lost or overlooked. Besides information relevance, participants identified reliability and duplication of information. These findings were consistent with cognitive load theory, which indicates that irrelevant and redundant information can distract learners and impose an unnecessary cognitive load that may interfere with learning (Sweller 2019). Similarly, Chen, Pedersen and Murphy (2011) found that information quantity and information quality in terms of difficult learning materials, redundant information and text ambiguities were factors influencing students' perception of information overload in online learning. In the context of non-educational use, Lee, Son and Kim (2016) found information equivocality to be a predictor of information overload, yet contrary to the findings of the current study, they found no relationship between information relevance and information overload, concluding that the amount of information exchanged in social media can exceed users' information-processing capacity regardless of the relevance of such information to their interest. The findings of this study suggest that irrelevant information can exacerbate the problem of information overload since it imposes additional cognitive load and requires effort to search for useful information (Chen, Pedersen & Murphy 2011; Sweller, 2019).

Group-related factors. Three factors associated with WhatsApp study groups were identified as contributing factors to perceived information overload: number of groups, group size and group rules of participation. Students joined a number of study groups every semester as explained previously in Section 4.4.3. Study groups act like sources of information that disseminate news, ideas and learning materials, etc. With the increased number of information sources, the amount of information received is more likely to increase (Jackson & Farzaneh, 2012). In addition, the data showed that joining multiple study groups was a reason for receiving repetitive, irrelevant, or trivial information. Size of group or number of students joining a study group was another factor perceived by participants to cause information overload. The number of participants in a study group can be large. Large groups are more likely to generate too much information and discussion, especially if group members are active participants (Jones, Ravid & Rafaeli, 2004). In addition, students in a large group can engage in multiple conversations at the same time, which may lead to confusion and difficulty in following the discussion (Hew, Cheung & Ng, 2010). In this study, large groups were perceived by participants to create side conversations and discussions unrelated to the study topic. Likewise, Gritsenko (2016) indicates that the large number of participants engaged in an online discussion at the same time and on the same topic can hinder meaningful group discussion. In addition to number of groups and group size, the results suggested that participation rules in study groups had an influence on perceived information overload. Participation rules guide students' behaviour and define what behaviour is expected of all members in online discussion (Cheung & Hew, 2007). Violation of these rules can lead to consequences, including a member being removed from the group. In terms of study groups, participation rules were explicitly stated by group admins or commonly accepted by students. Participation rules can play a role in managing the level and content of participations in online discussion (Cheung & Hew, 2007). According to interviewees, rules that prevented irrelevant information and unrelated conversations in a group helped manage the flow of information and improved the quality of participation by eliminating unnecessary posts, and thereby reduced information overload. Research has suggested that guidelines for participation provided by discussion facilitators can lead to effective participation in online discussions and reduce overload (Chen, Pedersen & Murphy, 2011; Hew, Cheung & Ng, 2010). Likewise, the findings showed that rules for participation and the presence of teaching members could effectively minimise the amount of content produced in a group and lead to sharing useful and reliable information. Nevertheless, this also has shortcomings, such as it may require time and effort from group admins to manage group conversations. In addition, the availability of teachers in study groups, though it can help manage interactions, may also place additional demands on teachers regarding reading the posts, monitoring the discussion and answering students' questions (Hew, 2015). Furthermore, some participants felt more comfortable being directed by their peers instead of teaching staff. This is similar to a study by Hew, Cheung and Ng (2010), which showed that a majority of students preferred to participate in online discussions directed by their classmates rather than by the teacher.

Technology-related factors. Information overload literature suggests that information technology can play a key role in exacerbating the problem of information overload (Edmunds & Morris, 2000; Eppler & Mengis, 2004; Jackson & Farzaneh, 2012; Roetzel, 2019). In terms of WhatsApp, the app facilitates sharing a vast amount of information to a large number of contacts in a quick and effortless manner. In this regard, WhatsApp works as push technology that distributes information to users (Jackson & Farzaneh, 2012). Push technology can potentially cause information overload because the recipient has little control over the pushed information (Jackson & Farzaneh, 2012). On one hand, pushing information to users can be helpful to keep them updated (Allen & Wilson, 2003; Savolainen, 2007). The findings showed that students perceived WhatsApp as useful for sharing study-related news and information. On the other hand, it also led to unnecessary and useless information being posted in groups. In addition, technology design can contribute to information overload (Eppler & Mengis, 2004). The data showed that participants were not able to organise and save useful messages according to their subject because the app did not have features for such purposes. Thus, due to the fact that conversations and discussions in WhatsApp groups could not be sorted as threads, it was difficult to follow discussions thematically. Students might get confused, especially when other students start side conversations. Similarly, Chen, Pedersen and Murphy (2011) found that a non-linear structure of discussions in computer conferencing can lead to confusion among students and difficulties with participating in the discussion. WhatsApp was also perceived to lack filtering features, such as features for setting priority levels for messages, which could help recognise important messages. Research suggests that cognitive load is affected by the way information is presented to an individual (Sweller, Merriënboer & Paas, 2019; Sweller, 2020). The exposure to disorganised information can increase cognitive load and lead to detrimental effects, including feelings of stress, pressure, anxiety, and mental and emotional fatigue (Bucher, Fieseler & Suphan, 2013; Eppler & Mengis, 2004; Matthes et al., 2020).

Individual-related factors. The literature on the subject indicates that information overload is influenced by personal factors including personal attitude towards the subject, prior knowledge and experiences, personal skills, cognitive style and personal situation (Allen & Wilson, 2003; Jackson & Farzaneh, 2012; Roetzel, 2019; Shrivastav & Hiltz, 2013). These personal factors directly influence the information-processing capacity of the person (Eppler & Mengis, 2004). In line with information overload research, the findings revealed that interviewees had different reactions towards information overload, which might be attributed to personal factors. Even though information overload was a common issue facing students, some of them were able to deal with it and thus they perceived information overload to be less problematic. Personal factors, such as students' attitude towards study groups, might explain why some students were more likely to be exposed to information overload than others. For instance, the data suggested that participants who perceived posts in study groups as helpful for exam revision were able to benefit from learning materials and academic discussion in these study groups, whereas those who felt study groups less useful and more distracting during exam days were more vulnerable to information overload, thus they were inclined to withdraw from study groups during this time. In addition, the results showed that personal skills, such as a time-management skill, helped some students in dealing with the increasing number of messages they received. Likewise, information overload literature suggests that time management can decrease the problem of information overload (Jackson & Farzaneh, 2012).

4.5.4 Invasion of personal life

Mobile-learning literature has shown that WhatsApp enables students to engage in conversations with other students and discuss study-related matter regardless of time and space considerations (Pimmer et al., 2019; Rambe & Bere, 2013). It allows students to interact with others and stay connected outside classrooms (Gachago et al., 2015). However, the results suggest that constant connectivity via WhatsApp led to academic work being extended into private life. This finding is in contrast with So’s (2016) results, which indicated that using WhatsApp to deliver learning materials outside school times was not perceived by students to interfere with their personal lives. The current study, however, agrees with Rambe and Bere’s (2013) study, which found that students perceived the educational use of WhatsApp to lead to the blurring of boundaries between academic and family life, specifically due to receiving learning materials 24/7 via the app. Technostress literature has shown that using information technology at home to perform work-related tasks can cross the boundaries between work and home domains. This invasion of personal life through technology can create stress among ICT users (Bucher, Fieseler & Suphan, 2013; Barber & Santuzzi, 2015; Tarafdar, Tu & Ragu-Nathan, 2007; Maier et al., 2015a; Yao & Cao, 2017). In line with technostress research, the findings indicated that invasion of their personal lives was a reason that students were suffering from fatigue. The use of WhatsApp outside of school time resulted in receiving messages from study groups at times when students might normally not want to work, such as late in the evening or during weekends. Students regularly checked study group messages because they wanted to stay updated and not miss out on something important. Connecting with other students outside of school hours was also necessary for group-based work. The increase in group projects might increase time spent on WhatsApp, leading students to spend less time with their family. Due to constant connectivity with study groups, it was difficult for some of the participants to separate study time and personal time. Studies have found that balancing academic work and personal life is a concern for university students (Butler, 2007; Martinez et al., 2013). Furthermore, work–life balance is a key factor influencing students’ well-being and can lead to consequences, such as stress, anxiety and depression (Hatcher & Hwang, 2020; Sprung & Rogers, 2020; Yusuf, Saitgalina & Chapman, 2020).

Although mobile-learning research has shown that MIM provides a flexible way of learning outside classrooms (Rambe & Bere, 2013; So, 2016; Tang & Hew, 2017), the current study suggests that mobile learning via WhatsApp comes at the cost of the invasion of students' private lives. In the context of non-educational use, studies have found that invasion of people's daily lives created by SNS leads to fatigue from social media (Lee, Lee & Suh, 2016; Maier et al., 2015b; Xiaoa & Mou, 2019). Arguably, individuals using social media for non-academic purposes may reduce their social-media use or even stop them using it any time they feel exhausted by such usage (Maier et al., 2015b; Yao & Cao 2017; Zhang et al., 2016). Yet, in the context of educational use, disconnection from technology might not be applicable for students, as the findings showed that students needed to be always connected, even during personal times, hence using ICT for learning could create more connectivity pressure on students. The findings also suggest that using MIM applications for personal communication as well as for academic use could possibly lead students to feel unable to separate their personal use, such as when they need to relax and chat with friends, from their study-related use.

4.5.5 Invasion of privacy

Advanced ICTs have created a growing concern regarding user privacy (Dhir, et al., 2019; Gao et al., 2018). ICTs enable users' activity and information to be visible to others via posts, comments, status updates and pictures (Treem & Leonardi, 2013). Visibility enables the monitoring of others without their awareness, thereby it can raise concerns regarding user privacy (Fox & Moreland, 2015; Xiao & Mou, 2019). Due to this visibility, users may become concerned that their personal information and their usage activities online can be monitored, tracked and exposed by others (Malik et al., 2020). In terms of WhatsApp, the app enables the presence of an online user to be recognised by other contacts. The app also provides clues on whether the message has been delivered and read by recipients and who has read the message (in WhatsApp groups). The presence awareness capabilities of WhatsApp and the visibility of user activities can enhance the effectiveness of online communications (Treem & Leonardi, 2013). Media richness theory and social presence theory suggest that the effectiveness of online communication is determined by the ability of a medium to provide a sense of the presence of a communication partner as well as its ability to provide immediate feedback (Dennis &

Kinney, 1998). Likewise, the results indicated that the awareness of the availability of the other person on WhatsApp and visibility of users' activity, such as who has received the message and who has read it, were perceived by some of the participants as useful when organising teamwork. Specifically, it enabled group leaders to ensure messages had been received and read by the team.

On the other hand, the findings suggest that creating awareness of the presence of the person and providing information about the read status of a message could interfere with individuals' privacy and lead to unwanted monitoring. In addition, the findings showed that monitoring enabled by WhatsApp was associated with negative emotions including psychological fatigue. Similarly, Fox and Moreland (2015) found that the inability to hide usage activities on Facebook has been found to violate users' privacy and lead to negative emotional experiences with Facebook. Research indicates that individuals perceive their privacy is being invaded when they feel that their ICT use can be easily monitored (Ayyagari, Grover & Purvis, 2011; Xiao & Mou, 2019; Yao & Cao, 2017). Furthermore, individuals with a high level of privacy concern may experience mental fatigue (Dhir et al., 2019; Kato & Kato, 2015; Zhu & Bao, 2018). The results suggest that the presence-awareness feature can led to perceived psychological fatigue in two ways. First, it could potentially increase the accessibility of a person and might expose them to increasing demands for communication. Second, someone's 'online' status on WhatsApp could create expectations regarding the availability of the person and lead to pressure related to giving an immediate response. Gibbs, Rozaidi and Eisenberg (2013) indicate that being visible is not always desirable for individuals as it can create pressure relating to giving an immediate response and lead to increased workload. Similarly, the results suggest that participants felt they had to respond to other messages perhaps because they did not want to be accused of not being responsive. To deal with immediate-response pressure, some of the participants attempted to limit their presence on WhatsApp. Nevertheless, they were not able to fully protect their privacy due to lack of technological features.

4.5.6 Coping with WhatsApp fatigue

The aim of the qualitative study was to investigate students' emotional and behavioural coping responses to stressors associated with WhatsApp. The current study extends coping with technostress research by exploring coping behaviours in an unstudied context, the educational use of WhatsApp. CMUA has determined two coping strategies, disturbance handling and self-preservation, which a person is more likely to engage in when he/she appraises an IT event or stressor as a potential threat to their well-being. The findings provide support for CMUA and indicate that disturbance handling and self-preservation strategies were the main coping strategies used by participants in order to deal with stressors.

Disturbance handling strategy. Coping theory suggests that when an IT user encounters a stressful technology-related event he/she assesses the available coping resources and the level of control he/she has over the situation; when the user feels he/she can control the situation, their coping efforts are more likely to be problem-focused (Bala & Venkatesh, 2016; Beaudry & Pinsonneault, 2005; Folkman & Lazarus, 1988). Consistent with coping literature, the findings show that the disturbance handling strategy was used with the aim to address the issues created by WhatsApp. Participants used this approach when they felt unpleasant situations facing them could be managed. For instance, participants who felt distracted by group messages and notifications tended to mute notifications but not leave study groups because they believed the benefits they would gain from joining study groups would outweigh the drawbacks, such as annoyance and information overload. CMUA suggests that in the disturbance handling strategy, coping efforts are more likely to be directed at oneself, the technology and/or the task (Beaudry & Pinsonneault, 2005). In line with CMUA, the results showed that participants attempted to deal with stressors by modifying the app features or modifying their usage of WhatsApp and managing the time the spent on the app. This coping strategy was used to deal with different types of stressors including distraction, annoyance and pressure created by constant connectivity. The findings also reveal that the disturbance handling strategy was used in two ways: (1) to eliminate the exposure to stressors, such as when participants reported turning off group notifications once they joined a group. Here, the modification of the app features was aimed at preventing exposure to unpleasant situations like distraction; and (2) to reduce negative outcomes resulting from stressors, such as regulating WhatsApp usage after experiencing fatigue.

Self-preservation strategy. The self-preservation strategy was used in situations where nothing could be done to handle stressors. According to CMUA, when IT users perceive they have limited control over a stressful IT event they are more likely to engage in emotion-focused coping, such as distancing, avoidance and withdrawal from IT use (Beaudry & Pinsonneault, 2005). The self-preservation strategy involves an individual’s cognitive efforts to separate themselves from stressful situations, thus it is emotion-focused coping (Folkman & Lazarus, 1988). Unlike the disturbance handling strategy, the self-preservation approach was applied when participants felt unable to manage stressful situations, thereby attempting to reduce fatigue by disengaging from the app, temporarily or permanently leaving WhatsApp groups or using an alternative mobile messaging app. The findings indicated that this approach aimed at minimising the negative outcomes associated with stressors rather than directly addressing them. In many situations, it was perceived as helping the person to recover from fatigue at least for a short time as it did not change the stressful situation. Research into coping with technostress has shown that users attempt to minimise stress created by overwhelming IT-related situations by distancing from IT (Pirkkalainen et al., 2019), reducing IT use (Salo et al., 2017; Yao & Cao, 2017), abandoning IT temporarily or permanently (Chen Tran & Nguyen, 2019; Maier, et al., 2015; Zhang et al., 2016) and avoiding IT usage (Bala & Venkatesh, 2016). Consistent with the technostress literature, this study shows that distancing from WhatsApp was a way for students to mitigate fatigue caused by academic use. Furthermore, the findings extend prior research on technostress by indicating that withdrawing either temporarily or permanently from WhatsApp groups helped students to cope with information and communication overload. Likewise, a study by Savolainen (2007) identifies withdrawal from information sources as a coping strategy to avoid information overload. This strategy suggests that individuals can reduce the amount of information they are exposed to by minimising the number of information sources. Yet, the findings also suggest that leaving study groups could be influenced by fear of missing out on important information.

4.6 Chapter Summary

The qualitative study was conducted to develop a deep understanding of the academic use of WhatsApp and the experience of fatigue associated with it as well as students' coping responses. This chapter reported and discussed the qualitative data that were collected in the first phase of the current study. It explained the process of semi-structured interviews and the procedure followed to analyse the data. Then it presented an in-depth analysis of the qualitative data and discussed the main findings. The findings provide insights into the phenomenon of fatigue and its causes in the context of academic use. Based on the results, five stressors were identified as influencing the experience of fatigue. In addition, two main coping strategies were used to reduce fatigue and stressors. The findings of this phase will be used to develop the conceptual research model and hypotheses. The development and testing of the research model will be discussed in the quantitative phase in Chapter 6.

Chapter 5: Academic use of WhatsApp during the COVID-19 lockdown

5.1 Chapter overview

The spread of coronavirus (COVID-19) has affected education system across the world. In many countries, the delivery of education has been moved online. This chapter attempts to explore how the academic use of WhatsApp by students was affected by the shift to distance learning during the COVID-19 lockdown in March 2020. The current study mainly focuses on mobile learning via WhatsApp during normal circumstances; however, due to the fact that the second phase of the study was conducted during the COVID-19 outbreak, there was a need to understand how the situation influenced WhatsApp use. Specifically, online questionnaires were distributed during the shift to distance learning, thus, it is important to explore how this shift might influence students' responses in the quantitative study. Follow-up interviews were conducted with undergraduate students at IAU in order to understand changes in WhatsApp academic use during the COVID-19 lockdown. This chapter starts with an overview of distance learning during the pandemic and explains how this differs from online learning during normal situations. After that the chapter reports the procedure of data collection and data analysis and then discusses the main findings of follow-up interviews.

5.2 Distance learning during the COVID-19 pandemic

The spread of COVID-19 has seriously impacted different sectors around the world. One sector affected by the outbreak is education. Since the World Health Organization (WHO) declared COVID-19 a pandemic, preventive measures have been imposed by governments in many countries such as lockdowns, quarantines and curfews. Such measures are necessary to maintain social distancing, prevent the spread of the virus and protect people's lives. As a result of applying social distancing, many schools, colleges and universities suspended face-to-face teaching and shifted their delivery to the mode of online learning. This action was taken by many educational institutions in order to continue teaching and learning while protecting the health of their faculties, staff and students at the same time.

Online learning is a form of distance learning that involves the use of different types of information and communication technology to deliver learning and teaching over the Internet (Moore, Dickson-Deane & Galyen, 2011). It is characterised by its flexibility, accessibility, connectivity and its ability to promote lifelong learning (Hiltz & Turoff, 2005). Synchronous online learning allows students to attend live lectures from anywhere, interact with teachers and other students in real-time and receive instant feedback (Singh & Thurman, 2019). On the other hand, asynchronous online learning does not allow immediate interactions between students and teachers: instead, students can access pre-recorded lectures at any time (Singh & Thurman, 2019). Online learning can be an alternative mode of education when traditional face-to-face learning is not possible, such as when natural disasters and crises occur (Tull, Dabner & Ayebi-Arthur, 2017), as in the current situation of the COVID-19 pandemic (Bonk, 2020; Dhawan, 2020). The adoption of online learning in higher education is not a new phenomenon; numerous universities around the world use information technology to offer both synchronous and asynchronous online learning. However, the transition to online learning during the COVID-19 outbreak was sudden, unplanned and without any careful preparation. There are differences between online learning that takes place in normal situations, and the sudden shift to online learning in response to the pandemic, which has been described as emergency remote teaching (Hodges et al., 2020). Many factors make online learning and emergency remote-teaching distinct learning experiences. Understanding these differences can help in understanding the difficulties and challenges that students faced during the shift to remote learning, and how these challenges might influence the experience of fatigue.

First, online learning involves the planning, preparation and design of a teaching and learning experience that fits the online context. Online learning instructors are experts in this mode of teaching. Teaching staff can get training and support with information technology to deliver online teaching. In addition, different IT resources, such as Internet access and computer devices, are available for students and teaching staff on campuses. Students are also prepared to engage in online learning environments and can receive training and support from IT teams. Moreover, module materials and specifications are designed to be compatible with the online-learning model. In contrast to well-planned and designed online-learning experiences, switching to remote learning during the COVID-19 outbreak happened overnight. Teaching staff and students were forced to move online without any preparation or training. Even though many universities and colleges had implemented online learning, it had been used to support traditional teaching methods. The complete shift to online learning was an unprecedented experience. While distance learning can be a solution in the present situation, adapting to the changes in such a short time was a challenging task that required extra effort from both students and faculty members. In addition, the situation was intense and involved extreme anxiety and stress, especially at the beginning of the COVID-19 outbreak. Students had to deal with different sources of stress, such as COVID-19 news and worries associated with protecting themselves and their family from the pandemic. While IT has offered many opportunities for education during emergency and crisis events (Tull, Dabner & Ayebi-Arthur, 2017), it can also be an additional source of stress for students during such difficult times. Hence, follow-up interviews were conducted to understand how the shift to distance learning during the COVID-19 lockdown in March 2020 influenced academic use of WhatsApp and how it potentially affected the experience of fatigue.

5.3 Data collection

The data were collected through semi-structured interviews with five undergraduate students at IAU who also participated in the main interviews. The participants who took part in the qualitative study were contacted and asked if they would like to participate in follow-up interviews. Five participants agreed to be interviewed again. Considering the purpose of the follow-up interviews, which was to obtain additional information about a specific emergent issue concerning the educational use of WhatsApp during distance learning, five participants was considered sufficient to obtain the needed information. Furthermore, it was not possible to interview all students who participated previously, because some of them had graduated before the COVID-19 outbreak. Participants from the previous interviews were chosen again because it was possible in this way to compare their answers about academic use before COVID-19 and during distance learning. The demographic information of the participants was presented in Chapter 4. The interviews were conducted online in April 2020 and lasted between 15 and 40 minutes. The interviews were recorded and transcribed for analysis with the participants' permission. The interviews focused on the transition to distance learning during the lockdown and how such transition influenced the way students at IAU use WhatsApp for academic use.

During the interviews the participants were asked to compare the educational use of WhatsApp pre-COVID-19 with use during the current situation of distance learning.

5.4 Data analysis

The interviews were transcribed and analysed using template analysis (King & Brooks, 2017). The procedure of template analysis was described in Chapter 3. The analysis focused on identifying changes in the academic use of WhatsApp due to the transition into distance learning. Participants were asked to describe WhatsApp use during distance learning and explain how such use differed from academic use before the pandemic. Themes were generated from the data without having pre-identified themes. Specifically, they were identified based on the participants' answers and their descriptions of how WhatsApp was used by undergraduate students and teaching staff during the COVID-19 lockdown and the shift to online learning.

Table 5.1: Themes and subthemes

Theme	Subthemes
1. Increased usage of WhatsApp	1.1 The use of a variety of platforms for online learning including WhatsApp. 1.2 More students joined study groups. 1.3 Constant connectivity to the app. 1.4 Increased group-based work due to adjustments in module requirements.
2. Technology dependence	2.1 WhatsApp became the main source of news and updates. 2.2 Increased reliance on the app led to fatigue.
3. Increased communication	3.1 Teachers joined study groups. 3.2 WhatsApp was used by teachers to communicate directly with students. 3.3 Increased interactions between students in study groups.

5.5 Findings

Three main themes were generated from the data indicating the key changes in WhatsApp use caused by the emergent situation of COVID-19. These themes were the increased usage of WhatsApp, technology dependence and increased communication. The following sections explain these themes in more detail.

5.5.1 Increased usage of WhatsApp

IAU suspended face-to-face teaching when the Saudi government announced a lockdown, and switched its delivery to online learning. As the shift was sudden, there were challenges in delivering online teaching. One of the challenges was the selection of appropriate platforms. The university recommended the use of Blackboard, which was adopted before the COVID-19 outbreak, thus students and faculty members were familiar with it. In addition, Zoom, a video-conferencing technology, was one of the most used platforms at that time. Participants also noticed the increased use of platforms, such as Telegram messenger and other social media platforms.

In addition to these platforms, WhatsApp was the most used texting app by students. WhatsApp was very popular among students before the COVID-19 situation, as discussed in the previous chapter. What was different in this time was that the participants reported greater reliance on the app. Participants described how they used the app during the lockdown:

> *I was all the time on WhatsApp, I would frequently check incoming messages because I did not want to miss anything.* – P10

> *All students I know used WhatsApp a lot to the degree that if I text any student, he/she would immediately answer.* – P1

Two participants also noted that students became more interested in joining study groups during the COVID-19 lockdown, as one mentioned:

> *I noticed that many students who left study groups previously, re-joined the groups since the crisis started.* – P10

Some students might have left study groups because they felt annoyed by their content or felt such groups were not necessary. However, during distance learning, as online communication became very important, they re-joined study groups in order to stay updated. In addition, as some faculty members joined study groups during the lockdown, students might have felt re-joining these groups was important in order to stay connected with their teachers and other students.

Another thing the participants noticed during this time was that students who were inactive members of study groups became active and more engaged in online discussions. A participant described how students including himself become more active in study groups.

> *I was one of the students who rarely would interact in study groups, I always liked to be just a recipient because study groups are mostly for sharing news related to the course, changes in lecture timetables, coursework submission deadlines and so on, so information would be sent to everyone and I would receive it as a recipient, but now this changed. There are interactions between students and teaching staff and interactions between students themselves in study groups. Interactions that usually would take place in classrooms became now in study groups: even students who were silent like me, became active participants.* – P6

The increased adoption of ICT during this time, particularly for distance learning, led students to become constantly connected to this technology compared to life pre-COVID-19. Participants reported spending lots of time on WhatsApp in particular, and on other e-learning platforms in general. One of the participants described the usage of WhatsApp during that time.

> *Chatting on WhatsApp would not stop almost 24 hours. The most active time was in the evening until 2:00 am. After that, students became less active.* – P10

Another participant indicated that even faculty members would respond during the night:

> *Conversations in groups could continue until the night. It was normal that a student would send work at night between 1:00 to 2:00 am. Even some teaching staff became available until late in the night, unlike in the pre-COVID-19 time, they would rarely respond in the night.* – P2

Distance learning is characterised by its flexibility as students can learn in their own time. Before the COVID situation, students used to attend classes at specific times. However, as learning became flexible and was not restricted by class times, students were able to attend lectures at different times, as in the case of pre-recorded lectures. In addition, they were able to communicate with faculty members and join conversations with other students via WhatsApp anytime during the day. Furthermore, working with a group did not require students to meet during school hours; instead, they could meet online whenever it was convenient for group members. As a result, participants noted that they were connected to ICT almost all of the time, as a participant explained.

> *I noticed that during the lockdown I was 24 hours in my room connecting to my laptop and other platforms while previously, once I returned home, I forgot everything about work unless I had exams or assignments I had to do.* – P7

The increased use of WhatsApp was also attributed to group projects and coursework that increased as a result of changes in module requirements. In response to COVID-19, adjustments were made to module requirements. This action was taken in order to help students complete learning effectively and achieve learning outcomes. As the situation required flexibility, assessment and exam formats were modified. For example, exams moved online. In some modules final exams were cancelled and replaced with alternative assessments, such as group projects, quizzes and coursework. A participant explained how the adjustment was done in most schools.

> *The decision from the university was to reallocate final exam marks to alternative assessments that academic staff chose. I had three modules and all final exams were cancelled. In two modules, final exams were replaced with coursework and two quizzes. In the other module, it was replaced with a group project. Group-based work was a little bit hard because in-person meetings were not possible.* – P6

Adjustments to module assessments had implications on the way students used WhatsApp during this time. Due to final-exam cancellations, more group-based projects were required from students to replace exams. As a result, students needed to create WhatsApp groups and spend more time on the app coordinating and organising group work. With the inability to meet face to face, managing group work online and communicating with group members were challenging tasks, as a group leader described:

> *Not all of them (group members) reply at the same time and some of them reply two days later, so the work becomes late. Sometimes, one person waits long time for the other person to send her the work. I might need to contact both persons individually because they do not enter the group chat. There are some problems in group work because not all members respect the time.* – P2

As final exams were replaced with two alternative requirements or more, students experienced too much academic work in a short period of time, as participants noted:

> *Within three weeks we had to complete the requirements of each module. There were lots of coursework and quizzes.* – P10

> *There was too much work. In one day, I submitted two or three items of coursework. In total, I did more than 20 items of coursework in a week. I also had lots of group work more than what I would have in normal school days.* – P2

For many students, WhatsApp was the main channel through which they received updates on assignments and group-based work. In short, the modification of module assessment and requirements contributed to the increased use of WhatsApp through the increase of coursework and group projects and the creation of more temporary study groups.

5.5.2 Technology dependence

Too much reliance on ICT was one notable practice during the shift to distance learning. Platforms such as WhatsApp, Zoom, and Blackboard were very important and without such platforms students would not have been able to continue online learning. The participants reported increased reliance on WhatsApp during the COVID-19 lockdown, to the extent that they would not be able to continue learning without it.

> *WhatsApp became very important. Without it I would not be able to continue my study online. Even teaching staff contacted us directly via WhatsApp. Any announcement or update regarding a new assignment or project were shared on WhatsApp.* – P7

> *WhatsApp became irreplaceable. In short, we could not do anything without it.* – P10

> *There was more reliance on WhatsApp. Official announcements, which were previously posted on Blackboard, were shared on WhatsApp. Because teaching staff joined study groups the communication became faster via WhatsApp.* – P2

Participants mentioned that because of some technical problems with the Blackboard mobile app, some students were not able to receive messages on the platform, so students who received Blackboard announcements tended to share them with other students on WhatsApp, thus WhatsApp was the main source of information for most students.

The increased reliance on technology can have many consequences. Research has found a connection between technology dependence and technostress (Shu Tu & Wang, 2011). Similarly, the interviews suggest that great reliance on technology exposed students to technostress. For example, one of the participants who was highly dependent on WhatsApp for study-related communications and tasks reported suffering from fatigue.

> *I told you previously (in the first interview) that I turned off all group notifications but during the lockdown, I had to turn them on because without notifications I could miss important things. For example, a quiz can be scheduled tomorrow if I do not check WhatsApp, I would not know that and I would miss the quiz. WhatsApp was very important. Checking WhatsApp was the first thing that I did once I opened my eyes in the morning. WhatsApp was more important than Blackboard to the degree that I feel we could attend lectures on WhatsApp. When I submitted the last project, automatically I disabled all notifications because WhatsApp was very exhausting.* – P10

Participants reported feeling exhausted by receiving too many messages as a result of extensive use of WhatsApp during the lockdown.

> *During the lockdown, WhatsApp was tiring. The number of messages in study groups was too much. Usually, a study group is formal and for a specific course, so I had to read all messages in order to not miss important things.* – P6

> *There were lots of messages. It is true that most of the group conversations were relevant but sometimes students go off the subject and talked about irrelevant topics so I could find three groups with 500 unread messages in each group. It was very hard to know what was important in these conversations.* – P10

Technology dependence also can lead to anxiety and worry if something goes wrong when using IT or when technical problems occur. One of the participants who was not able to use his university email due to technical issues was also not able to access Blackboard as the platform was linked to university emails. He mentioned that not all faculty members allowed students to contact them via WhatsApp, therefore he was worried and faced a difficult time trying to find a way to contact faculty members.

5.5.3 Increased communication

During lockdowns, online communications became more important than ever. As face-to-face meetings were not possible, online communications were the only way faculty members could communicate with students. In these uncertain times, online communications were crucial to provide students with COVID-19-related updates and information, such as changes in module requirements or assessment methods, as well as safety information. Maintaining communications could help students cope with stress and anxiety in such difficult times. Students experienced too much anxiety, especially at the beginning of the COVID-19 outbreak and due to the sudden shift to distance learning, as a participant explained:

> *At the beginning of the COVID-19 crisis, although we were familiar with working online on assignment or group projects, however, the transition to online learning happened suddenly without planning, therefore we were in a state of panic and that was clear through our conversations on WhatsApp. The reason for the panic was because the school did not respond quickly to the situation. We spent the first three weeks of the lockdown waiting for news and updates from the school. All exams and*

> *assignments were cancelled until unknown dates. Blackboard did not work effectively. When teaching staff posted announcements on Blackboard, we did not get notifications, therefore there were difficulties in communication with teaching staff. After three weeks of waiting, the school sent us updates on rescheduled exams and coursework deadlines. There were too many updates and new requirements, which we had to do all within three weeks. Every hour there was an update on a new assignment or quiz, even in the middle of the night, there were updates.* – P2

Communication between students and teaching staff was usually via Blackboard and university email. However, some faculty members, who probably preferred to be close to their students during these difficult times, joined WhatsApp groups. Students mentioned that before the COVID-19 situation, communication with faculty members was either face-to-face at the university or online via Blackboard and over email, and most faculty members did not use WhatsApp to contact students. However, during the lockdown, there was a need for a more flexible and fast way to connect with students, thus WhatsApp became the official communication channel for many teaching staff.

> *Before the COVID-19 pandemic, as I mentioned in the previous interview, most study groups were created by students so it was mostly student-to-student communication, however, after in-person teaching had been suspended, each faculty member was keen to create a study group or assign a leader to create and admin a study group so that any student who had technical problems and was not able to contact the faculty members could get the information he needed on WhatsApp such as lecture times, exam dates and coursework submission deadlines.* – P6

The participants viewed direct communication with teaching staff via WhatsApp as a positive thing that allowed them to get quick responses from their teachers. In addition, it helped students feel connected with their teachers and with other students. It also helped to reduce anxiety associated with these challenging times. On the other hand, the lack of communication or difficulties in reaching teaching staff was one reason for student anxiety, as mentioned by two participants. Most notably, students perceived that the availability of teaching staff in study groups helped prevent the spread of misinformation and rumours as well as eliminating irrelevant chatting.

> *In my opinion, when a faculty member joins a study group that would be helpful. I think it would save time and effort. For example, if I have a question, it would be easier to ask in WhatsApp groups, instead of signing in to Blackboard, searching for a particular course and then posting my question on the forum. Thinking of all that could make me lazy to ask. Moreover, if a student has a question and asks in a student-only group, someone may give him incorrect information or answer based on his opinion without knowledge while if a faculty member was in the group, then students would get more accurate information.* – P6

> *Honestly, I prefer teaching staff joining WhatsApp groups because I would be confident that I would get the right and accurate information. Moreover, students became more serious and respectful whereas previously, there was too much irrelevant chatting, which sometimes led to important information getting missed.* – P2

Not all faculty members deemed communication with students via WhatsApp as convenient; some of them contacted students by WhatsApp indirectly through assistants or group leaders, and others preferred the traditional methods of communication, via university email or Blackboard. A participant indicated that quick responses from faculty members were important for students regardless of the communication channels they used.

> *I think it is helpful for us as students to communicate with faculty members directly through WhatsApp, but it also can overload them and there are other ways for communication that could reduce the overload, for example, in our school we do not contact a faculty member directly by WhatsApp, but we can contact their assistant who helps us in study groups if we have questions or need advice. I do not feel like I need to contact faculty members via WhatsApp, there were alternatives, such as emails, actually they respond quickly to our emails.* – P1

Another notable thing during the lockdown was the increased interaction between students in study groups. Probably, interactions through texting increased as a way to compensate for the lack of face-to-face interactions.

> *The interactions in study groups increased, especially in the day before exams or submission dates, students ask lots of questions. Previously, in the lecture before the*

> *exam, students who had questions asked the lecturer in the class, but now such questions are asked on WhatsApp groups.* – P7

> *Previously, there was not too much talk in study groups, sometimes students would ask questions about simple things. Study groups could be inactive until the end of the semester before exams, but now the use of study groups became intense to the extent that students would send their work to the teacher via WhatsApp groups.* – P2

Another participant described the conversations between students on exam and submission days:

> *Conversations on WhatsApp increased too much, particularly during days before submission deadlines. Questions about projects, assignments and quizzes increased more than before. In the three weeks before the last submission, chatting on WhatsApp would not stop. Even students who would not previously talk in groups joined the conversations.* – P10

In summary, follow-up interviews were conducted with the aim to collect additional information that can explain how the transition to distance learning during the pandemic affected the educational use of WhatsApp and contributed to the experience of fatigue. The results showed that the shift to online learning resulted in an increase in WhatsApp use: with the lack of face-to-face communication, there was great reliance on WhatsApp for online communication. Moreover, the modification of module assessments and replacement of paper exams with coursework and group work contributed to this increased use of WhatsApp for academic purposes. The results also highlighted the importance of online communication during the lockdown. WhatsApp helped students to stay updated and connected with other students as well as with teachers. The findings suggest that the use of WhatsApp during the lockdown could have implications on the experience of fatigue. The increased usage of the app for academic purposes was a source of stress for students. Although WhatsApp could help students to overcome the lack of face-to-face communication, the increased reliance on the app could also expose them to information and communication overload. On the other hand, the results suggest that direct communication via WhatsApp with teachers was useful during that time and helped to mitigate anxiety and stress.

5.6 Chapter summary

This chapter reported the results of follow-up interviews that were conducted during the spread of COVID-19 in 2020. The purpose of this chapter was to highlight the main changes in the educational use of WhatsApp during the transition to distance learning. The interviews were carried out with five undergraduate students who also participated in the main interviews. The findings of the follow-up interviews will be discussed in Chapter 7. The next chapter will explain the development of the research conceptual model and hypotheses. In addition, the process of developing and pilot testing the study instrument will be described.

Chapter 6: Development of the conceptual model and the study instrument

6.1 Chapter overview

The quantitative study aims to examine factors that were identified in the qualitative phase as stressors that lead to fatigue, and to examine the effects of fatigue on coping behaviours and students' perceived performance. This chapter focuses on the quantitative phase of the study. It starts with the development of the conceptual model and the study hypotheses and explains the relationships between different constructs used in this study. The chapter then discusses the development of the survey instrument, which is an online questionnaire. It explains the questionnaire design and the process of developing scales to measure the study constructs and provides the operational definitions of the constructs. Prior to conducting the main study, the questionnaire was pilot-tested in order to evaluate the reliability and validity of the measurement items. The pilot tests and the results of the reliability and validity assessments are discussed in this chapter.

6.2 Research model and hypotheses development

Drawing on the transactional model of stress (Cooper, Dewe & O'Driscoll, 2001; Lazarus & Folkman, 1984) and the theoretical background that explains technostress, as discussed in Section 2.6, this study develops a research model that explains factors creating fatigue in the context of the educational use of WhatsApp. The research model consists of the following: *stressors*: communication overload, distraction, information overload, invasion of personal life and invasion of privacy; *fatigue*: a form of psychological strain; *coping responses*: disturbance handling and self-preservation strategies and *outcome:* the consequence of fatigue on perceived performance. In brief, the research model explains that five stressors associated with the educational use of WhatsApp can create psychological fatigue among students. Fatigue leads to two coping behaviours. The experience of fatigue as well as coping responses can have effects on perceived academic performance (see Figure 6.1). The following sections describe the conceptual model and develop the hypotheses for this study.

6.2.1 Techno-stressors associated with fatigue

6.2.1.1 Communication overload

The findings of the qualitative study showed that students using WhatsApp for learning suffered from communication overload. Likewise, prior studies have found communication overload to be a factor that causes fatigue among social media users (Cao & Sun, 2018; Lee, Son & Kim, 2016; Lin et al., 2020; Yu et al., 2018). In the context of academic use, the present study proposes that students who experience communication overload will be more likely to suffer from WhatsApp fatigue. Thus, the following hypothesis is proposed:

H1: Communication overload is positively associated with fatigue.

6.2.1.2 Distraction

The qualitative study showed that WhatsApp led to interruptions in learning activities, particularly via message notifications and group chat messages. WhatsApp could potentially create distraction in three ways. First, visual and auditory notifications may distract students' attention while in class or during studying (Wood et al., 2012). Second, the need to be constantly connected with others and not to miss out on important things may lead to constant checking of the app, which in turn might weaken students' focus and negatively affect academic performance (Amez & Baert, 2020). Third, students tend to multitask, which may be due to boredom and lack of academic motivation and texting via WhatsApp provides a way to escape (Rosen, Carrier & Cheever, 2013). Empirical research has demonstrated that multitasking can have negative impacts on learning and academic performance due to the division of attention and the rapid switching from one task to another (Junco, 2012; May & Elder, 2018; Wood et al., 2012). According to threaded cognition theory (Salvucci, Taatgen & Borst, 2009), the human mind has limited resources for information processing. A particular resource can only be used by a single task at a time. When two tasks need the same resource, only one task can be processed, and the other task has to wait. The resource needs to switch between tasks, which leads to a decrease in performance in at least one of the tasks (Borst, Taatgen & Van Rijn, 2010). Attempting to perform more than one task simultaneously overloads the person's information-processing capacity (Mayer & Moreno, 2003). In terms of WhatsApp, checking messages, or texting and attending to a class lecture at the same time, can reduce the information-processing capacity of learners and result in cognitive overload. This is because both tasks (texting and listening) use the same information-processing channel (auditory/verbal) (Mayer & Moreno, 2003). Hence, this study argues that students who are constantly interrupted by WhatsApp messages and notifications while in class or while studying outside of class may experience difficulties when concentrating on learning tasks (Hsiao, Shu & Huang, 2017), and are more likely to experience fatigue. Thus, the second hypothesis is framed as:

H2: Distraction is positively associated with fatigue.

6.2.1.3 Information overload

The findings of the qualitative study showed that WhatsApp study groups created an information-overload problem for students. The results revealed that students faced this issue due to a number of factors including the amount and relevance of the content, the number of groups students joined, the number of active participants in a group and other personal factors. Prior studies have shown that information overload can have negative effects on individuals including anxiety, pressure, confusion, cognitive strain and decreased performance (Cao & Sun, 2018; Eppler & Mengis, 2004; Lee, Son & Kim, 2016; Matthes et al., 2020). Given the detrimental effects of information overload, this study argus that constant exposure to an increasing amount of information, conversations and chatting in WhatsApp groups can exceed the information-processing ability of students and consequently lead to fatigue. Therefore, the third hypothesis is as follows:

H3. Information overload is positively related to fatigue.

6.2.1.4 Invasion of personal life

Technostress research suggests that technology invasion occurs when individuals feel that work-related usage of ICT interferes with their personal lives and blurs the boundaries between work and private domains (Ayyagari, Grover & Purvis, 2011; Bucher, Fieseler & Suphan, 2013; Tarafdar et al., 2011). The qualitative findings indicated that the use of WhatsApp for educational purposes can lead to the invasion of students' personal lives. Research has shown that a perceived invasion of one's life by technology can lead to psychological strain (Lee, Lee & Suh, 2016; Maier et al., 2015a; Xiao & Mou, 2019). This study proposes that students who feel the educational use of WhatsApp invades their personal life are more likely to feel fatigued. Therefore, the following hypothesis is proposed:

H4. *Invasion of personal life is positively related to fatigue.*

6.2.1.5 Invasion of privacy

The perceived lack of privacy was identified as a factor contributing to the experience of fatigue. WhatsApp, through its presence-awareness features, could potentially enable monitoring and create expectations for availability and immediate response. Ayyagari, Grover and Purvis (2011) argue that the invasion of privacy creates psychological strain due to the misfit between what a person wants (i.e. protecting his/her privacy) and what the environment offers (e.g. enabling monitoring). Technostress research has shown that social media users experience fatigue when they feel that they are under social surveillance (Bright, Kleiser & Grau, 2015; Xiao & Mou, 2019). Not only this, but invasion of privacy can lead to negative emotions such as disappointment, weariness, anger and fatigue (Ravindran, Kuan & Lian, 2014). Thus, this study proposes that students who perceive that WhatsApp invades their privacy by enabling others to monitor their usage will be more likely to feel fatigued. Therefore, the following hypothesis is proposed:

H5. *Invasion of privacy is positively related to fatigue.*

6.2.2 Fatigue and perceived performance

Mobile-learning literature has demonstrated that the educational use of WhatsApp can help students to improve their academic performance and achieve learning outcomes (Pimmer et al., 2019; So, 2016). Likewise, the qualitative study indicated that WhatsApp was perceived to be useful for online learning. However, the increased dependency on the app for various learning-related activities might also lead to adverse outcomes (Shu, Tu, & Wang, 2011; Salo, Pirkkalainen & Koskelainen, 2019). The concept of technology overload suggests that there is an inverted U-shaped relationship between ICT usage and productivity (Karr-Wisniewski & Lu, 2010). The increased usage of ICT does not always enhance people performance; instead, it may sometimes be counterproductive (Chen & Wei, 2019; Maier, Laumer & Eckhardt, 2015). Studies have found an association between techno-stressors and employees' reduced performance and productivity at work (Lee, Lee & Suh, 2016; Tarafdar, Tu & Ragu-Nathan, 2010). Perceived performance, in the current study, refers to the extent to which students perceive that WhatsApp helps them to improve their academic performance and effectively accomplish study-related tasks (Wang, Tan & Li, 2020). In terms of academic use, stressors associated with WhatsApp may lead to reduced performance. For example, communication overload can negatively affect students' ability to effectively complete learning activities (Aharony & Zion, 2019) because it often causes distractions and leads to multitasking, as students need to constantly switch their attention between learning activities and checking WhatsApp messages (Hsiao, Shu & Huang, 2017). In addition, the increasing amount of information and learning materials in study groups may inhibit students from effectively understanding and making use of these materials. Fatigue created by WhatsApp usage could thus weaken the mental resources required for students to perform their academic work, thus reducing their performance (Wang, Tan & Li, 2020). Therefore, the present study argues that students who feel fatigued will be more likely to perceive WhatsApp as negatively affecting their performance. The following hypothesis is proposed:

H6. *Fatigue is negatively related to perceived performance.*

6.2.3 Fatigue and coping behaviours

Coping theory suggests that individuals cope with a stressful situation by managing the situation or reducing negative outcomes associated with it (Cooper, Dewe & O'Driscoll, 2001).

Literature on coping with technostress has shown that the perception of techno-stressors and the experience of emotional exhaustion can lead to coping responses (Bala & Venkatesh, 2016; Salo et al., 2017). The CMUA indicates that users engage in problem-focused and emotion-focused coping in order to deal with a threatening IT situation or demand (Elie-Dit-Cosaque & Straub, 2011). In terms of WhatsApp, the current study suggests that two coping strategies are likely to be used in order to deal with fatigue. Students who feel fatigued may use a disturbance handling strategy in order to directly manage the disturbance situation created by the app. This strategy includes modifying the app's features and muting notifications. Students may also engage in a self-preservation strategy as a way to reduce the negative feelings associated with WhatsApp. In this strategy, students distance themselves from the situation by disengaging from the app and/or leaving WhatsApp groups. Therefore, the following hypotheses are proposed:

H7. Fatigue is positively associated with a disturbance handling strategy.
H8. Fatigue is positively associated with a self-preservation strategy.

6.2.4 Coping and perceived performance

Technostress research has demonstrated that techno-stressors can lead to different outcomes for individuals including decreased performance (Cao et al., 2018; Tarafdar, Tu & Ragu-Nathan, 2010), reduced life satisfaction (Lee, Lee & Suh, 2016), job dissatisfaction (Califf et al., 2020) and health problems (Salo, Pirkkalainen, & Koskelainen, 2019). According to stress and coping theory, coping behaviours can influence the relationship between stressors and outcomes (Cooper, Dewe & O'Driscoll, 2001). For example, Pirkkalainen et al. (2017) found that distress venting lowers the relationship between techno-stressors and strain. Furthermore, they found that emotional coping responses in terms of distress venting and distancing from IT directly increase emotional exhaustion. Beaudry and Pinsonneault (2010) indicate that seeking social support increases IT use while distancing decreases it. Chen, Tran and Nguyen (2019) found that disturbance handling strategies reduce users' intention to discontinue using a mobile shopping app, whereas self-preservation strategies encourage discontinuous usage intentions. Consistent with prior studies on coping with technostress, this study suggests that coping strategies can have effects on perceived performance. According to the CMAU, in a disturbance handling strategy, an individual attempts to minimise the negative consequences associated with stressors and tries to find ways to improve the situation and benefit from it (Elie-Dit-Cosaque & Straub, 2011). Hence, in the context of WhatsApp, a disturbance handling strategy may help students to reduce stressors while at the same time benefit from its academic use. Thus, this study proposes that students who use this strategy when facing stressors are more likely to perceive WhatsApp as useful and enhancing their learning. On the other hand, since self-preservation is an emotion-focused adaptation used to regulate negative feelings associated with disturbance situations, it does not improve the situation (Elie-Dit-Cosaque & Straub, 2011). Therefore, using this strategy may have a negative influence on perceived performance. For instance, in this strategy students tend to distance themselves from the use of WhatsApp and/or leave study groups. It is reasonable thus to assume that students who use a self-preservation strategy are more likely to feel that WhatsApp has a negative influence or no influence on their academic performance. Accordingly, the following hypotheses are framed:

H9. Disturbance handling strategy is positively associated with perceived performance.
H10. Self-preservation strategy is negatively associated with perceived performance.

6.2.5 Control variables

Seven control variables that may have an influence on the perception of fatigue were included in the research model: negative affectivity, non-academic usage, gender, daily usage time, number of study groups, number of non-study groups, and academic year.

Negative affectivity is a mood-dispositional factor that refers to an individual's tendency to experience low self-esteem and negative mood states, such as feelings of nervousness, tension and worry (Watson & Clark, 1984). Past research has indicated that individuals with greater negative affectivity are more likely to experience psychological stress and other negative outcomes such as dissatisfaction with their lives (Ayyagari, Grover & Purvis, 2011; Moore, 2000). Researchers have suggested controlling for negative affectivity when examining the relationship between stressors and strain using self-report data (Cooper, Dewe & O'Driscoll, 2001), thus this factor was controlled for this in our study.

Non-academic usage refers to the extent to which students use WhatsApp for non-learning purposes. Students might experience fatigue when using WhatsApp for reasons not associated with academic usage. The qualitative study did not focus on non-educational use, thus its potential effect on fatigue is unknown. Studies have found that individuals who heavily use social media to communicate with friends and who provide too much social support experience a higher level of fatigue (Maier et al., 2015b; Luqman et al., 2017). Therefore, non-academic usage was included as a control variable in this study.

Academic usage reflects the extent to which students use the platform to perform academic-related activities. This type of usage may have an influence on perceived performance, as students who use the app frequently for academic purposes may also perceive it as enhancing academic performance, therefore, it was added to the model as a control variable.

With regards to the effects of demographic variables, research on technostress has shown that gender, the extent of usage and education level can all have effects on technostress (Ayyagari, Grover & Purvis, 2011; Ragu-Nathan et al., 2008). Ravindran, Kuan and Lian (2014) suggest that the influence of gender on the experience of social media fatigue needs more investigation. Thus, gender, daily usage time and academic year were included in the model as control variables. In addition, as the qualitative findings suggest that the number of WhatsApp groups can contribute to information overload, the number of study groups and non-study groups were added to the model in order to examine their potential influence on fatigue.

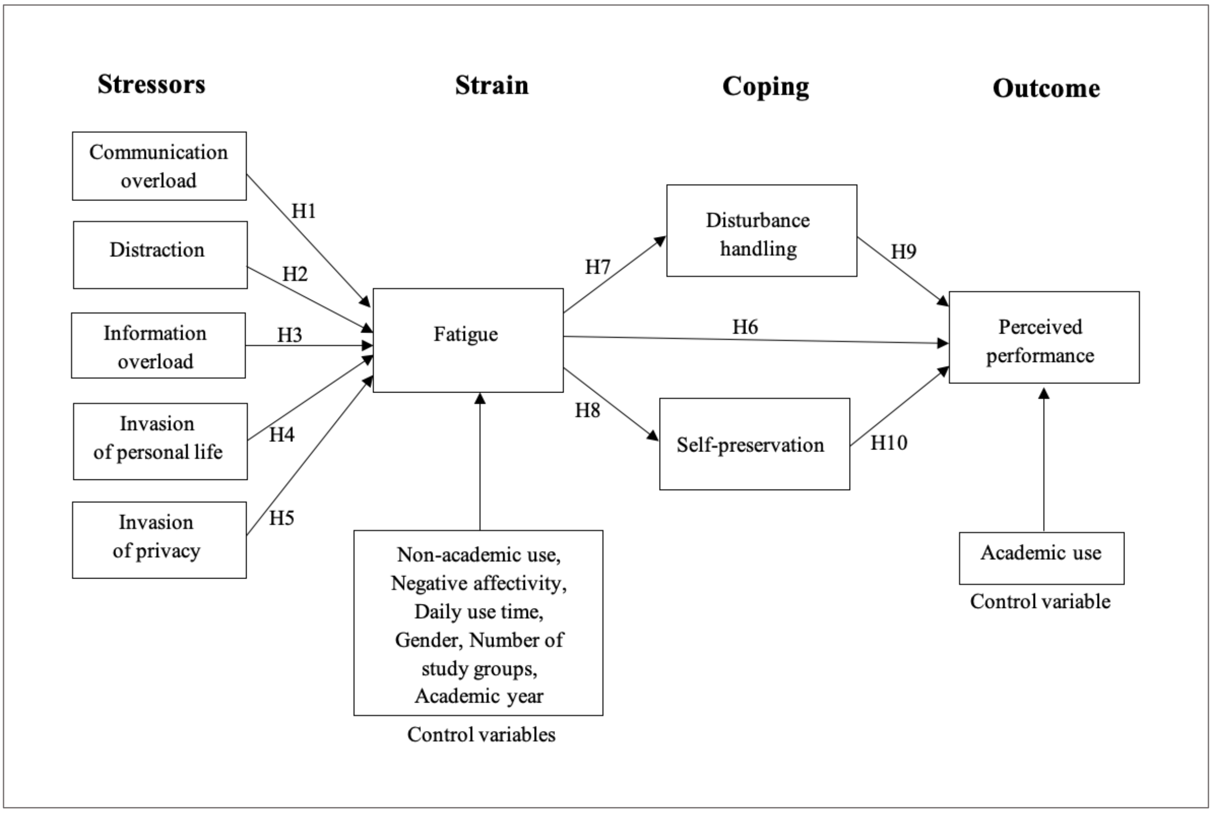

Figure 6.1: The conceptual research model

6.3 Questionnaire design

Designing a questionnaire is a key stage in the research design process because it is the tool through which the research data are collected. In the quantitative phase of this study, an online questionnaire was the key tool for communication with participants. The questionnaire design thus was critical to obtain accurate results (Bryman, 2012). A questionnaire design can have implications for response rates and the reliability and validity of the data (Saunders, Lewis & Thornhill, 2016). As self-completed questionnaires often do not require the presence of the researcher it may not be possible for participants to ask for clarification when they need it. In addition, the researcher also may not be able to get back to the participants due to anonymity of respondents (Saunders, Lewis & Thornhill, 2016). Given the significance of the questionnaire design, time and effort were given to this stage to ensure that the survey was well-designed and did not have any issues with regards to question wording, format or language. The questionnaire was developed to capture data that would be used later to test hypotheses and validate the conceptual research model. Questions, therefore, were developed to measure key concepts in the conceptual model. All questions in the questionnaires were formulated as closed-ended questions with fixed answers, as these types of questions are often used in quantitative research to measure constructs. The process of developing measures is explained in detail in the next section. The questionnaire was divided into four main parts. The first part contained questions about the academic and non-academic use of WhatsApp. Respondents were asked to identify how often they used WhatsApp for specific academic and non-academic activities. The second part included questions about the experience of fatigue and factors creating fatigue during a current semester. In the third part, respondents were asked to determine their coping responses when they encountered unpleasant situations using WhatsApp. In both the second and third parts, respondents were provided with a list of statements (measures) and asked to determine to what extent they agreed or disagreed with the statements. The final part included questions about demographic information (age, gender, academic level, current academic year and school) and general questions related to WhatsApp use, such as number of WhatsApp study groups, and daily time spent on the app (see Appendix C). The questionnaire was developed in English and then translated into Arabic, which was the language of the targeted respondents. The questionnaire was pre-tested with a group of students in order to evaluate its design and questions as well as to assess the accuracy of the translation. Moreover, a pilot test was conducted to examine the reliability and validity of measures before conducting the final survey. The final version of the questionnaire was designed and distributed using SmartSurvey, a UK-based survey platform. This survey tool provides a range of user-friendly features that help in designing an online survey in different languages including Arabic. It enables researchers to view responses and analyse the collected data in real-time.

6.4 Development of measures

Measurement items of the constructs used in this study were developed using procedures recommended by Devellis (2017) for scale development. The process of developing measures included six steps as shown in Figure 6.2. First, the constructs used in this study were clearly defined using existing theory and research. This was an essential step to provide a valid conceptual basis (Worthington & Whittaker, 2006). The operational definitions of the study constructs are explained in the next section. Once the constructs were clearly defined, items that capture the domain of the constructs under examination were developed (Worthington & Whittaker, 2006). In this step, existing measures were reviewed before constructing a scale (Churchill, 1979; Devellis, 2017). Wherever possible, items were derived from prior studies.

This step was necessary to ensure the content validity of the measures as will be explained later in the validity assessment (Section 6.7.2). Nearly all constructs in the research model were measured using existing measures except items for non-academic use, which were developed for this study. The wording of items used in this study was adjusted to suit the WhatsApp and mobile-learning context. The items were translated into Arabic in order to be understood by the targeted respondents. A Likert-scale format was used to measure the items, which is commonly used in survey research to measure opinions, beliefs and attitudes (Devellis, 2017). All items were measured on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree', except academic use and non-academic use items, which were measured on a five-point frequency scale ranging from 'never' to 'always'. Commonly used rating scales include either five or seven response categories (Bryman, 2012; Preston & Colman, 2000). A five-point scale is considered less confusing and readily comprehensible to respondents (Devlin et al., 1993). It was used in order to reduce respondent frustration and to increase response rate. Moreover, a five-point scale has been frequently used in technostress and SNS fatigue studies (e.g. Gao et al., 2018; Pirkkalainen et al., 2019; Tarafdar et al., 2007; Yao & Cao, 2017; Yu et al., 2018), thus it was possible to compare the reliability coefficients of items used in the current study against similar items used in these studies. The developed items were reviewed to assess item quality in terms of clarity, conciseness, grammar and face validity. Items along with construct operational definitions were given to researchers in the IS field, namely the researcher's supervisors and two research students in order to check the measures and assess whether they reflect the operational definitions of the constructs. Furthermore, the translated items were assessed by five research students who speak both English and Arabic fluently. Items were evaluated in terms of the accuracy of the translation, the wording, vocabulary and sentence structure. Accordingly, items were modified and revised. Pilot tests were conducted to assess the reliability and validity of the measurement items as well as to evaluate the survey design in general (Section 6.7). In the final step, the performance of the items was evaluated through performing a number of tests including exploratory factor analysis (Section 6.7.2.1).

1. Specifying the domain of the construct
2. Generating an item pool
3. Determining the format for measurement
4. Reviewing items by experts
5. Pilot testing the items on some subjects
6. Evaluating the items

Figure 6.2: Scale development steps (Devellis, 2017)

6.5 Operationalisation of constructs

The research model includes nine main constructs (information overload, communication overload, distraction, invasion of personal life, invasion of privacy, fatigue, disturbance handling, self-preservation and perceived performance) and three constructs as control variables (academic use, non-academic use and negative effectivity) (see Figure 6.1). The study constructs were measured by more than one items. This section explains the operational definitions of the study constructs and items that were used to capture the constructs. A list of all items used with their corresponding codes is displayed in Table 6.1.

6.5.1 Techno-stressors

Information overload

Information overload in this study is described as a situation experienced by a student in which the amount of information and messages exchanged in study groups exceeds his/her information-processing capacity, making them unable to find relevant information. The construct was measured by four items that assess the extent to which a student feels overwhelmed by the amount of information and interactions in study groups. The items were adapted from Zhang et al. (2016) and Luqman et al. (2017). Originally, these items have been used to measure information overload in the context of social media, therefore modifications were made to the items to fit the context of WhatsApp study groups.

Communication overload

Communication overload refers to a status created by receiving too many messages and notifications through WhatsApp, which exceeds a student's ability to deal with them and results in students spending lots of time on the app. The construct was measured by a scale adapted from Cao and Sun (2018) and Lee, Lee and Suh (2016), which measures the extent to which a student receives too many messages, notifications, and announcements via WhatsApp and wastes their time on the app as a result.

Distraction

Distraction was measured by three items adapted from Hsiao, Shu and Huang (2017) and Ou and Davison (2011) and modified to fit the academic use context. The items measure the degree to which a student feels that receiving WhatsApp notifications and messages in class and while studying outside of class distracts their attention and prevents them from concentrating on learning tasks.

Invasion of personal life

Technology invasion is defined as an individual's perception that constant connectivity enabled by ICT leads to invasion of personal life and the blurring of boundaries between work and home (Tarafdar et al., 2011). In this study, invasion of personal life was operationalised as the degree to which a student perceives that due to the use of WhatsApp for learning purposes they must always be connected with study groups, and must sacrifice their weekend time to stay updated on study-related news and work. The construct was measured by a scale originally developed by Tarafdar et al. (2007). The scale was slightly adjusted to fit the educational-use context.

Invasion of privacy

Invasion of privacy was operationalised as a student's perception that their privacy is invaded because their usage activity on WhatsApp, such as 'online status', the last time the person used the app and read-receipt information, can be monitored by others. A scale consisting of three items and adopted from Ayyagari, Grover and Purvis (2011) was used to measure this construct.

6.5.2 Psychological strain

Fatigue

SNS fatigue is described as an SNS-user experience of feelings such as tiredness, annoyance, anger, disappointment, and loss of interest because of SNS-related activities (Ravindran, Kuan & Lian, 2014). Drawing on this definition, fatigue associated with WhatsApp refers to the extent to which a student feels tired, bored, drained and worn out due to WhatsApp use. Drawing on Ravindran, Kuan and Lian’s (2014) conceptualisation of fatigue, Zhang et al. (2016) developed a scale to capture SNS fatigue. This scale of four items was adapted for this study to measure WhatsApp-induced fatigue.

6.5.3 Coping response

Disturbance handling

Disturbance handling reflects the extent to which a student would perform certain actions including disabling notifications and adjusting the privacy settings of the app when encountering unpleasant situations caused by WhatsApp. To measure this construct, four items were adapted from Chen, Tran and Nguyen (2019) and slightly modified to fit the context of the current study.

Self-preservation

The self-preservation scale captures a student’s cognitive efforts to deal with fatigue or unpleasant situations induced by WhatsApp. It measures the degree to which a respondent would use a self-preservation strategy, which includes distancing from the app, turning to other activities to distract themselves, and avoiding study groups. The scale was adapted from Pirkkalainen et al. (2019) and adjusted to the WhatsApp-use context. Moreover, two items (SP4 and SP5) were developed for this study, which measure a student’s tendency to avoid study groups and group messages.

6.5.4 Perceived academic performance

In prior studies, academic performance has been measured in different ways. Studies have used the actual Grade Point Average (GPA) of students (e.g., Junco, 2012), other studies have measured the reported GPA by respondents (e.g. Uzun & Kilis, 2019). On the other hand, subjective measures have also been used to capture perceived academic performance (e.g. Miloševic et al., 2015). In this study, perceived academic performance was used instead of actual academic performance because the current study examines students' perception of the usefulness of WhatsApp in learning. This construct is based on the concept of perceived usefulness in the technology acceptance model (TAM), which refers to the extent to which a user believes that the use of a particular IT system would enhance their job performance (Davis, 1989). The perceived academic performance scale contains three items adapted from Davis (1989) and Miloševic et al. (2015). The scale measures the extent to which a student perceives that using WhatsApp would improve their academic performance, enhance the effectiveness of their learning and enable them to accomplish study tasks more quickly.

6.5.5 Control variables

Academic use

Academic use of WhatsApp was measured by five items adapted from Qi (2019) and slightly adjusted. The scale measures how often a respondent uses the app to perform academic-related activities and tasks, such as accessing and sharing study-related information and announcements, engaging in academic discussion and organising group projects.

Non-academic use

Non-academic use refers to the use of WhatsApp for purposes not related to learning. A scale of four items was developed in this study based on the interviews. The scale measures how often the respondent uses WhatsApp for non-academic purposes, such as chatting with friends and family, and sharing non-study content.

Negative affectivity

Negative affectivity is a personality trait that reflects the tendency of an individual to experience negative emotions, such as worry and nervousness. The construct was measured by four items adopted without modification from Agho, Price and Mueller (1992).

Table 6.1: Item wordings and codes

Construct	Item code	Item wording
Communication overload	CO1	I receive too many messages (chat, private messages), notifications and announcements through WhatsApp.
	CO2	I generally send too many messages and posts through WhatsApp.
	CO3	I waste a lot of my time responding to WhatsApp messages.
	CO4	I end up spending more time on WhatsApp than planned.
Information overload	IO1	I am often distracted by the excessive amount of information shared in study groups.
	IO2	It is difficult for me to focus on the essential information in study groups.
	IO3	The amount of messages in study groups makes me overlook important information.
	IO4	Because of too much information/chatting/discussion in study groups, I find it difficult to read all messages and posts.
Distraction	DS1	WhatsApp notifications often distract me while studying.
	DS2	I feel WhatsApp during lectures distracts my attention.
	DS3	I feel using WhatsApp while studying inhibits my concentration on study work.
Invasion of personal life	IPL1	Because of the use of WhatsApp for study-related purposes, I have to be in touch with my study-related work even during the weekend.
	IPL2	I have to sacrifice my vacation and weekend time to keep current with study-related work.
	IPL3	I feel I have to be always connected with study groups.
	IPL4	I spend less time with my family due to academic use of WhatsApp.
Invasion of privacy	IP1	I feel uncomfortable that my use of WhatsApp can be easily monitored.
	IP2	I feel my privacy can be compromised because information about my use of WhatsApp ('online status', 'last seen') can be accessed by others.
	IP3	I feel my privacy on WhatsApp can be invaded because my reading activities can be monitored.
Fatigue	FT1	Sometimes, I feel tired when using WhatsApp.
	FT2	Sometimes, I feel bored when using WhatsApp.
	FT3	Sometimes, I feel drained from using WhatsApp.
	FT4	Sometimes, I feel worn out from using WhatsApp.

Disturbance handling	HD1	I would change notification settings to decide which groups I want to turn notifications off for.
	HD2	I would I disable unnecessary WhatsApp notifications.
	HD3	I would adjust the privacy settings of the app.
	HD4	I keep the app up to date to provide more control over the notifications.
Self-preservation	SP1	I try to keep away from the app.
	SP2	I separate myself as much as possible from WhatsApp.
	SP3	I turn to other activities to take my mind off WhatsApp.
	SP4	I avoid entering some WhatsApp groups.
	SP5	I try to ignore some groups' messages.
Perceived performance	PP1	Using WhatsApp would improve my academic performance.
	PP2	Using WhatsApp would enhance my effectiveness in learning.
	PP3	Using WhatsApp enables me to accomplish study tasks more quickly.
Academic use	AU1	Accessing study-related information, announcements and materials.
	AU2	Sharing study-related information, announcements and materials.
	AU3	Discussing study-related matters with other students.
	AU4	Collaborating on course projects with other students.
	AU5	Exam preparation.
Non-academic use	NAU1	Reading and sending direct messages.
	NAU2	Sending messages containing videos, photos, information or broadcasts.
	NAU3	Chatting in WhatsApp groups.
	NAU4	Reading group messages.
Negative affectivity	NA1	I often find myself worrying about something.
	NA2	I suffer from nervousness.
	NA3	My mood often goes up and down.
	NA4	I often lose sleep over my worries.

6.6 Pre-testing

Before administrating the final questionnaire, a pre-test was conducted. The aim of the pre-test was to detect and amend potential issues with regards to the questionnaire's design and structure, and to ensure that the translated items were clear and understandable. The questionnaire was tested with eight participants who were students in Saudi Arabia and used

WhatsApp for learning. Those participants were not part of the final sample. The questionnaire was sent to the participants to assess its overall design and structure. In addition, the participants were requested to read each question in the questionnaire, identify whether it was clear or not, and provide their suggestions for modification. This method helped to identify any confusion and ambiguity in the questions and modify them according to participants' suggestions. Overall, there was no issue with the questionnaire design and small adjustments to wording were made.

6.7 Pilot study

In the next step, a pilot study was performed to assess the reliability and validity of the measurement items. A convenience sampling method, which is commonly employed in pilot testing, and snowball sampling were used to select participants. The questionnaire was administrated among university students who were similar to the targeted respondents. Participants were recruited via Twitter and WhatsApp during January 2019. An invitation to the pilot questionnaire was sent to academic staff in different universities in Saudi Arabia, who voluntarily forwarded the questionnaire to students in their classes. Students were informed that their participation was voluntary and assured of the confidentiality of their information. In total, 505 students accessed the pilot survey. Of these, 240 completed the survey. After examining the data, 10 responses were removed because they were completed by students who did not use WhatsApp for learning. After removing disqualified responses, the final sample of the pilot study contained 230 valid responses. The participants were students from 11 universities and three colleges in Saudi Arabia and who used WhatsApp for learning purposes. The sample included 77.8% female and 22.2% male respondents. The majority were undergraduate students (65.7%) aged between 18 and 25 (93%). The participants had joined at least one study group and on average had joined between one and five study groups (62.2%), and many of them had joined between 6 and 10 study groups (29%). In addition, 21.7% of them spent between one to two hours a day on the app. The characteristics of the sample is presented in Appendix D. With regards to the sample size, the number of participants in a pilot test is identified based on the research objectives and questions and the size of the research project; it has been suggested that for small surveys, the number can be as small as 10 participants, whereas for large surveys between 100 and 200 participants are considered sufficient (Saunders, Lewis & Thornhill, 2012). For reliability assessment, Yurdugül (2008) suggests that the minimum sample size for Cronbach's coefficient alpha depends on the largest eigenvalue obtained from principal component analysis of the sample dataset. A sample size of 30 is considered sufficient when the largest eigenvalue is higher than 6.00. The results of principal component analysis showed that the largest eigenvalue was 7.20 (see Table 6.4). In addition, for exploratory factor analysis, a sample size of greater than 150 is recommended when 10 or more factor loadings are greater than .40 (Field, 2013). The results in Table 6.5 also show that most of the factor loadings are above .40, thus, based on these recommendations a sample size of 230 was sufficient to conduct the reliability and validity tests for the pilot study. The completed responses were downloaded from the survey tool (SmartSurvey) for analysis. The data were coded to be analysed. The reliability and construct validity (Sections 6.7.2.1, 6.7.2.2) were examined using SPSS software version 26. The results of the reliability and validity tests are discussed below.

6.7.1 Reliability assessment

The reliability test is one of the most important indicators of the quality of measurement items (Devellis, 2017). It evaluates whether a set of items produces consistent results across different contexts (Field, 2013). Reliability was assessed using Cronbach's alpha, the most common measure of internal consistency (Field, 2013). Cronbach's alpha measures the correlation between a set of items on the same scale (Hair et al., 2017a). The recommended values for Cronbach's alpha are normally between 0.7 and 0.8. However, Devellis (2017) indicates that a value between 0.65 and 0.70 is acceptable. Researchers also indicate that alpha values near of 0.6 can be accepted (Hair et al., 2014a; Van Griethuijsen et al., 2014) especially, in the early stages of research (Field, 2013). Alpha values must not be below 0.60 (Ursachi, Horodnic & Zait, 2015). The results of the reliability test showed that the majority of the constructs had alpha values above the recommended cut-off point of 0.7 (see Table 6.2) except four constructs – communication overload, invasion of personal life, distraction and disturbance handling – which all had values below 0.7. As a rule of thumb, when Cronbach's alpha is less than 0.7, removing an item should be considered only if it would increase the reliability of the scale (Field, 2013). For invasion of personal life, SPSS outputs suggested that removing one item (IPL4) would increase the reliability score from 0.657 to 0.740, thus to improve the reliability of the scale, IPL4 was deleted. However, for the other constructs (communication overload, distraction and disturbance handling) the results suggested that deleting an item would not improve the alpha values of these scales, therefore, no item was removed. Although alpha values of the constructs were below 0.7, they were still within the acceptable range between 0.6 and 0.7 (Field, 2013; Hair et al., 2014a, Van Griethuijsen et al., 2014), therefore, the scales were retained.

Table 6.2: Construct reliability

Construct	Items	Mean	Standard deviation	Cronbach's alpha
Communication overload	CO1	3.97	1.032	0.648
	CO2	3.31	1.195	
	CO3	3.23	1.155	
	CO4	2.99	1.224	
Information overload	IO1	3.75	1.107	0.752
	IO2	3.64	1.084	
	IO3	4.04	1.996	
	IO4	4.12	1.019	
Invasion of personal life	IPL1	3.56	1.142	0.740
	IPL2	3.49	1.105	
	IPL3	3.69	1.100	
	IPL4	2.78	1.253	Removed
Invasion of privacy	IP1	3.42	1.233	0.757
	IP2	3.09	1.256	
	IP3	3.11	1.213	
Distraction	DS1	3.59	1.187	0.672
	DS2	3.84	1.110	
	DS3	3.27	1.174	
Fatigue	FT1	3.13	1.181	0.842
	FT2	3.58	1.118	
	FT3	3.10	1.155	
	FT4	3.37	1.144	
Disturbance handling	DH1	4.23	1.060	0.685
	DH2	4.36	0.965	
	DH3	3.90	1.105	
	DH4	3.68	1.185	
Self-preservation	DST1	3.34	1.163	0.715
	DST2	3.43	1.118	
	DST3	3.51	1.177	
	DST4	4.02	1.045	
	DST5	3.65	1.309	

Perceived performance	PP1	3.65	1.024	0.747
	PP2	3.72	0.936	
	PP3	3.77	0.991	
Academic use	AU1	4.60	0.737	0.783
	AU2	4.29	0.994	
	AU3	4.58	0.803	
	AU4	4.44	0.904	
	AU5	4.13	1.016	
Non-academic use	NAU1	4.21	0.977	0.745
	NAU2	2.85	1.351	
	NAU3	3.79	1.146	
	NAU4	3.83	1.152	
Negative affectivity	NA1	3.67	1.126	0.745
	NA2	3.56	1.187	
	NA3	3.74	1.194	
	NA4	3.43	1.285	

6.7.2 Validity assessment

Validity refers to the ability of an instrument to measure what it is intended to measure (Field, 2013). There are different types of validity. *Face validity* is defined as the extent to which the content of the measure reflects the construct of interest (Hair et al., 2014a). Face validity is a subjective assessment and can be established by using expert judgement (Field, 2013). As discussed earlier in Section 6.4, the measurement items were reviewed by academic staff in the IS field as well as PhD students in business and management. Specifically, people who reviewed the measures were given the definition of each measure and asked to evaluate whether the measure being used appeared to reflect the concept being measured.

Content validity is another form of validity which refers to the degree to which the measure sufficiently covers all aspects of the construct being measured (Field, 2013). Similar to face validity, content validity can be assessed by seeking expert opinions on whether the scale is an appropriate indicator of the construct. Moreover, content validity can be established by searching the literature and using existing measures. In this study, as mentioned previously in Section 6.4, content validity was ensured by the review of existing literature and by adopting measures from prior studies.

6.7.2.1 Exploratory factor analysis

Construct validity was assessed by performing exploratory factor analysis (EFA), which is a statistical method commonly used during scale development to analyse relationships among a relatively large number of variables (Field, 2013). EFA is used to reduce a large set of variables into a small number of factors based on correlations between variables (Field, 2013). EFA determines whether measures of the same construct are highly correlated with each other and have low correlations with measures of other constructs. This technique helps the researcher to identify underlying factors (constructs) for a set of measured variables (items). Prior to performing EFA, sampling adequacy was tested to determine whether the data collected is appropriate for conducting EFA. The Kiser-Meyer-Olkin (KMO) measure is normally used to test sampling adequacy. KMO represents the ratio of the squared correlation between variables to the squared partial correlation between variables (Field, 2013). The KMO statistic can take values between 0 and 1. A value close to 1 indicates that the sample size is suitable for conducting EFA. The minimum acceptable value of KMO should be greater than 0.5 (Field, 2013). Another test used to identify the suitability of the data for factor analysis is Bartlett's test, which determines whether the correlation between variables is significantly different from zero. Bartlett's measure should be significant in order to run factor analysis. The result showed that for the KMO statistic, the value was 0.75, which is well above the minimum value of 0.5, and Bartlett's test was significant ($p < .001$) (see Table 6.3). Thus, both KMO and Bartlett's measures suggest that the sample size was adequate for EFA.

Table 6.3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.753
Bartlett's Test of Sphericity	Approx. Chi-Square	3271.636
	df	741
	Sig.	.000

6.7.2.2 Principal component analysis

There are different types of techniques for clustering variables. One of the most widely used techniques is principal component analysis (PCA). PCA is used to reduce the number of variables in the dataset while retaining as much of the original information as possible (Field, 2013). In the pilot study, PCA was used to assess factor loadings and to detect potential cross-loading issues. The factor loading of an item refers to the variance explained by the item on a particular factor (i.e. construct). It shows the correlation between the item and the factor. Cross-loading means that the item loads on two or more factors. Factor loadings should be above 0.4 and all items should have high loadings on their intended factors and low loadings on the other factors (Field, 2013).

PCA was conducted on the 46 items with orthogonal rotation (varimax). The purpose of the rotation is to reduce the complexity of the component matrix and to facilitate interpretation (Hair et al., 2014a). An initial analysis was run to obtain eigenvalues of each factor in the data. Kaiser's criterion suggests that if an eigenvalue of a factor is greater than 1, then the factor is retained (Field, 2013). Accordingly, 12 factors were extracted, which had eigenvalues over Kaiser's criterion of 1, and together the factors explained 64.8% of the total variance. The first factor had the largest eigenvalue of 7.209 and explained 16.38% of the variance (see Table 6.4). The results showed that there was no cross-loading issues, which means that all items loaded highly on their expected factor (see Table 6.5). In addition, all factor loadings were above the cut-off value of .40 (Field, 2013), therefore construct validity was established.

Table 6.4: Total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulat-ive %	Total	% of Variance	Cumulat ive %	Total	% of Variance	Cumulat-ive %
1	7.209	16.383	16.383	7.209	16.383	16.383	2.997	6.811	6.811
2	4.239	9.635	26.018	4.239	9.635	26.018	2.663	6.051	12.862
3	2.736	6.217	32.236	2.736	6.217	32.236	2.609	5.929	18.791
4	2.172	4.937	37.172	2.172	4.937	37.172	2.598	5.904	24.695
5	2.027	4.608	41.780	2.027	4.608	41.780	2.585	5.876	30.571
6	1.972	4.482	46.262	1.972	4.482	46.262	2.451	5.570	36.142
7	1.774	4.032	50.294	1.774	4.032	50.294	2.379	5.406	41.548
8	1.507	3.425	53.719	1.507	3.425	53.719	2.340	5.317	46.865
9	1.337	3.039	56.758	1.337	3.039	56.758	2.248	5.110	51.975
10	1.291	2.934	59.691	1.291	2.934	59.691	2.120	4.818	56.793
11	1.193	2.712	62.403	1.193	2.712	62.403	2.056	4.672	61.465
12	1.094	2.485	64.888	1.094	2.485	64.888	1.506	3.424	64.888

Extraction Method: Principal Component Analysis

Table 6.5: Item factor loadings and cross-loadings

	CO	IO	IPL	IP	DS	FT	DH	SP	PP	AU	NAU	NA
CO1	**0.486**	.381	.034	.216	-.023	-.002	.053	-.046	.216	-.058	.500	.109
CO2	**0.724**	.009	.317	.088	.582	.004	-.048	.118	.088	.088	.452	.070
CO3	**0.770**	.298	.350	.150	.519	.380	-.082	.111	.150	.159	.179	-.004
CO4	**0.750**	.108	.287	.080	672.	.292	.092	-.113	.080	.088	.108	.070
IO1	-.077	**.656**	.125	.014	.105	.241	.163	.041	.071	.016	.115	.184
IO2	-.011	**.775**	-.108	.038	.071	.177	.092	.102	.118	.014	.035	.131
IO3	-.041	**.774**	.068	.084	.191	.159	.050	.082	-.002	-.002	-.083	.123
IO4	.198	**.688**	.069	.046	.181	.025	.121	.028	-.064	.082	.038	.074
IPL1	.131	.104	**.801**	.099	.207	.082	-.007	.062	.112	.006	.053	-.100
IPL2	.098	.023	**.804**	.009	-.031	.001	.117	.002	.125	.133	-.011	.154
IPL3	-.095	.009	**.688**	.042	.244	-.176	.000	-.044	.243	.076	.171	.036
IP1	-.076	.044	.141	**.732**	.114	.215	.036	-.006	.027	-.109	.079	.189
IP2	.059	-.017	.083	**.833**	.161	.176	-.017	-.026	.071	.070	.066	.085
IP3	.025	.149	-.051	**.740**	-.039	.116	.063	.108	.045	.088	.124	.168
DS1	.553	.167	.128	.003	**.627**	.093	-.102	-.071	.030	-.078	.131	.219
DS2	.201	.314	.044	.068	**.832**	.045	.206	.014	.021	.020	.037	.067
DS3	.156	.349	.008	.129	**.837**	.137	.073	.081	-.251	.077	.010	.023
FT1	.135	.117	.046	.052	.178	**.837**	-.020	.131	-.103	.020	.111	.082
FT2	-.053	.262	-.165	.201	040	**.657**	.201	.175	-.058	.058	-.117	.047
FT3	.050	.124	.014	.134	.079	**.853**	-.055	.166	.005	.066	.071	.099
FT4	.061	.199	-.030	.270	.184	**.671**	.142	.110	-.214	.021	-.161	.098
DH1	.035	.204	.091	.030	.112	.052	**.775**	.093	.052	.034	-.013	.105
DH2	-.068	.169	.000	.027	-.044	.070	**.791**	.134	.019	-.068	.057	.130
DH3	-.577	.029	.302	.342	-.270	-.017	**.700**	.137	-.079	.044	.029	-.033
DH4	-.005	.100	-.083	.098	-.005	.251	**.613**	.325	.032	.026	-.016	.007
SP1	-.022	.621	.011	-.051	-.042	.242	.079	**.769**	-.079	-.023	-.087	.223
SP2	-.061	.761	-.040	.021	.158	.082	.090	**.823**	-.075	.001	-.102	.090
SP3	.049	.667	.129	.077	.015	.067	-.049	**.741**	-.028	-.018	-.009	-.045
SP4	-.097	.131	.193	.039	.044	.155	-.154	**.588**	-.193	.044	-.023	-.009
SP5	-.260	.104	.240	.104	.048	.036	-.253	**.497**	-.049	.048	.010	.174
PP1	.105	.064	.077	.165	.005	-.123	.098	.049	**.814**	.209	-.032	.010
PP2	.015	-.056	.197	.010	-.015	-.046	.003	-.147	**.821**	-.032	.062	.042
PP3	-.177	.118	.269	-.026	-.131	-.118	-.021	.065	**.610**	.199	.020	.140
AU1	.218	-.012	.034	.077	.039	-.060	.068	-.032	.311	**.661**	.060	-.023
AU2	.012	-.015	.028	.047	.120	.079	-.135	.105	.053	**.757**	.194	.061
AU3	-.328	-.037	.134	-.119	.186	.230	-.076	-.145	.080	**.633**	.072	.187
AU4	.042	.187	.048	.041	-.203	-.052	.090	-.017	-.053	**.799**	.088	-.024
AU5	-.027	-.044	.175	-.017	.001	-.047	-.005	-.005	.363	**.651**	.092	.146
NAU1	.224	.066	.033	.123	.179	-.051	.041	-.132	-.261	.144	**.697**	.030
NAU2	-.136	-.016	.094	.002	.001	.176	-.142	.049	.101	.131	**.727**	.035
NAU3	.006	.018	.140	.025	.025	-.043	.038	-.075	.013	.086	**.799**	.054
NAU4	.068	.026	-.071	.112	.094	-.082	.086	-.056	.151	.051	**.717**	-.129
NA1	.009	.083	.040	.096	.161	.241	.019	.097	.084	.040	.176	**.671**
NA2	.100	.107	-.024	.070	-.110	.118	.082	.041	.116	.103	-.047	**.795**
NA3	-.103	.136	.118	.074	.058	-.037	.137	.048	-.090	.038	-.108	**.733**
NA4	.107	.234	-.054	.308	.149	.013	.001	.093	.073	-.014	-.004	**.638**

6.8 Chapter summary

This chapter focused on the quantitative phase of the current study. It presented the process of developing the conceptual model and forming the study hypotheses. In addition, the relationships between different variables were explained. The chapter also reported the development of measures and the procedures for testing and validating the measurement items. The results of Cronbach's alpha and principal component analysis confirmed the reliability and validity of the measurements. The next chapter will report the distribution of the main questionnaire and the number of responses, then it will present in detail the procedure followed in data analysis. In addition, the results of the quantitative phase and the discussion of the results will be provided.

Chapter 7: Quantitative data analysis and results

7.1 Chapter overview

This chapter presents the process of collecting and analysing the quantitative data and discusses the main findings of the study. It starts with the distribution of the final questionnaire, the number of responses and discusses the assessment of non-response bias. The data collected via the final questionnaire were used to examine the proposed research model and test the relationships between the study variables. The proposed model was tested using PLS-SEM, in which a two-step process was followed to assess the measurement model and the structural model. This chapter provides an in-depth analysis of the collected data including data examination and cleansing, measurement model assessment, structural model assessment, collinearity assessment, common method bias and multigroup analysis. A descriptive analysis of the respondents' demographics is also provided. The chapter concludes with a discussion of the quantitative results.

7.2 Distribution of the final questionnaire

The main study was conducted after the pilot study. An invitation to the final survey together with information about the study were sent to students via email. This step was done with the help of the public relations and media office at IAU. In addition, reminders were sent via email, WhatsApp and the university's Twitter account to remind respondents to complete the questionnaire and to encourage non-respondents to take part. The survey was restricted to allow only one response per person so that each respondent could complete the survey only once. The data collection procedure took place between March and April 2020, during the COVID-19 lockdown and the transition to remote learning.

7.3 Number of responses

In total, 1328 completed responses were obtained. However, 135 responses were excluded from the analysis as they were completed by disqualified respondents. Specifically, they were graduated students (49 responses), postgraduate students (74 responses) and students at other universities (12 responses). After disqualified responses were omitted, 1193 completed responses were kept for further analysis.

7.4 Completion rate

The completion rate is the number of respondents who completed the survey divided by the total number of people who viewed the survey. The survey tool (SmartSurvey) provided a summary of all partial responses in addition to completed responses. In total, 2640 individuals accessed the survey. Of these, 1328 completed the survey. The completion rate is thus computed as follows: 1328 / 2640 = 0.503.

The completion rate shows that about 50% of responses were completed. The high number of partial responses might be due to the timing of the survey distribution, as it was close to the end of the semester when students had lots of study work and exams, therefore they might have been busy with exam preparation and unable to complete the survey. Overall, the result indicates a good completion rate.

7.5 Non-response bias

Non-response is a source of non-sampling error that occurs when some members of the sample refuse to participate in the study or answer a question, or cannot be contacted (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). Most sample surveys include a certain amount of non-response (Bryman, 2012; Saunders, Lewis & Thornhill, 2016). Non-response becomes an issue when it leads to bias in the findings, making them not generalisable (Tourangeau et al., 2013). A high response rate can reduce the risk of non-response bias, yet a low response rate does not necessarily lead to bias in the sample (Dillman, 1991; Saunders, Lewis & Thornhill, 2016). Particularly, when the respondents' characteristics resemble those of the whole population, non-response bias may not be a concern (Dillman, 1991; Tourangeau et al., 2013). However, the distribution of the population characteristics is usually unknown, which makes it difficult to compare respondents with non-respondents (Dillman, 1991). The bias occurs when people who answered the survey differ substantially from those who did not (Tourangeau et al., 2013). Non-response can exist on different levels such as complete non-response and partial response (Saunders, Lewis & Thornhill, 2016). Complete non-response happens when none of the questions are answered. This type of non-response may occur because people refused to cooperate or due to the inability to contact respondents. To minimise the issue of non-response, efforts were made during data collection to ensure that the survey reached a large number of targeted respondents. Different distribution channels were used to send the survey. Moreover, follow-up reminders were sent three weeks later to remind respondents to complete the survey and to encourage non-respondents to participate.

7.5.1 Assessment of non-response bias

There are many ways to address the problem of non-response. Among these are conducting follow-up surveys and short interviews with non-respondents to investigate their reasons for non-response (Lynn, 1996). However, due to the anonymity of respondents, it was not possible to identify non-respondents among students who received the survey and then contact them. Other methods suggest comparing respondents to the sample or comparing respondents to non-respondents (Miller & Smith 1983; Oppenheim, 1992). In addition, researchers suggest the use of the weighting adjustment method for demographic variables (Lynn, 1996). However, these methods assume that the characteristics of the sample are known, which was not the case in this study. The weighting adjustment method also assumes that respondents and non-respondents who have similar demographic characteristics are also equal on the variables of interest (Lynn, 1996).

A common method used in social science research to assess non-response bias is the comparison between early and late respondents (Armstrong & Overtons, 1977; Miller & Smith, 1983). The underlying assumption of this method is that late respondents (who replied to the survey later and probably would have not replied if they had not received a reminder), are assumed to be similar to non-respondents (Armstrong & Overtons, 1977). Given the fact that the characteristics of non-respondents were unknown in this study, late respondents were compared to early respondents to check for non-response bias. The first 300 responses were defined as being completed by early respondents, which represent students who answered the questionnaire once it was published. The last 300 respondents were students who replied later when they received another invitation to the survey. The two groups were compared on key variables that might lead to bias if the discrepancy between early and late respondents was significant. These variables are gender, the amount of time spent on the app on a daily basis, number of study groups and number of non-study groups. A t-test was used to compare the mean scores for the two groups. The results of the t-test (see Table 7.1) show that there were no significant differences between the two groups on daily time spent on the app and the number of groups. However, a significant difference between the groups was found on gender ($p < 0.05$), which indicates that gender response bias may pose a concern in this study. To address this issue, the difference between female and male respondents was tested, as will be explained later in Section 7.12.

Table 7.1: Characteristics of early and late respondents

Respondents' characteristics	**Independent samples t-test**	
	t	**Sig.**
Time spent on the app	0.606	0.545
Number of study groups	0.838	0.403
Number of non-study groups	0.437	0.662
Gender	-2.824	0.005

7.6 Data examination and cleaning

Data examination was a necessary and initial step performed before conducting data analysis (Hair et al., 2014a). This step involved evaluating the effect of missing data, identifying outliers and examining the normality of the data (Hair et al., 2014a). Examining the characteristics of the data helps to ensure that the data meet all the requirements for the data analysis technique (Hair et al., 2014a). The following sections explain the process of data examination performed in this study.

7.6.1 Missing data

Missing data refers to cases in which values on one or more variables are not available for analysis (Hair et al., 2014a). It occurs in a questionnaire when one or more questions are either intentionally or accidentally left blank (Hair et al., 2017a). Hair et al. (2017a) suggest that when an observation includes more than 15% of missing data it should be removed from the dataset. As mentioned in Section 7.4, out of 2640 responses, there were 1312 partial responses that had over 50% of unanswered questions. These partial responses were excluded from the analysis as recommended by Hair et al. (2017a). In addition, 135 responses were removed because they were completed by disqualified respondents (see Section 7.3). Accordingly, the dataset included 1193 completed responses that had no missing values.

7.6.2 Suspicious response pattern

Prior to conducting data analysis, a response pattern was examined (Hair et al., 2017a). Specifically, the data were checked to uncover any pattern or straight-lining in the responses. Hair et al. (2017a) indicate that a response that shows the same answer for almost all questions should be omitted. Consequently, five responses were discarded because they included extreme answers for all questions, which indicated that these responses were not reliable and could not be included in the final analysis. After deleting these responses, 1188 valid responses were retained for data analysis.

7.6.3 Outliers

Outliers are observations with high or low values making them distinctly different from other observations (Hair et al., 2014a). In questionnaires, outliers are responses that include extreme answers on a question or several questions (Hair et al., 2017a). The detection of outliers involves examining the distribution of each variable and detecting cases that fall outside the overall pattern of distribution (Hair et al., 2014a). Outliers can be detected using graphs such as histograms and boxplots, however when outliers are not extreme, graphs may not be the accurate method to spot them (Field, 2013). In this case, z-scores can be used to detect outliers in the sample (Field, 2013). A z-score indicates how much standard deviations a given data point is from the mean (Field, 2013). For example, a z-score of 1 indicates the point is one standard deviation above the mean whereas -1 denotes that the point is one standard deviation below the mean. Z-score is calculated as follows: $z = (x – \mu) / \sigma$ (x= data point, μ = mean, σ = standard deviation). In a normal distribution, 95% of the data fall between z-scores of ±1.96 and approximately 99% of the data fall between z-scores of ±2.58.

Z-scores for each variable were calculated using SPSS. Afterwards, using z-scores, the number of outliers in each variable was computed along with their degree of deviation from the mean. Absolut values of z-score greater than 3.29, 2.58 and 1.96 respectively are considered extreme, probable and potential outliers, whereas z-scores less than 1.96 are considered to fall within the normal range (Field, 2013). Among 46 variables, 12 were found to have no outliers (IO1, CO3, CO4, DS3, IP1, IP2, IP3, FT1, FT3, FT4, NA4, SP4) and only four variables had few extreme outliers (see Table 7.2). The remaining variables showed some potential and probable outliers, however, a high percentage of z-scores fell within the normal range, indicating that most cases had no outliers.

Table 7.2: Examples of outliers

Variable	Outliers	Frequency	%
CO1	Extreme outliers (z > 3.29)	21	1.8
	Probable outliers (z > 2.58)	0	0
	Potential outliers (z > 1.96)	55	4.6
	Normal range (z < 1.96)	1112	93.6
AU1	Extreme outliers (z > 3.29)	34	2.9
	Probable outliers (z > 2.58)	0	0
	Potential outliers (z > 1.96)	63	5.3
	Normal range (z < 1.96)	1091	91.8
AU4	Extreme outliers (z > 3.29)	38	3.2
	Probable outliers (z > 2.58)	0	0
	Potential outliers (z > 1.96)	72	6.1
	Normal range (z < 1.96)	1078	90.7
AU5	Extreme outliers (z > 3.29)	27	2.3
	Probable outliers (z > 2.58)	30	2.5
	Potential outliers (z > 1.96)	0	0
	Normal range (z < 1.96)	1131	95.2

7.6.4 Dealing with outliers

Once the outliers are detected, the researcher decides whether to retain or exclude them based on the characteristics of the outliers and the objective of the analysis (Hair et al., 2014a). The nature of outliers should be examined before dealing with them. Outliers can occur due to a data entry error, an extraordinary event or an extraordinary observation that cannot be explained (Hair et al., 2014a). In addition, observations can be considered outliers not because they fall outside the normal range of the values but because they are unique in their combination of values across the variables (Hair et al., 2014a). In this study, responses can take values between 1 and 5 (i.e. each question is expected to have an answer ranging from 'strongly disagree' to 'strongly agree'), therefore outliers on a variable were not extraordinary observations but rather values that fell within the ordinary range of values. In this case, removing outliers might imply that respondents' opinions are disregarded. Researchers suggest that if the high and low values can be explained then outliers should be retained because they represent cases in the population (Hair et al., 2017a). In addition, the impact of outliers on the analysis should be examined, as if there is no substantial impact on the results then the outliers can be retained (Hair et al., 2017a). In the light of this guidance, the data analysis was executed with and without the cases that have extreme values across several variables and no effect was found on the results: accordingly, the outliers were retained.

7.6.5 Normality

Normality refers to "the shape of the data distribution of an individual metric variable and its correspondence to normal distribution" (Hair et al., 2014a, p.69). Data are considered normal when they follow a normal distribution. Normality is a basic assumption in many multivariate analysis techniques including SEM (Hair et al., 2014a). There are two types of normality: univariate and multivariate normality. Univariate normality represents the distribution of a single variable while multivariate is the distribution of multiple variables (Hair et al., 2014a). Normality can be assessed through the shape of the distribution and the sample size (Hair et al., 2014a). The distribution of data can indicate whether the data are normal or not and the sample size can determine if the deviation from normality is acceptable (Hair et al., 2014a). The shape of the distribution can be assessed using two measures: skewness and kurtosis. *Skewness* refers to the balance of the distribution; a positive value of skewness indicates the distribution shifted to the right, while a negative value indicates a shift to the left (Hair et al., 2014a; Field, 2013). *Kurtosis* reflects the 'flatness' of the distribution; a positive value of kurtosis indicates a peaked distribution, whereas a negative value reflects a flatter distribution (Hair et al., 2014a; Field, 2013). The skewness and kurtosis values of the normal distribution are equal to zero and any value above or below zero indicates deviations from normality (Hair et al., 2014a). Z-scores of skewness and kurtosis can be used to assess the degree to which skewness and kurtosis depart from a normal distribution (Field, 2013; Hair et al., 2014a). The data is considered normal when z-scores are between +2.58 and -2.58 ($p < .01$) (Hair et al., 2014a). However, the effects of sample size should also be considered when evaluating the degree of departure from normality (Field, 2013; Kim, 2013). In small sample sizes of 50 or less, a large deviation from normality can cause significant effects on the results while in sample sizes of 200 or more, such effects may be insignificant (Hair et al., 2014a). In other words, as a sample size gets larger, the normality assumption becomes less of a concern (Field, 2013; Hair et al., 2014a). In large samples, Kim (2013) suggests examining the absolute values of skewness and kurtosis without considering z-scores as they are sensitive to sample size. An absolute skewness value larger than 2 or an absolute kurtosis value larger than 7 can be an indication of substantial non-normality (Kim 2013). In this study, all absolute skewness and kurtosis values fell within the acceptable range as recommended by Kim (2013) except for three items; AU1, AU3 and AU4, which depart slightly from normality (absolute skew values > 2) (see Table 7.3). Considering the large sample size and according to Hair et al. (2014a) and Field (2013), non-normal variables should not be a concern in this study.

Table 7.3: Normality test (skewness and kurtosis of the variables)

Item	Skewness	Kurtosis	Item	Skewness	Kurtosis
CO1	-1.217	1.218	**PP3**	-.690	.022
CO2	-.241	-.981	**DH1**	-1.370	1.140
CO3	.068	-.920	**DH2**	-1.486	1.487
CO4	-0.54	-1.057	**DH3**	-.828	-.179
IO1	-.661	-.359	**DH4**	-.517	.142
IO2	-.381	-0.729	**SP1**	-.335	-.809
IO3	-.563	-.698	**SP2**	-.396	-.712
IO4	-.936	.163	**SP3**	-.379	-.896
DS1	-0.561	-0.673	**SP4**	-.990	.243
DS2	-0.643	-0.512	**SP5**	-1.390	1.841
DS3	-0.83	-0.924	**AU1**	-2.377	6.210
IP1	-.018	-1.285	**AU2**	-1.348	1.005

IP2	.105	-1.236	**AU3**	-2.454	6.186
IP3	.199	-1.159	**AU4**	-2.107	4.316
IPL1	-.797	- .245	**AU5**	-1.064	0.329
IPL2	-1.081	.659	**NAU1**	-1.266	.803
IPL3	-.717	-.357	**NAU2**	.194	-1.212
FT1	-.029	-1.062	**NAU3**	-.580	-.770
FT2	-.403	.795	**NAU4**	-.721	-.407
FT3	-.017	-1.089	**NA1**	-.636	-.515
FT4	-.297	-.963	**NA2**	-.449	-.843
PP1	-.655	-.021	**NA3**	-.641	-.544
PP2	-.589	.039	**NA4**	-.283	-1.090

7.7 Descriptive statistics of demographic variables

The results show that there were more female students in the sample than male students. Female students accounted for 75% of the total number of respondents. The high percentage of females in comparison to male respondents may be attributed to the fact that female students constituted 75% of the population. More than half of respondents were in the 18–21 age group, which is normally the age of undergraduate students. The sample included an approximately equal percentage of first- and third-year students (22%) and a slightly higher proportion of fourth-year students (26%). The demographic characteristics of the survey respondents are illustrated in Table 7.4 below.

Table 7.4: Demographic characteristics of the participants

Variable	Category	Frequency	%
Gender	Male	287	24.2
	Female	901	75.8
Age	18 – 21	737	62
	22 – 25	401	33.8
	26 – 29	14	1.2
	30 – 34	13	1.1
	> 34	23	1.9
Academic year	First year	261	22.0
	Second year	191	16.0
	Third year	271	22.8
	Fourth year	316	26.6
	Fifth year	97	8.2
	Sixth year	52	4.4

College	College of Applied Studies and Community Service	190	16.0
	College of Art	189	15.9
	College of Medicine	142	11.9
	College of Science	136	11.4
	College of Business Administration	123	10.4
	College of Computer Science and Information Technology	92	7.7
	College of Education	71	6.0
	College of Design	53	4.5
	College of Engineering	25	2.1
	Other	167	14.1

7.7.1 WhatsApp usage

Table 7.5 below gives information related to the use of WhatsApp by the respondents. Specifically, it illustrates the amount of time they spent on the app on a daily basis and the number of study and non-study groups they had. The results show that about 44% of the respondents spent between an hour to three hours on the app every day and 22% of them spent more than four hours. A vast majority of students joined between 1 and 10 study groups (n = 1027, 86.4%) and a small proportion of them had more than 11 study groups (n = 134, 11%). With regard to non-study groups, about 75% of the respondents had between 1 and 5 groups and 13% had between 6 and 10 groups.

Table 7.5: Descriptive statistics of WhatsApp usage

Variable	Category	Frequency	%
Daily hours spent on the app	Less than 30 minutes	84	7.1
	30 mins to 1 hour	181	15.2
	More than 1 hour to 2 hours	261	22.0
	More than 2 hours to 3 hours	258	21.8
	More than 3 hours to 4 hours	137	11.5
	More than 4 hours to 5 hours	112	9.4
	More than 5 hours to 6 hours	61	5.1
	More than 6 hours	94	7.9

Number of study groups	No group	27	2.3
	1 – 5 groups	655	55.1
	6 – 10 groups	372	31.3
	11 – 15 groups	83	7.0
	16 – 20 groups	24	2.0
	21 – 25 groups	13	1.1
	26 – 30 groups	3	.3
	> 30 groups	11	.9
Number of non-study groups	No group	91	7.7
	1 – 5 groups	882	74.2
	6 – 10 groups	157	13.2
	11 – 15 groups	35	2.9
	16 – 20 groups	7	.6
	21 – 25 groups	7	.6
	26 – 30 groups	2	.2
	> 30 groups	7	.6

7.8 Partial least squares structural equation modelling (PLS-SEM) analysis

The conceptual model was tested using PLS-SEM (see Chapter 3). The analysis was performed using SmartPLS version 3.3.3. PLS-SEM was executed in a two-step process: (1) the assessment of the measurement models and (2) the assessment of the structural model (Hair et al., 2017a) (see Figure 7.1). In the first step, the reliability and validity of the measures were examined. Once reliability and validity were established, then the structural model including the research hypotheses were tested (Hair et al., 2017a). The assessment of the measurement model and the structural model are discussed in the following sections.

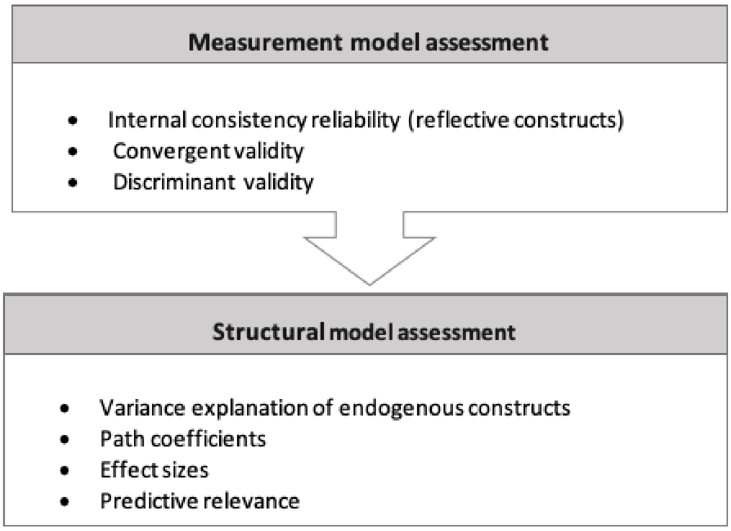

Figure 7.1: Two-step process of PLS path model assessment (adapted from Henseler, Ringle & Sinkovics (2009))

7.8.1 Assessment of the measurement model

The measurement model, also known as the outer model in PLS-SEM, represents the relationships between indicators and their underlying latent constructs (see Chapter 3). Evaluating the measurement model was an essential step to ensure the constructs were accurately measured and represented (Hair et al., 2019). This step involved assessing the internal consistency reliability and validity of the measurement model.

7.8.1.1 Internal consistency reliability

Internal consistency reliability is the first criterion to be examined. The reliability of a construct is estimated independently of other constructs. Two measures were used to assess the reliability of the measurements: Cronbach's alpha and composite reliability.

7.8.1.1.1 Cronbach's alpha

Cronbach's alpha is the most widely used measure to assess internal consistency (Field, 2013). It is used to evaluate the correlation between multiple items on the same scale (Hair et al., 2017a). A commonly accepted rule of thumb is that a coefficient alpha of 0.8 and above indicates a very good level, alpha values between 0.6 and 0.7 indicate an acceptable level of reliability (Devellis, 2017; Field, 2013; Ursachi, Horodnic & Zait, 2015) and a value below 0.6 indicates a lack of reliability (Henseler, Ringle & Sinkovics, 2009). The results showed that the Cronbach's alpha values of two constructs (invasion of privacy and fatigue) were above 0.8, indicating a good level of reliability. Two constructs, communication overload and disturbance handling, had alpha values below 0.7 but were within the acceptable range of between 0.6 and 0.7. The remaining variables had alpha values above 0.7 (see Table 7.6). Although Cronbach's alpha is the most commonly used measure for internal consistency reliability, it has some limitations. Cronbach's alpha assumes that all indicators are equally related to the construct and thus have equal loadings on the construct (Hair et al., 2017a; Henseler, Ringle & Sinkovics, 2009). Moreover, Cronbach's alpha is sensitive to the number of items in the measure (Hair et al., 2017a), which means that a scale with a large number of items would show a high value of alpha. Given these limitations, an alternative measure of internal consistency reliability such as composite reliability is recommended (Hair et al., 2017a; Henseler, Ringle & Sinkovics, 2009). Hair et al. (2017a) indicate that Cronbach's alpha tends to give an underestimation of measurement reliability; on the other hand, composite reliability tends to overestimate the reliability of the constructs. Therefore, they suggest reporting both measures, indicating that the true values of internal consistency reliability fall between the Cronbach's alpha and composite reliability values.

7.8.1.1.2 Composite reliability

In contrast to Cronbach's alpha, composite reliability (CR) considers different factor loadings of indicators, therefore it is considered a more appropriate measure of internal consistency reliability (Hair et al., 2014). CR can take values between 0 and 1, and higher values indicate a higher level of reliability (Hair et al., 2017a). In general, CR values between 0.6 and 0.7 are acceptable and values above 0.7 up to 0.9 are considered satisfactory to good, whereas values of 0.95 and higher are not desirable as they indicate redundant items (Hair et al., 2017a). CR values of the constructs displayed in Table 7.6 show that all constructs have CR values above the threshold value of 0.7, which indicates a satisfactory level of reliability. Both Cronbach's alpha and CR results show evidence for internal consistency reliability of the constructs.

7.8.1.2 Convergent validity

Convergent validity refers to the extent to which a set of measures that are theoretically supposed to measure the same construct is positively correlated (Hair et al., 2014a). To establish convergent validity, items measuring the same construct should share a high proportion of variance (Hair et al., 2014a). Convergent validity was evaluated using two measures: the factor loadings of the indicators and the average variance extracted (Hair et al., 2017a).

7.8.1.2.1 Factor loadings

Factor loadings on a construct reflect how much the indicators have in common (Hair et al., 2017a). A factor loading is also referred to as indicator reliability (Hair et al., 2017a). All factor loading should be significant. Moreover, as a common rule of thumb, standardised loadings should be 0.7 or above (Hair, Ringle & Sarstedt, 2011). However, in exploratory research, values of 0.5 and above are also acceptable (Hair et al., 2014a; Urbach & Ahlemann, 2010). The results showed that all factor loadings were statistically significant and above the threshold value of 0.5 except three indicators, CO2, DH4 and NAU2, which had values of 0.334, 0.431 and 0.408 respectively. In social sciences, researchers can get factor loadings below 0.7 when the scale is considered newly developed (Hair et al., 2017a). Generally, indicators that have low factor loadings (below 0.4) should always be removed, thus CO2 was deleted. Moreover, when an indicator has a factor loading between 0.4 and 0.7, the effect of the indicator elimination on reliability and validity should be examined (Hair et al., 2017a). Deleting the indicator should be considered only if doing so substantially increases composite reliability and the average variance extracted (AVE), otherwise, the indicator should be retained (Hair et al., 2017a; Henseler, Ringle & Sinkovics, 2009). Accordingly, changes in reliability and validity of disturbance handling and non-academic use were assessed after removing DH4 and NAU2. The results indicated AVE values of both constructs were below the cut-off value of 0.5. Removing these indicators would improve AVE values of disturbance handling from 0.475 to 0.608 and non-academic use from 0.499 to 0.622. Furthermore, CR values increased from 0.775 to 0.821 for disturbance handling and from 0.786 to 0.829 for non-academic use, therefore both DH4 and NAU2 were removed. For the remaining constructs, although some constructs had items with factor loadings below 0.7, the results suggested that item removal did not increase the reliability and validity of these constructs, therefore all items between 0.7 and 0.5 were retained (see Table 7.6).

7.8.1.2.2 The average variance extracted

The AVE proposed by Fornell and Larcker (1981) is another measure to assess convergent validity. Specifically, it measures the average amount of variation in an indicator that is explained by a construct (Hair et al., 2014a). AVE can be computed as the sum of the square loadings divided by the number of indicators (Fornell & Larcker, 1981). AVE values should be 0.5 or above, which indicate that the construct explains more than half of the variance in the indicators (Hair et al., 2017a). As shown in Table 7.6, the AVE values of all constructs are above the threshold value of 0.5, indicating a good level of convergent validity. Altogether, factor loadings and AVE values showed evidence for convergent validity.

Table 7.6: Factor loadings

Construct	Item	Mean	Std. Deviation	Loadings	Cronbach's Alpha	Composite Reliability	AVE
Communication overload	CO1	4.19	0.943	0.528*	0.617	0.772	0.540
	CO3	3.10	1.176	0.837*			
	CO4	3.16	1.234	0.799*			
Information overload	IO1	3.75	1.120	0.825*	0.778	0.857	0.600
	IO2	3.53	1.091	0.776*			
	IO3	3.76	1.157	0.743*			
	IO4	4.02	1.035	0.751*			
Distraction	DS1	3.55	1.220	0.809*	0.706	0.835	0.629
	DS2	3.77	1.136	0.699*			
	DS3	3.23	1.186	0.862*			
Invasion of personal life	IPL1	3.84	1.136	0.918*	0.746	0.842	0.646
	IPL2	4.03	1.034	0.795*			
	IPL3	3.76	1.145	0.679*			
Invasion of privacy	IP1	3.09	1.382	0.875*	0.851	0.910	0.771
	IP2	2.96	1.363	0.902*			
	IP3	3.84	1.130	0.857*			
Fatigue	FT1	3.10	1.246	0.859*	0.856	0.902	0.698
	FT2	3.48	1.182	0.792*			
	FT3	3.07	1.260	0.857*			
	FT4	3.34	1.238	0.831*			
Disturbance handling	DH1	4.21	1.054	0.826*	0.670	0.821	0.608
	DH2	4.25	1.056	0.844*			
	DH3	3.83	1.154	0.654*			

Self-preservation	SP1	3.42	1.199	0.844*	0.765	0.837	0.513
	SP2	3.52	1.172	0.812*			
	SP3	3.43	1.249	0.702*			
	SP4	4.00	1.069	0.620*			
	SP5	4.22	.935	0.562*			
Perceived performance	PP1	3.76	1.013	0.830*	0.772	0.868	0.687
	PP2	3.75	0.967	0.862*			
	PP3	3.83	1.015	0.793*			
Academic use	AU1	4.61	0.767	0.749*	0.795	0.857	0.545
	AU2	4.27	1.030	0.745*			
	AU3	4.62	0.790	0.734*			
	AU4	4.50	0.901	0.709*			
	AU5	4.14	1.047	0.752*			
Non-academic use	NAU1	4.26	1.015	0.614*	0.748	0.829	0.622
	NAU3	3.80	1.188	0.788*			
	NAU4	3.95	1.073	0.932*			
Negative affectivity	NA1	3.71	1.158	0.813*	0.773	0.854	0.596
	NA2	3.55	1.219	0.850*			
	NA3	3.72	1.178	0.652*			
	NA4	3.35	1.316	0.761*			

Notes: * P-value < 0.01

7.8.1.3 Discriminant validity

Discriminant validity refers to the extent to which two conceptually different constructs are actually different from each other. Establishing discriminant validity means that "a construct is unique and captures phenomena not represented by other constructs in the model" (Hair et al., 2017a, p.115). Three measures were used to assess discriminate validity: cross-loadings, the Fornell-Larker criterion and the heterotrait-monotrait ratio (HTMT) (Henseler, Ringle & Sarstedt, 2015).

7.8.1.3.1 Cross-loadings

The first approach to evaluate the discriminant validity of indicators is to examine cross-loadings. To establish discriminant validity, an indicator's correlation with its corresponding construct should be higher than any of its correlations with other constructs (Chin, 1998; Henseler, Ringle & Sarstedt, 2015). The results demonstrated that there were no cross-loading issues as all indicators loaded high on their associated constructs and the loadings exceeded the cross-loadings (see Table 7.7).

7.8.1.3.2 The Fornell-Larker criterion

The Fornell-Larker criterion is the second measure to evaluate discriminant validity (Fornell & Larcker 1981). This criterion examines whether a construct shares more variance with its associated indicators than with any other constructs in the model (Fornell & Larcker, 1981; Urbach & Ahlemann, 2010). In order to establish discriminant validity on the construct level, the square root of the AVE value of a construct should be higher than its highest correlation with any other constructs (Hair et al., 2017a). The Fornell-Larker criterion evaluation is displayed in Table 7.8. The results indicate that the square root of each construct's AVE (on the diagonal of the table in bold) is greater than the inter-construct correlations in the off-diagonal position, which suggests good discriminate validity.

Table 7.7: Item factor loadings and cross-loadings

	CO	IO	DS	IPL	IP	FT	DH	SP	PP	AU	NAU	NA
CO1	**0.528**	0.215	0.235	0.213	0.141	0.177	-0.045	0.023	0.117	0.193	0.192	0.124
CO3	**0.837**	0.388	0.514	0.171	0.253	0.365	0.020	0.142	-0.046	0.061	0.046	0.229
CO4	**0.799**	0.245	0.352	0.247	0.252	0.335	0.067	0.108	0.083	0.129	0.138	0.248
IO1	0.321	**0.825**	0.458	0.042	0.26	0.413	0.126	0.209	-0.161	-0.041	-0.043	0.279
IO2	0.339	**0.776**	0.405	0.036	0.31	0.363	0.120	0.178	-0.165	-0.035	-0.029	0.281
IO3	0.283	**0.743**	0.306	0.037	0.228	0.299	0.101	0.174	-0.157	-0.087	-0.054	0.215
IO4	0.268	**0.751**	0.354	0.073	0.233	0.344	0.186	0.193	-0.128	0.005	-0.079	0.195
DS1	0.456	0.406	**0.809**	0.092	0.265	0.327	0.059	0.125	-0.095	0.045	0.087	0.252
DS2	0.316	0.302	**0.699**	0.028	0.172	0.270	0.070	0.143	-0.139	-0.04	0.024	0.065
DS3	0.452	0.457	**0.862**	0.042	0.283	0.409	0.083	0.184	-0.245	-0.069	-0.020	0.212
IPL1	0.229	0.058	0.074	**0.918**	0.117	0.116	0.084	0.066	0.190	0.278	0.138	0.134
IPL2	0.214	0.041	0.04	**0.795**	0.071	0.066	0.119	0.054	0.273	0.284	0.123	0.144
IPL3	0.257	0.046	0.04	**0.679**	0.058	0.042	0.049	0.016	0.317	0.300	0.196	0.115
IP1	0.267	0.295	0.261	0.111	**0.875**	0.369	0.151	0.221	-0.052	-0.013	0.009	0.215
IP2	0.260	0.277	0.275	0.101	**0.902**	0.379	0.102	0.174	-0.078	-0.021	-0.006	0.200
IP3	0.268	0.306	0.275	0.080	**0.857**	0.391	0.066	0.214	-0.099	-0.057	-0.001	0.265
FT1	0.450	0.396	0.378	0.106	0.385	**0.859**	0.109	0.308	-0.140	0.034	-0.071	0.299
FT2	0.187	0.378	0.300	0.034	0.310	**0.792**	0.154	0.323	-0.195	-0.105	-0.161	0.243
FT3	0.431	0.372	0.402	0.117	0.385	**0.857**	0.129	0.313	-0.105	0.033	-0.068	0.312
FT4	0.291	0.402	0.351	0.083	0.360	**0.831**	0.170	0.354	-0.196	-0.074	-0.131	0.28
DH1	0.024	0.136	0.069	0.070	0.048	0.127	**0.826**	0.34	0.079	0.066	-0.084	0.162
DH2	0.014	0.151	0.093	0.056	0.045	0.144	**0.844**	0.332	0.056	0.061	-0.095	0.173
DH3	0.043	0.113	0.043	0.130	0.211	0.117	**0.654**	0.230	0.039	0.042	-0.024	0.110
SP1	0.126	0.206	0.181	0.019	0.204	0.376	0.243	**0.844**	-0.138	-0.033	-0.115	0.231
SP2	0.058	0.176	0.121	0.015	0.147	0.306	0.275	**0.812**	-0.139	-0.049	-0.110	0.162
SP3	0.132	0.122	0.145	0.086	0.183	0.246	0.261	**0.702**	-0.038	0.017	0.045	0.215
SP4	0.091	0.189	0.098	0.084	0.166	0.220	0.341	**0.620**	-0.016	0.043	-0.060	0.245
SP5	0.101	0.209	0.143	0.072	0.131	0.178	0.404	**0.562**	0.038	0.047	-0.086	0.194
PP1	0.061	-0.162	-0.161	0.218	-0.091	-0.13	0.059	-0.071	**0.830**	0.300	0.169	-0.021
PP2	0.035	-0.166	-0.198	0.206	-0.085	-0.17	0.043	-0.123	**0.862**	0.320	0.194	-0.002
PP3	0.026	-0.162	-0.160	0.281	-0.044	-0.163	0.085	-0.071	**0.793**	0.338	0.193	-0.002
AU1	0.074	-0.051	-0.056	0.218	-0.079	-0.042	0.032	-0.035	0.26	**0.749**	0.168	-0.011
AU2	0.176	-0.04	0.003	0.284	-0.008	-0.012	0.033	-0.005	0.243	**0.745**	0.236	0.015
AU3	0.149	-0.002	0.012	0.273	-0.004	0.002	0.086	0.021	0.265	**0.734**	0.257	0.024
AU4	0.088	-0.018	-0.02	0.26	-0.01	0.013	0.098	0.043	0.234	**0.709**	0.174	0.037
AU5	0.080	-0.059	-0.041	0.23	-0.027	-0.049	0.034	-0.036	0.378	**0.752**	0.214	0.050
NAU1	0.175	0.063	0.099	0.089	0.047	-0.026	-0.013	-0.038	0.100	0.171	**0.614**	0.039
NAU3	0.213	-0.002	0.091	0.193	0.025	-0.072	-0.087	-0.037	0.182	0.270	**0.788**	-0.002
NAU4	0.069	-0.104	-0.017	0.135	-0.021	-0.14	-0.083	-0.116	0.214	0.243	**0.932**	-0.035
NA1	0.259	0.275	0.208	0.161	0.217	0.314	0.175	0.219	-0.025	0.016	-0.019	**0.813**
NA2	0.247	0.27	0.22	0.158	0.226	0.267	0.137	0.213	-0.015	0.050	-0.009	**0.850**
NA3	0.158	0.193	0.109	0.024	0.135	0.21	0.162	0.218	0.007	0.031	-0.053	**0.652**
NA4	0.193	0.228	0.163	0.124	0.212	0.248	0.121	0.228	0.011	0.010	0.013	**0.761**

Notes: FT = fatigue, CO = communication overload, IO = information overload, DS = distraction, IPL = invasion of personal life, IP = invasion of privacy, NAU = non-academic use, NA = negative affectivity, DH = disturbance handling, SP = self-preservation, PP = perceived performance, AU = academic use

7.8.1.3.3 Heterotrait-monotrait ratio

The Heterotrait-monotrait ratio of correlations (HTMT) is an alternative measure for assessing discriminant validity proposed by Henseler, Ringle and Sarstedt (2015). They argue that cross-loadings and the Fornell-Larcker criterion are inaccurate when assessing discriminate validity. Under certain conditions, these measures have been found unable to detect discriminant validity issues (Hair et al., 2017a; Henseler, Ringle & Sarstedt, 2015). HTMT is estimated as the average of the correlations between indicators across constructs representing different phenomena (i.e., heterotrait-heteromethod correlations) relative to the average of the correlations between indicators of the same construct (i.e., the monotrait-heteromethod correlations) (Henseler, Ringle & Sarstedt, 2015). The cut-off value of HTMT is 0.9 and values above 0.9 indicate a lack of discriminant validity (Henseler, Ringle & Sarstedt, 2015). A more conservative threshold value of 0.85 is also suggested, particularly when the model includes constructs that are conceptually different from each other (Hair et al., 2017a). In addition to assessing HTMT, the values of HTMT should be tested using the bootstrapping method to examine whether such values are significantly different from 1 or a lower threshold value of 0.85 (Hair et al., 2019).

The HTMT test presented, in Table 7.9, indicates that all HTMT values are clearly below the conservative cut-off value of 0.85. Moreover, the bootstrapping procedure was applied to test the statistical significance of HTMT values. Table 7.10 presents the confidence intervals for HTMT, the lower bounds and upper bounds of the 95% confidence interval are displayed in the columns named 2.50% and 97.50%. The results indicate that all values in the upper bound are lower than the threshold value of 0.85, which shows evidence for discriminant validity (Hair et al., 2019; Henseler, Ringle & Sarstedt, 2009).

Table 7.8: Correlation matrix and square root of AVE

	AU	CO	DH	SP	DS	PP	FT	IPL	IO	IP	NAU	NA
AU	**0.738**											
CO	0.149	**0.734**										
DH	0.073	0.034	**0.779**									
SP	-0.017	0.133	0.354	**0.716**								
DS	-0.03	0.519	0.089	0.192	**0.793**							
PP	0.387	0.049	0.076	-0.107	-0.209	**0.829**						
FT	-0.028	0.415	0.166	0.387	0.431	-0.187	**0.835**					
IPL	0.341	0.277	0.104	0.063	0.069	0.288	0.104	**0.803**				
IO	-0.049	0.391	0.172	0.244	0.498	-0.197	0.463	0.061	**0.774**			
IP	-0.035	0.302	0.121	0.231	0.308	-0.087	0.433	0.110	0.334	**0.878**		
NAU	0.284	0.141	-0.091	-0.098	0.03	0.226	-0.125	0.173	-0.065	0.000	**0.789**	
NA	0.034	0.283	0.192	0.282	0.233	-0.01	0.341	0.159	0.316	0.259	-0.020	**0.789**

Table 7.9: The HTMT assessment

	AU	CO	DH	SP	DS	PP	FT	IPL	IO	IP	NAU	NA
AU												
CO	0.265											
DH	0.104	0.097										
SP	0.072	0.193	0.589									
DS	0.092	0.777	0.127	0.258								
PP	0.474	0.168	0.104	0.134	0.272							
FT	0.092	0.556	0.222	0.458	0.541	0.233						
IPL	0.461	0.454	0.152	0.099	0.093	0.420	0.122					
IO	0.082	0.573	0.238	0.325	0.652	0.254	0.562	0.078				
IP	0.054	0.418	0.174	0.287	0.389	0.108	0.505	0.127	0.408			
NAU	0.365	0.329	0.112	0.135	0.138	0.265	0.133	0.247	0.098	0.048		
NA	0.055	0.401	0.266	0.383	0.295	0.036	0.413	0.202	0.400	0.315	0.055	

Table 7.10: Confidence intervals for HTMT values

	2.50%	97.50%		2.50%	97.50%
CO -> AU	0.199	0.346	**IO -> PP**	0.181	0.323
DH -> AU	0.058	0.191	**IO -> FT**	0.506	0.617
DH -> CO	0.063	0.176	**IO -> IPL**	0.04	0.157
SP -> AU	0.069	0.129	**IP -> AU**	0.041	0.116
SP -> CO	0.137	0.288	**IP -> CO**	0.343	0.495
SP -> DH	0.513	0.659	**IP -> DH**	0.126	0.248
DS -> AU	0.069	0.143	**IP -> SP**	0.215	0.359
DS -> CO	0.711	0.844	**IP -> DS**	0.324	0.455
DS -> DH	0.061	0.212	**IP -> PP**	0.048	0.184
DS -> SP	0.169	0.328	**IP -> FT**	0.444	0.560
PP -> AU	0.398	0.544	**IP -> IPL**	0.057	0.203
PP -> CO	0.11	0.243	**IP -> IO**	0.347	0.469
PP -> DH	0.053	0.192	**NAU -> AU**	0.287	0.446
PP -> SP	0.1	0.222	**NAU -> CO**	0.265	0.402
PP -> DS	0.198	0.341	**NAU -> DH**	0.068	0.183
FT -> AU	0.072	0.136	**NAU -> SP**	0.099	0.185
FT -> CO	0.483	0.630	**NAU -> DS**	0.09	0.204
FT -> DH	0.142	0.294	**NAU -> PP**	0.186	0.34
FT -> SP	0.409	0.539	**NAU -> FT**	0.087	0.182
FT -> DS	0.473	0.605	**NAU -> IPL**	0.167	0.329
FT -> PP	0.160	0.304	**NAU -> IO**	0.078	0.151
IPL -> AU	0.39	0.529	**NAU -> IP**	0.034	0.102
IPL -> CO	0.372	0.536	**NA_ -> AU**	0.045	0.121
IPL -> DH	0.085	0.235	**NA_ -> CO**	0.318	0.483
IPL -> SP	0.062	0.166	**NA_ -> DH**	0.181	0.352
IPL -> DS	0.058	0.169	**NA -> SP**	0.298	0.451
IPL -> PP	0.345	0.491	**NA -> DS**	0.223	0.372
IPL -> FT	0.0074	0.192	**NA -> PP**	0.036	0.102
IO -> AU	0.06	0.144	**NA -> FT**	0.345	0.480
IO -> CO	0.496	0.649	**NA -> IPL**	0.138	0.284
IO -> DH	0.155	0.324	**NA -> IO**	0.327	0.469
IO -> SP	0.224	0.382	**NA -> IP**	0.244	0.384
IO -> DS	0.591	0.708	**NA -> NAU**	0.041	0.109

Notes: FT = fatigue, CO = communication overload, IO = information overload, DS = distraction, IPL = invasion of personal life, IP = invasion of privacy, NAU = non-academic use, NA = negative affectivity, DH = disturbance handling, SP = self-preservation, PP = perceived performance, AU = academic use.

7.8.2 Assessment of the structural model

Having established the reliability and validity of the measurement models (the outer models), the next step involved examining the theoretical structural model (the inner model). In this step, the predictive capabilities of the model and the relationships between the constructs were tested. The structural model was assessed based on the following criteria: variance explained (R^2), effect size (f^2), predictive relevance (Q^2) and path coefficient (β) (Hair et al., 2017a; Henseler, Ringle & Sarstedt, 2009).

7.8.2.1 Collinearity assessment

Collinearity refers to a high correlation between two variables (Hair et al., 2017a). When more than two variables are very closely linearly correlated, this is referred to as multicollinearity (Field, 2013). In the structural model, the collinearity assessment involves examining the correlations between each set of predictor constructs (Hair et al., 2017a). This is a necessary step before estimating the structural relationships in the model to ensure that collinearity does not affect the regression estimates (Hair et al., 2019). Collinearity can be tested by one of two measures: the tolerance (TOL) and the variance inflation factor (VIF). VIF indicates whether two predictors have a strong linear relationship (Field, 2013). VIF is estimated as the reciprocal of the tolerance (VIF = 1/TOL) (Hair et al., 2017a). A VIF value of 5 and above denotes a potential collinearity issue among predictor constructs (Hair et al., 2019). In this study, two endogenous constructs had more than two predictor constructs; fatigue and perceived performance. The results of the collinearity assessment (see Table 7.11) showed that the VIF scores of the endogenous constructs were considerably below the threshold value of 5, thus collinearity was not an issue in this study.

Table 7.11: Collinearity test

Exogenous construct	Fatigue
Communication overload	1.608
Information overload	1.497
Distraction	1.623
Invasion of personal life	1.126
Invasion of privacy	1.210

Non-academic use	1.062
Negative affectivity	1.187
Exogenous construct	**Perceived performance**
Disturbance handling	1.178
Self-preservation	1.350
Fatigue	1.188
Academic use	1.008

7.8.2.2 Coefficient of determination (R^2)

The coefficient of determination (R^2) is the most common criterion used to assess the structural model (Hair et al., 2017a). In particular, it is used to evaluate the explanatory power of a structural model (Shmueli & Koppius, 2011). R^2 measures the proportion of the variance in the endogenous constructs that is explained by exogenous constructs (Urbach & Ahlemann, 2010). R^2 values range between 1 and 0; higher values denote a greater level of predictive accuracy (Hair et al., 2017a). There are no clear rules of thumb for an acceptable R^2 value as it depends on the field of the study and the complexity of the model (Hair et al., 2019). Commonly used rules suggested by Chin (1998) indicate that R^2 values of 0.670, 0.33 and 0.190 in the PLS-SEM inner model are considered substantial, moderate and weak respectively. The R^2 values of the endogenous constructs are presented in Table 7.12. The adjusted R^2 value of fatigue (0.386) is considered moderate and acceptable (Chin, 1998). This implies that 38% of the variance in fatigue is explained by the exogenous constructs linked to it. The adjusted R^2 value of fatigue without control variables (negative affectivity and non-academic use), is 0.352, also considered moderate. The R^2 values of perceived performance (0.190) and self-preservation (0.150) are considered weak, whereas disturbance handling shows a too-weak value (0.027). Such weak R^2 values of self-preservation and disturbance handling might be attributed to the fact that these constructs were explained by only one exogenous construct (fatigue).

7.8.2.3 Testing the structural model relationships

The hypothesised relationships among the constructs in the structural model were examined. The path coefficients (β) between the constructs were obtained by running the PLS-SEM algorithm. The size of a path coefficient represents the strength of the relationship between two constructs. Coefficients closer to +1 indicate strong positive relationships, and coefficients closer to -1 denote negative relationships, while path coefficients closer to 0 indicate weak relationships (Hair et al., 2014b). The bootstrapping method was applied to estimate the significance of the coefficients. This method enables estimating *t*-values and *p*-values for all path coefficients. All hypotheses in this study were directional, thus a one-tailed test and a significance level of 5% were used to estimate the significance of the path coefficients (Kock, 2015a). Table 7.12 presents all paths along with their coefficients (β) and their significance (*p*-value). As shown in the table, almost all relationships in the structural model were significant ($p < 0.05$). However, the relationship between invasion of personal life (IPL) and fatigue (FT) was not significant ($\beta = 0.014$, $t = 0.520$, $p > 0.05$). Assessing the relative importance of the exogenous constructs for fatigue (FT) showed that invasion of privacy (IP) was the key driver construct ($\beta = 0.236$, $t = 8.391$), followed by information overload ($\beta = 1.95$, $t = 6.951$). In addition, the results showed that academic use was the primary predictor of perceived performance as indicated by the increased path coefficient ($\beta = 0.373$, $t = 13.767$), followed by fatigue ($\beta = -0.164$, $t = 5.189$). The results of hypotheses testing are summarised in Section 7.9.

Table 7.12: The structural model assessment

Path	β	**Std Error**	**t-value**	***p*-value**	R^2	f^2	Q^2	q^2
FT					0.386		0.267	
CO -> FT	0.167	0.032	5.205	0.000		0.030		0.012
IO - > FT	0.195	0.028	6.951	0.000		0.040		0.017
DS -> FT	0.146	0.031	4.707	0.000		0.021		0.009
IPL -> FT	0.014	0.026	0.520	0.603		0.000		0.000
IP -> FT	0.236	0.028	8.391	0.000		0.076		0.032
NAU -> FT	-0.146	0.027	5.412	0.000		0.031		0.013
NA -> FT	0.131	0.026	5.134	0.000		0.024		0.010
FT -> DH	0.167	0.030	5.542	0.000	0.027	0.028	0.016	0.016
FT -> SP	0.388	0.027	14.562	0.000	0.150	0.176	0.074	0.085
PP					0.190		0.127	
FT -> PP	-0.164	0.032	5.189	0.000		0.028		0.011
SP -> PP	-0.083	0.030	2.747	0.006		0.006		0.004
DH -> PP	0.108	0.031	3.529	0.000		0.012		0.006
AU -> PP	0.373	0.027	13.767	0.000		0.171		0.092

Notes: FT = fatigue, CO = communication overload, IO = information overload, DS = distraction, IPL = invasion of personal life, IP = invasion of privacy, NAU = non-academic use, NA = negative affectivity, DH = disturbance handling, SP = self-preservation, PP = perceived performance, AU = academic use

7.8.2.4 Effect size (f^2)

Cohen's f^2 is a measure for estimating the effect size of each path in the structural model (Cohen, 1988). The f^2 effect size measures the magnitude of the change in the R^2 value when a particular predictor construct is removed from the model (Urbach & Ahlemann, 2010). It can be used to assess whether the removed predictor construct has a substantive effect on the endogenous construct (Hair et al., 2019). f^2 values of 0.02, 0.15 and 0.35 indicate that the removed construct has a small, medium and large effect respectively on the endogenous construct (Cohen, 1988). The effect size can be estimated as follows:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

The f^2 values in Table 7.12 indicate that communication overload, information overload, distraction, invasion of privacy, non-academic use and negative-affectivity constructs had small effect sizes on fatigue (f^2 < 0.15). Fatigue had small effects on disturbance handling and perceived performance and a medium effect on self-preservation (f^2 > 0.15). Disturbance handling and self-preservation had very small effects on perceived performance (f^2 < 0.02), whereas academic use had a medium effect on perceived performance (f^2 > 0.15).

7.8.2.5 Predictive relevance Q^2

Another criterion for evaluating the structural model's predictive relevance is Stone-Geisser's Q^2 (Geisser, 1974; Stone, 1974). The Q^2 value can be measured using the blindfolding procedure, which is a sample reuse technique that systematically removes data points in the endogenous construct's indicators and predicts their values (Hair et al., 2017a; Tenenhaus et al., 2005). Q^2 values reflect the extent to which this prediction is accurate. A Q^2 value for an endogenous construct greater than zero denotes that the structural model has predictive relevance for the construct (Henseler, Ringle & Sarstedt, 2009). As shown in Table 7.12, Q^2 values of all endogenous constructs were above zero. Specifically, fatigue had the highest Q^2 value (0.267), followed by perceived performance (0.127). Overall, the Q^2 values demonstrate the predictive relevance of the endogenous constructs (fatigue, disturbance handling and self-preservation, perceived performance).

7.8.2.6 Effect size (q^2)

Similar to the f^2 effect size, the q^2 measure is used to assess the effect size of the predictive relevance (Hair et al., 2017a). The q^2 effect size values of 0.02, 0.15 and 0.35 denote a small, medium and large predictive relevance of an exogenous construct respectively (Henseler, Ringle & Sarstedt, 2009). The q^2 effect size can be computed using the following formula:

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$$

As illustrated in Table 7.12, the results of testing the effect size q^2 of all relationships indicated that three constructs – invasion of privacy, academic use and fatigue– had small effects on their associated endogenous constructs, q^2 = 0.032, 0.092 and 0.085 respectively, whereas the remaining constructs had very small effects ($q^2 < 0.02$).

7.9 Summary of hypotheses testing results

The results of the structural model assessment provide support for all study hypotheses but H4. Specifically, it was predicted that communication overload would positively influence fatigue (H1). The path between communication overload and fatigue was significant ($\beta = 0.167$, $t = 5.205$, $p < 0.001$) and the effect size of the path was considered small, $f^2 = 0.030$., thus H1 was supported. In addition, it was proposed that distraction would have a positive effect on fatigue (H2). A significant positive relationship between distraction and fatigue was found ($\beta = 0.146$, $t = 4.707$, $p < 0.001$) with a small effect size $f^2 = 0.021$, therefore H2 was confirmed. Hypothesis 3 indicated that students who experienced information overload in study groups would be more likely to feel fatigued. The relationship between information overload and fatigue was significant and positive ($\beta = 0.195$, $t = 6.951$, $p < 0.001$). The size of this effect was small, $f^2 = 0.040$. As a result, H3 was confirmed. In hypothesis 4, it was proposed that students' perception that WhatsApp for academic use invades their personal life would positively influence their experience of fatigue. Contrary to this expectation, no significant relationship between invasion of personal life and fatigue was found ($\beta = 0.014$, $t = 0.520$, $p > 0.05$), thus H4 was rejected. Hypothesis 5 predicted a positive relationship between invasion of privacy and fatigue. The results showed support for this hypothesis indicating that invasion of privacy positively influences fatigue (β = 0.236, t = 8.391, p < 0.001). The effect size of the relationship was considered small, f^2 = 0.076. It was proposed in hypothesis 6 that the experience of fatigue would negatively impact perceived performance as students who feel fatigued would be less likely to perceive WhatsApp as enhancing academic performance. The results showed support for this hypothesis indicating that the path between fatigue and perceived performance was significant and negative (β = - 0.164, t = 5.189, p < 0.001) with a small effect, f^2 = 0.028. With regards to the relationship between the experience of fatigue and coping behaviours, it was predicted that fatigue would have positive effects on disturbance handling (H7) and self-preservation (H8). As expected, significant positive relationships were found between fatigue and disturbance handling (β = 0.167, t = 5.542, p < 0.001) with a small effect, f^2 = 0.028, and between fatigue and self-preservation (β = 0.388, t = 14.562, p < 0.001), with a medium effect, f^2 = 0.176, therefore H7 and H8 were confirmed. Hypothesis 9 proposed that a disturbance handling strategy would positively increase perceived performance. The path between disturbance handling and perceived performance was significant and positive (β = 0.108, t = 3.529, p < 0.001), with a very small effect, f^2 = 0.012, thus H9 was confirmed. Hypothesis 10 predicted a negative association between self-preservation strategy and perceived performance as students who used this strategy would be less likely to perceive WhatsApp as useful for learning. As predicted, a significant negative relationship between self-preservation and perceived performance was found (β = -0.083, t = 2.747, p < 0.001). The relationship had a very small effect, f^2 = 0.006, therefore H10 was supported. Furthermore, in order to better understand how coping behaviours influence perceived performance, the mediating effects of coping strategies were examined. A bootstrapping method was used as suggested by Hair et al. (2017a) to perform the mediation analysis with PLS (1000 bootstrap resamples). Indirect effects of fatigue on perceived performance through coping strategies were tested. The results showed that disturbance handling and self-preservation partially mediated the relationship between fatigue and perceived performance (see Table 7.13). Fatigue had a significant positive indirect effect on perceived performance through disturbance handling (β = 0.018, t = 3.006, p < 0.01), which means that disturbance handling as a mediator decreases the negative impact of fatigue on perceived performance. On the other hand, the indirect effect of fatigue on perceived performance through self-preservation was significant and negative (β = -0.032, t = 2.624, p < 0.01).

Table 7.13: Results of mediation effect of fatigue

Independent variable	**Mediator**	**Dependent variable**	**Bootstrapping results Bias-corrected confidence interval**		
			Indirect effect	**2.5%**	**97.5%**
Fatigue	Disturbance handling	Perceived performance	0.018	0.008	0.031
Fatigue	Self-preservation	Perceived performance	-0.032	-0.056	-0.007

7.10 Testing control variables

The effects of negative affectivity, non-academic use and the demographic variables gender, daily usage time, number of study groups and academic year on fatigue were examined. The results indicated that negative affectivity had a significant positive influence on fatigue (β = 0.131, t = 5.134, $p < 0.001$). The size of the effect was small, $f^2 = 0.024$. This means that respondents with a high level of negative affectivity had also a high level of fatigue. A significant negative relationship with a small effect was found between non-academic use and fatigue (β = -0.146, t = 5.412, $p < 0.001$), $f^2 = 0.031$, which suggests that the use of WhatsApp for non-educational purposes led to decreased fatigue. Daily usage time, number of WhatsApp groups and academic year had no significant relationship with the experience of fatigue (Table 7.14). The effect of gender was tested using multigroup analysis as will be discussed later in Section 7.12. In addition, the influence of academic use on perceived performance was examined. The results showed that academic use had a significant positive relationship with perceived performance, with a medium effect size (β = 0.373, t = 13.767, $p < 0.001$), f^2 = 0.171.

Table 7.14: The effects of control variables

Path	*β*	*t*-value	*p*-value
Usage time -> fatigue	-0.021	0.790	0.430
Number of study groups -> fatigue	0.046	1.774	0.076
Number of non-study groups -> fatigue	0.014	0.583	0.560
Academic year -> fatigue	-0.025	1.119	0.263

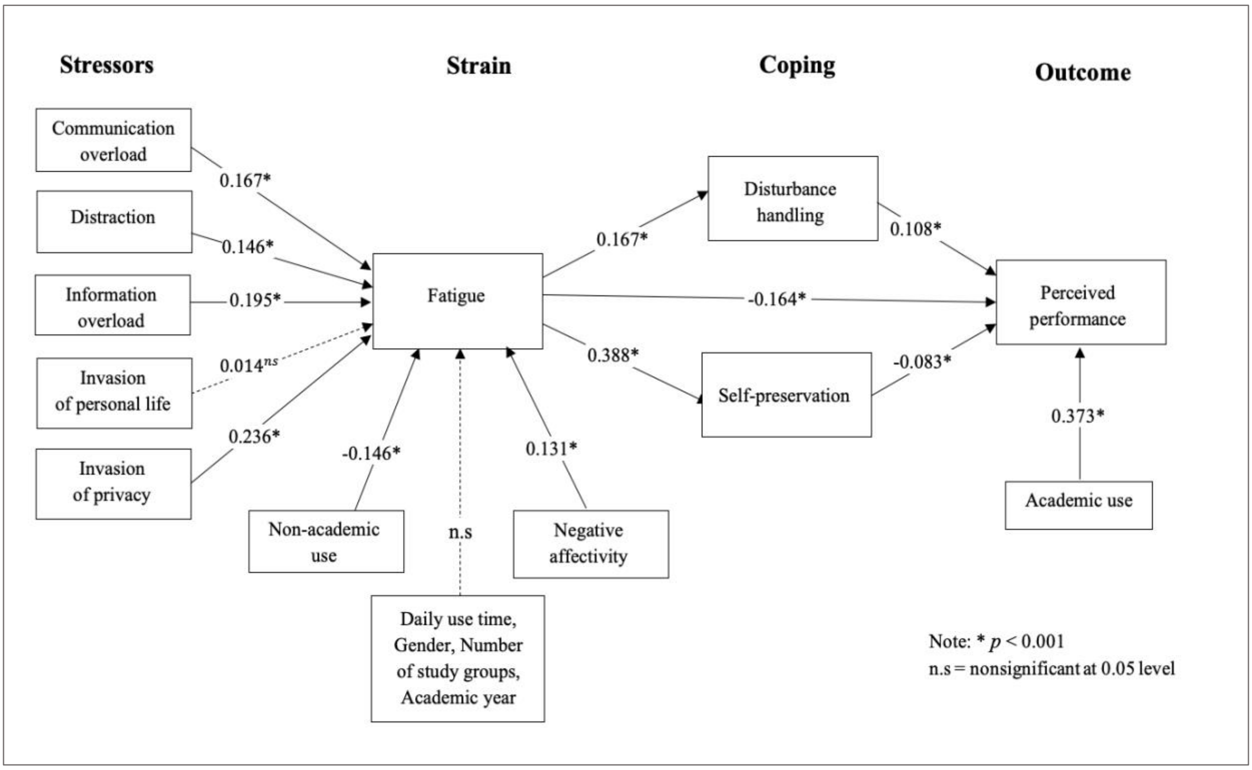

Figure 7.2: The results of the structural model

7.11 Common method bias

Common method bias (CMB) is described as a phenomenon that is attributable to the measurement method used in a study rather than to the network of causes and effects in the model being examined (Kock, 2015b). CMB, also known as common method variance, occurs when measures share a certain amount of variance due to the measurement method used (Spector, 2006). The existence of CMB can potentially cause a serious problem. CMB can result in inflated or deflated estimates, which ultimately may lead to misleading conclusions (Podsakoff et al., 2003). For example, Kock (2015b) found that CMB creates an inflation effect in path coefficients as well as factor loadings. Such inflation can falsely increase the level of the convergent and discriminant validity of a measurement model and may lead to false inference in hypothesis testing. Podsakoff et al. (2003) identify different sources of common method biases, which can be summarised as follows. First, CMB can be caused by questionnaire respondents, such as their mood state, negative or positive affectivity, and social desirability, which may lead respondents to answer questions in a way that seems to be more socially acceptable regardless of their true answer (Nock, 2015; Podsakoff & Organ, 1986; Spector, 2006). Second, CMB can occur due to item content that includes an ambiguous or complex meaning, or a negatively worded statement (Podsakoff et al., 2003). In addition, the way questions are presented and organised in a questionnaire can cause CMB (Kock, 2015b). For example, intermixing items of different constructs might lead to intercorrelations between such constructs, especially if the constructs have a similar meaning (Podsakoff et al., 2003). Third, the context in which measures are collected, such as time and location of data collection, can be a source of CMB. According to Podsakoff et al. (2003), CMB is likely to occur when the measures of both dependent and independent variables are gathered from the same person at the same point in time. Given the fact that in this study self-reported data were collected from the same source, CMB might exist in the data. Thus, evaluating its potential impact was important.

There are two approaches for controlling CMB, procedural methods and statistical methods (Podsakoff et al., 2003). In this study, several procedural methods were applied during the questionnaire design to eliminate CMB, which are summarised as follows.

- As CMB can be created by item formats and content, the items were carefully developed and reviewed by many people, including students, in order to ensure that they were simple, clear and understandable (Tourangeau et al., 2000). In addition, a reversed-coded item was avoided as it may lead to CMB when respondents fail to recognise the negative wording of the item (Podsakoff et al., 2003).
- As respondents tend to be consistent when answering similar questions, the scale reordering technique was used to reduce the potential consistency effect (Podsakoff &

Organ, 1986). In this technique, the order of the items was altered for each respondent. This was done with the help of the survey tool (SmartSurvey).

- The anonymity of respondents was assured, and they were informed that there were no right or wrong answers, thus they should answer based on their true feelings. In this way, the effect of social desirability can be eliminated (Podsakoff et al., 2003).
- As mentioned above, negative affectivity has been suggested as a source of bias that can lead to CMB (Podsakoff et al., 2003). It has been suggested that an individual with high negative affectivity is prone to experience a variety of negative emotions, therefore, their responses in a survey are likely to be biased in a negative direction (Spector, 2006). To mitigate its potential biasing effects, negative affectivity was statistically controlled in this study.

7.11.1 Statistical methods

While procedural methods can be used before data collection to alleviate potential CMB, statistical tests are used to assess the extent to which CMB affects the data. Two statistical tests were used: Harman’s single factor test and full collinearity test.

7.11.1.1 Harman’s single factor test

Harman’s single factor test is one of the most widely used tests in IS research to assess the issue of CMB. It is used to examine whether one single factor accounts for the majority of the variance in variables (Podsakoff et al., 2003). The problem of CMB exists when a high proportion of variance in the variables is explained by a single factor (Harman, 1976). To examine CMB using Harman’s single factor test, exploratory factor analysis was conducted using SPSS. All variables in the study were entered into the analysis. The results of the unrotated factor solution showed that more than one factor was extracted (12 factors), which altogether explained 61.17% of the variance. Moreover, the maximum variance explained by a single factor was 15.74% of the total variance (see Appendix E). It was clear from the results that none of the extracted factors accounted for the majority of the variance, thus CMB is unlikely to be a problem in this study.

Harman's single factor test has some limitations, although it is a widely used method for CMB. Podsakoff et al. (2003) indicate that when the number of variables increases it is likely that more than one factor will emerge from the factor analysis, therefore this test is considered an insensitive test. Furthermore, there are no clear rules on the amount of variance a factor should explain in order to be identified as a general factor (Podsakoff et al., 2003). Given these limitations, an additional and more conservative test was used to detect the effect of CMB, which is the full collinearity test suggested by Kock (2015b).

7.11.1.2 The full collinearity assessment

Traditionally, collinearity is assessed by examining the extent to which two or more predictors measure the same construct (Kock, 2015b). Such a type of collinearity is referred to as vertical collinearity or predictor-predictor collinearity (Kock & Lynn, 2012). Lateral collinearity is another type of collinearity that represents predictor-criterion collinearity. It occurs when two variables that are supposed to be causally linked measure the same construct (Kock & Lynn, 2012). The full collinearity test involves a simultaneous evaluation of both vertical and lateral collinearity (Kock & Lynn, 2012). To test CMB using the full collinearity test, variance inflation factors (VIFs) of all variables should be equal to or lower than 3.3 to demonstrate a lack of common method bias (Kock, 2015b). The full collinearity assessment was performed using SmartPLS. All the latent variables were linked to a random dummy variable (a latent variable with a single indicator) as recommended by Kock and Lynn (2012). In such a technique, both vertical and lateral collinearity were assessed. The results of the test revealed that VIF values of all variables were well below 3.3 (see Table 7.15), thus, CMB was not a serious issue in this study.

Table 7.15: Full collinearity test

Construct	VIF
Communication overload	1.115
Distraction	1.426
Information overload	1.540
Invasion of personal life	1.271
Invasion of privacy	1.302
Fatigue	1.541
Disturbance handling	1.072
Self-preservation	1.193
Perceived performance	1.298
Academic use	1.276
Non-academic use	1.162
Negative affectivity	1.210

7.12 Multigroup analysis

Multigroup analysis (MGA) was performed in order to control for potential gender differences in this study. Due to the fact that the sample included more female than male participants, MGA was conducted to assess whether gender had any effects on the final results. Gender is a categorical variable, thus MGA was the appropriate method to test its potential effects on the model (Hair et al., 2017a; Sarstedt, Henseler & Ringle, 2011). MGA enables researchers to explore differences between identical models estimated for different groups (e.g. males vs. females) (Hair et al., 2017a). In MGA, the overall model was compared in two subgroups (female and male) and all the relationships were included in the comparison (Cheah et al., 2020; Hair et al., 2017a). In this way, MGA enabled the examination of the influence of gender on all paths in the model.

Prior to running MGA, it is important to ensure that the subgroups have enough statistical power or at least have a minimum sample size of 160 (Cheah et al., 2020). Unequal sample sizes could also decrease the statistical power of the analysis, thus similar sample sizes for the subgroups should be selected (Cheah et al., 2020). In this study, there were unequal sample sizes for female and male groups. The sample included 287 male and 901 female students.

Therefore, to address unequal sample sizes, 287 female responses were randomly selected to be compared against male responses in the sample. The next step in MGA involves testing measurement invariance to ensure that the same constructs are being measured in the same way across the subgroups (Henseler, Ringle & Sarstedt, 2016). This step is necessary to confirm that the group differences in the model estimates do not result from different meanings that the groups' respondents ascribe to the phenomena being measured (Hair et al., 2017a). Measurement invariance was examined following the measurement invariance of composite models (MICOM) procedure (Cheah et al., 2020), with the help of SmartPLS. Partial measurement invariance was established (see Appendix F), and MGA was performed accordingly (Henseler, Ringle & Sarstedt, 2016). The results of PLS-MGA illustrate that there were no significant differences between female and male groups in all relationships in the structural model ($p > 0.05$) (see Table 7.16), which indicates that gender had no effect in this study.

Table 7.16: Multigroup test results

Path	**Path Coefficients-diff (Male - Female)**	**p-Value original 1-tailed (Male vs Female)**	**p-Value new (Male vs Female)**
Communication overload -> Fatigue	0.001	0.498	0.996
Distraction -> Fatigue	0.002	0.491	0.983
Information overload -> Fatigue	0.126	0.071	0.142
Invasion of personal life -> Fatigue	0.037	0.31	0.621
Invasion of privacy -> Fatigue	-0.059	0.755	0.491
Fatigue -> Perceived performance	-0.133	0.939	0.122
Fatigue -> Disturbance handling	0.114	0.096	0.193
Fatigue -> Self-preservation	-0.016	0.581	0.837
Disturbance handling -> Perceived performance	0.058	0.262	0.525
Self-preservation -> Perceived performance	-0.005	0.522	0.955
Negative affectivity-> Fatigue	-0.048	0.715	0.569
Non-academic use -> Fatigue	0.06	0.237	0.475
Academic use -> Perceived performance	-0.024	0.617	0.766

7.13 Discussion of the quantitative findings

The purpose of the quantitative study was to examine factors that cause fatigue due to WhatsApp usage for academic purposes and to investigate the impacts of fatigue and coping responses on perceived performance. The research model was developed based on the transactional model of stress and the concept of technostress. Quantitative data were collected through online questionnaires to validate the proposed conceptual model and to test the research hypotheses. The data were collected during the COVID-19 lockdown between March and April 2020, at a time when education in Saudi Arabia moved to remote teaching. As discussed in the previous chapter, follow-up interviews were also conducted at the same time in order to collect additional information on the academic use of WhatsApp during the lockdown. This section discusses the results of the quantitative study and interprets the results based on follow-up interviews.

7.13.1 Predictors of fatigue

The results of PLS-SEM analysis showed that almost all proposed hypotheses were supported, thus confirming the proposed conceptual model. The key stressors that significantly influenced fatigue were communication overload, distraction, information overload, and invasion of privacy. In general, the results were consistent with prior studies on technostress and technology overload (Lee, Son & Kim, 2016; Malik et al., 2020; Tarafdar, Tu & Ragu-Nathan, 2010; Zhang et al., 2016). The current study contributes to mobile-learning literature by shedding light on the negative aspects of using MIM for education, especially during remote learning. The results suggested that the use of WhatsApp for information sharing and study-related communication led to fatigue among students. Follow-up interviews revealed that there was a heavy reliance on WhatsApp during the lockdown for academic purposes. Due to the cancellation of final exams, the amount of group work students had to do increased. As face-to-face meetings were not possible, WhatsApp was one of the most used platforms to receive study-related updates and news and to organise group work. Even though WhatsApp helped students during the lockdown to stay in touch with other students as well as with teachers, the results indicated that the increased use of WhatsApp led to communication and information overload and resulted in fatigue. In addition, the results revealed that texting or checking WhatsApp while studying or attending a lecture was a significant predictor of fatigue. This suggests that staying focused while attending online classes might have been a challenge during the lockdown. The availability of many digital devices surrounding students (e.g. smartphones, laptops and tablets) as well as many platforms (e.g. WhatsApp, social media, Zoom etc.) could easily distract students' attention and attract them to multitask and switch between studying and off-task use of technology (Amez & Baert, 2020; Rosen, Carrier & Cheever, 2013). As students study from home without guidance from teachers to keep them on track, students could struggle to remain focused and not get distracted by digital devices and platforms while studying online (Dontre, 2021). Likewise, Hussein et al. (2020) found that distraction and an inability to stay focused during online classes were issues facing university students during the lockdown. Empirical studies have shown that academic distraction has detrimental effects on academic performance (Feng et al., 2019; Junco, 2012; Junco & Cotton, 2012; Wood et al., 2012). In line with these studies, the results of the current study indicated that distraction created by WhatsApp negatively influenced performance through fatigue.

A key factor that was found to increase fatigue in this study is invasion of privacy. This suggests that the lack of privacy on WhatsApp and the inability to hide user presence can lead to negative effects on individuals' well-being. This finding is consistent with prior studies on technostress, which also have found that invasion of privacy creates stress for ICT users (Bright, Kleiser & Grau, 2015; Dhira et al., 2019; Xiao & Mou, 2019; Yao & Cao, 2017). Technostress research has indicated that an individual's perception that work-related usage of ICT invades their personal life can result in stress (Bucher, Fieseler & Suphan, 2013; Gaudioso, Turel & Galimberti, 2017; Lee, Lee & Suh, 2016; Tarafdar et al., 2011). In contrast with technostress research, the current study did not find a significant relationship between invasion of personal life and fatigue. This result also did not support the findings of the qualitative study, which showed that the perception that educational use of WhatsApp invades students' private lives was a reason for the experience of fatigue. This suggests that being constantly connected to study groups and with other students via WhatsApp during distance learning was not perceived by students as negative. Similarly, So (2016) found that students did not view academic use of WhatsApp outside school hours as interfering with their personal lives. This inconsistency in the results may be attributed to the fact that the qualitative and quantitative studies were conducted in different contexts. The interviews were carried out prior to the shift to remote learning while the quantitative study was conducted at the time of the pandemic and the transition to distance learning, thus the situation has changed. As face-to-face meetings were not possible due to the lockdown, students might have felt they needed to be more connected with their peers and teachers in order to stay informed of any news or updates. In addition, being connected at all times and in all locations might facilitate group-based work in a distance-learning context; thus, students perceived continual connection via WhatsApp during these times as helpful and not stressful.

7.13.2 Fatigue, coping behaviours and perceived performance

Technostress literature has indicated that psychological strain created by ICT use can lead to consequences for individuals (La Torre et al., 2019; Salo, Pirkkalainen & Koskelainen, 2019; Tarafdar et al., 2011). This study examined the influence of fatigue and coping behaviours on perceived performance. There have been different results published in mobile-learning literature regarding the influence of educational use of MIM on learning outcomes (Tang & Hew, 2017). The results of the present study showed a positive association between academic use and perceived performance. On the other hand, fatigue created by information overload, communication overload, distraction and invasion of privacy led to reduced perceived performance. These findings provide support for technology overload research, which argues that the use of ICT can enhance individuals' performance yet when the optimal level of ICT usage is exceeded, adverse outcomes can occur (Karr-Wisniewski & Lu, 2010; Yu et al., 2018). The present study suggests that the use of WhatsApp for various academic purposes helped students to improve their academic performance. However, the increased dependence on WhatsApp for learning resulted in fatigue and reduced performance.

Consistent with prior research on coping with technostress (Bala & Venkatesh, 2016; Beaudry & Pinsonneault, 2005; Elie-Dit-Cosaque & Straub, 2011), the findings indicated that fatigue was positively associated with two coping strategies: disturbance handling and self-preservation. This suggests that students may cope with fatigue created by academic use through adjusting technology features, managing usage time or reducing their engagement with the technology. The findings also revealed that coping behaviours were associated with different outcomes. The use of a disturbance handling strategy was associated with increased perceived performance. Furthermore, the results showed that disturbance handling partially mediated the relationship between fatigue and performance, which indicates that this strategy can reduce the negative influence of fatigue on performance. These findings imply that using a disturbance handling strategy can help students minimise stressors and benefit from using WhatsApp for learning, thereby leading to improving their academic performance. On the other hand, using a self-preservation strategy was found to decrease perceived performance. Likewise, Beaudry and Pinsonneault (2005) indicate that a self-preservation strategy may not lead to improvement in IT users' performance at work. This suggests that although this strategy can mitigate fatigue and help students to feel relief by disengaging from WhatsApp use, it may also prevent students from taking advantage of its academic use, thereby it does not lead to enhancing their academic performance. The qualitative findings also indicated that leaving study groups could result in losing important learning content. This was particularly relevant during distance learning as the follow-up interviews showed WhatsApp was an essential platform for learning, thus disengaging from WhatsApp or avoiding study groups might not be an effective way to deal with the overload.

7.13.3 The effects of control variables

The current study examined the effect of control variables, namely non-academic use, negative affectivity, gender, academic year, daily usage time and number of WhatsApp groups. Interestingly, the results revealed that non-academic use of WhatsApp was negatively associated with fatigue. This suggests that the use of WhatsApp for non-educational purposes during the lockdown, such as chatting with friends or family, decreased the feeling of fatigue. Social distancing measures and the inability to meet others in-person could lead to feelings of anxiety and isolation. Communication via WhatsApp during these stressful times perhaps helped students to cope with the situation and feel less stressed by WhatsApp. Studies on mobile learning also have indicated that the use of MIM including WhatsApp can help students in online courses overcome negative feelings of stress, isolation and loneliness (Pimmer, et al., 2019; Tang & Hew, 2017). Likewise, Park and Noh (2018) found that the use of MIM to connect with family and friends helps international students to feel less stressed by their new life and enhances their psychological well-being.

Past studies on technostress suggest that stress can be influenced by a personality trait, negative affectivity (Agogo & Hess, 2018; Ayyagari, Grover & Purvis, 2011; Yan et al., 2013). Research has indicated that individuals with high negative affectivity are likely to experience negative emotions, which negatively influence how they perceive their environment (Cooper, Dewe &

O'Driscoll, 2001). Consistent with these studies, the results revealed that negative affectivity was a predictor of fatigue, which implies that part of the experience of fatigue can be attributed to personality factors.

In terms of gender, prior research on technostress has shown inconsistent results regarding the impact of gender on technostress and techno-stressors. Studies found that men are more likely to experience technostress than women (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Zhang et al., 2016). On the other hand, other studies did not find a significant relationship between gender and social media fatigue (Lee, Son & Kim, 2016; Maier et al., 2015b; Whelan, Islam & Brooks, 2020a). Likewise, the current study showed that gender had no significant effect on fatigue and the other variables in the conceptual model. With regards to the effects of usage time, studies found that the more time spent on ICT, the higher level of techno-stressors a person experiences (Ayyagari, Grover & Purvis, 2011; Maier et al., 2015b). However, this study did not find a significant relationship between daily time spent on WhatsApp and fatigue. A possible reason for this result is that students used WhatsApp for different purposes; while academic use was found to increase fatigue, non-academic use reduced fatigue, thus fatigue was influenced by the type of usage rather than the amount of time spent on WhatsApp. Similar to usage time, academic year and number of WhatsApp groups did not have a significant effect on fatigue.

7.14 Chapter summary

This chapter aimed to report the process of analysing the quantitative data that were collected via online questionnaires. It explained the process of data cleaning and examination and provided descriptive statistics for the study sample. The chapter presented extensively a series of statistical analyses that were performed to validate the proposed conceptual model and to test the causal relationship between the study variables. The results of the two-step process used to evaluate the measurement models and the structural model were explained in detail. Overall, the results provided support for the proposed model and confirmed the research hypotheses. The quantitative findings were discussed at the end of the chapter and explained with reference to the follow-up interviews. In the next chapter, the main findings of both the qualitative and quantitative phases will be discussed. The theoretical contributions, as well as the practical implications of this study, will be explained afterwards. In addition, the limitations of the study will be presented with the aim to provide directions for future research.

Chapter 8: Discussion and conclusion

8.1 Chapter overview

This chapter provides an overall summary of the thesis, highlights the main findings of the qualitative and quantitative phases and explains how the research questions have been addressed. It then presents the theoretical contributions that the current study provides to technostress and coping literature and mobile-learning research, followed by the practical implications of the study findings. The study has some limitations with regards to the generalisation of the results, as well as methodological and other limitations, which are explained in detail along with suggestions for further research. The chapter concludes with recommendations of avenues for future work.

8.2 Summary of the thesis

Despite the increasing use of MIM in higher education, there is limited knowledge regarding the negative aspects of educational use of MIM on students. The present study aims to provide insight into the negative side of WhatsApp use for learning and its consequences on students and their performance. Using the transactional perspective of technostress, the study investigates how WhatsApp leads to fatigue among university students and how they react to fatigue and techno-stressors. In addition, it examines the influence of fatigue and coping behaviours on students' perceived performance. The current study extends existing technostress research by focusing on stress associated with WhatsApp in an educational context. In order to achieve the study objectives, a mixed-methods approach was used in which the data were collected in two phases. In the first phase, qualitative data were gathered through interviews with undergraduate students in Saudi Arabia. The purpose of the qualitative phase was to understand and identify key factors that create fatigue due to academic use from students' perspectives, and to understand coping behaviours. The results of the qualitative phase were used to develop a conceptual model that explains the relationship between stressors and fatigue and the influence of fatigue and coping behaviours on students' performance. In the quantitative phase, data were collected via online questionnaires with the aim to examine the proposed research model and to validate the qualitative findings. The quantitative study was carried out during the shift to remote learning due to the COVID-19 pandemic. As the qualitative study was conducted prior to the pandemic, additional information on the academic use of WhatsApp during remote learning was gathered from students through follow-up interviews. These interviews helped to connect the findings of the quantitative and quantitative phases and better understand the quantitative results. The findings of the qualitative phase were discussed in Chapter 4 and the quantitative results were presented and explained in Chapter 7. Overall, the current study aimed to answer four research questions that were stated in Chapter 1, these questions were addressed as follows:

RQ1. What are the significant techno-stressors that lead to fatigue among students?

An extensive literature review on the phenomenon of technostress, stress theory and existing research on technostress in organisational/ work use and private use contexts was conducted to develop a theoretical foundation for understanding technostress in the context of academic use. In addition, existing literature on technostress was reviewed in order to identify key creators of technostress. Among the main techno-stressors identified in the literature, technology overload and technology invasion were determined as relevant to the academic use context. In the first phase of the study, semi-structured interviews were conducted with undergraduate students in order to explore other techno-stressors that create fatigue for students. Based on the qualitative findings, the research conceptual model was developed and five techno-stressors were included in the model. In the second phase, quantitative data were gathered from students via surveys in order to validate the proposed conceptual model. A number of statistical tests were used to validate the developed conceptual model (See Table 8.1). The results of the statistical analysis revealed the significant techno-stressors that were positively associated with fatigue.

RQ2. What factors contribute to information and communication overload when using WhatsApp for learning?

To answer this question, a thorough review of the concept of technology overload, information overload and communication overload was conducted. Furthermore, existing literature on information overload was reviewed to understand the causes of this problem. In the qualitative phase, the interviews focused on exploring information and communication overload in

WhatsApp study groups. The qualitative data revealed the main factors that contribute to this issue as will be explained in Section 8.3.

RQ3. What are the main coping strategies that students use to deal with fatigue?

A literature review was conducted in order to understand the concept of coping and coping theory. Moreover, existing studies on coping with technostress in IS literature were reviewed to understand how coping has been conceptualised in IS literature and to understand IT user coping behaviours. Two general coping strategies were identified based on the CMUA. The interviews were carried out to explore how students deal with fatigue and techno-stressors associated with academic use. The qualitative data provided support to the CMUA and revealed that disturbance handling and self-preservation strategies were used by students to reduce fatigue and techno-stressors. In the second phase, the quantitative data was used to examine the association between fatigue and coping strategies. The results of the statistical analysis showed positive relationships between fatigue and coping strategies, which confirmed the qualitative findings.

RQ4. What are the effect of fatigue and coping strategies on performance?

Based on technostress literature and the transaction-based model of stress, perceived performance was included in the conceptual model as an outcome of psychological strain. A negative relationship between fatigue and perceived performance was hypothesised. In addition, a direct relationship between coping strategies and perceived performance was proposed. In the second phase, the quantitative data were collected and analysed to examine these proposed relationships. Moreover, using a statistical technique, the mediation effect of fatigue on perceived performance through coping strategies were tested.

Table 8.1: Summary of statistical tests used in the quantitative phase

	Assessment	**Test**
1. Pilot study (Chapter 6)	1.1 Reliability	Cronbach's alpha
	1.2 Construct validity	Exploratory factor analysis (factor loadings and cross loading)
2. Main study (PLS-SEM) (Chapter 7)	2.1 Measurement model 2.1.1 Internal consistency reliability 2.1.2 Convergent validity 2.1.3 Discriminant validity	 Cronbach's alpha, composite reliability Factor loadings, AVE Cross-loadings, the Fornell-Larker criterion, HTMT
	2.2 The structural model	Variance explained (R^2), effect size (f^2), predictive relevance (Q^2) and path coefficient (β), collinearity assessment (VIF)
	2.3 Common method bias	Harman's single factor test, full collinearity assessment
	2.4 Multigroup analysis	MICOM, MGA

The next section provides a general discussion of the overall results of this study and presents the main findings of both qualitative and quantitative phases with reference to the question being answered by the presented findings.

8.3 Discussion of key findings from qualitative and quantitative phases

The benefits of using WhatsApp for learning purposes have been recognised in prior mobile-learning studies. In spite of the advantages of WhatsApp in learning and its potential in enhancing students' academic achievement, the results of the current study suggest that WhatsApp can also have adverse outcomes on students and their performance. The current study investigates fatigue associated with academic use. Many factors have been recognised in technostress literature to be IT-related stressors; however, in the context of the academic use of MIM, this study finds that information overload and communication overload, distraction, and invasion of privacy are the key stressors that lead to fatigue among university students (RQ1). The results provide empirical support for the argument that the increasing dependency on ICT can lead to overload. As students become more dependent on MIM to perform various academic-related activities including academic discussion, information sharing, organising group work and exam preparation, they could suffer from information and communication overload (RQ2). Furthermore, the results suggest that students could face overload, especially during remote learning, due to the heavy reliance on ICT and the lack of face-to-face teaching and meetings. The qualitative findings suggest that receiving too many messages and notifications, piling up of messages and feeling obligated to respond can lead to communication overload (RQ2). In addition, the qualitative phase investigated perceived information overload in study groups. Information overload and its influence on fatigue have been examined in previous literature on technology overload (Lee, Son & Kim, 2016; Zhang et al., 2016), however, there has been little focus on what factors contribute to this problem in the context of academic use of technology. This study extends existing research on technology overload and social media fatigue by providing a thorough explanation of how study groups on WhatsApp create information overload for students. It suggests that information overload is influenced by many factors, which are attributed to the amount of information or content posted in study groups and the quality of this content in terms of its relevance to the purpose of the group, its reliability and its repetition (RQ2). In addition, the number of study groups a student joins and the number of active members in a group can contribute to perceived information overload (RQ2). The findings indicate that receiving too much information and irrelevant messages cause students to perceive study groups as creating information overload. Moreover, information overload could reduce the perceived usefulness of study groups and lead students to decrease their engagement or leave such groups in order to eliminate fatigue associated with the overload. On the other hand, withdrawal from study groups may not be always possible as students could miss out on important information or learning materials when they leave. The qualitative findings suggest that the problem of information overload in study groups can be addressed by defining rules for participation that can reduce irrelevant information and discussion in the group (RQ2). In addition, the presence of teachers in study groups can manage group conversations and improve the quality of exchanged information and thus increase the perceived usefulness of study groups.

In addition to the problem of information and communication overload, this study suggests that staying focused without getting distracted by WhatsApp may be a challenge for students. WhatsApp messages and notifications induce students to multitask, which can ultimately negatively influence their performance. The quantitative study shows that the use of WhatsApp in class or while studying outside of class results in the feeling of fatigue and students' perception of reduced performance. The present study also investigates the concept of technology invasion in the context of academic use. The results suggest that receiving messages and learning materials via WhatsApp outside school hours and the need to be constantly connected to study groups can lead to the invasion of students' personal lives and result in fatigue. However, in the distance-learning context, continual connectivity may not be an issue for students: instead, it could help them to stay informed and overcome the lack of face-to-face communication. The study finds the lack of privacy on WhatsApp to be a significant stressor. It finds that the indication of whether a person is online, is writing, or has read a message creates expectations around availability and immediate response, which places pressure on the person. Even though invasion of privacy is not directly associated with academic use like the other techno-stressors in the study, the study finds that it was an important factor creating fatigue. It was frequently reported by interviewees and linked with negative feelings such as anger and annoyance. Moreover, the qualitative results suggest that quick-response expectations can induce individuals to feel pressured to respond and thus lead to communication overload. The quantitative results also show that invasion of privacy was the strongest predictor of fatigue. Overall, the findings denote that visibility of user activity and the loss of privacy can be a source of concern for students using WhatsApp, which can negatively affect their mental health and lessen their perception of the usefulness of WhatsApp for learning.

Another topic the current study focuses on is coping with WhatsApp fatigue and stressors. Coping with technostress, though an important topic, has received little attention from researchers in the IS field. Most existing studies have focused on causes of technostress and its consequences on individuals and businesses; however, these studies have paid little attention to IT users' coping behaviours. The present study contributes to technostress literature by investigating students' coping behaviours with stress caused by WhatsApp. The study focused on two coping strategies. The results demonstrate that a disturbance handling strategy, which is a sort of problem-focused method of coping lessens the negative influence of fatigue on perceived performance (RQ3). While a self-preservation strategy, which is emotion-focused, can help students to feel less stressed by WhatsApp use, it does not improve the stressful situation (RQ3). Overall, the findings suggest that a disturbance handling strategy can help students to deal with stressors or alleviate fatigue associated with them. Moreover, it can increase the effectiveness of WhatsApp in learning, consequently positively influencing academic performance (RQ4). On the other hand, a self-preservation strategy, though it can help students temporarily decrease fatigue, can also reduce the usefulness of the academic use of WhatsApp (RQ4).

8.4 Theoretical contributions

The current study has several important theoretical contributions to technostress and coping literature as well as to mobile-learning literature. The contributions are explained in the following subsections.

8.4.1 Contribution to technostress literature

First, the current study contributes to technostress literature by focusing on stress associated with the academic use of WhatsApp. As shown in the literature review chapter, an increasing number of studies have examined techno-stressors and technostress outcomes in the context of work and personal use of ICT, however little attention has been given to technostress in the context of academic use. This study extends technostress research by studying technostress in a different context, namely the academic use context. The study leverages the transactional model of stress and coping as a theoretical framework to explain stress created by the educational use of WhatsApp. Consequently, it identifies and empirically examines factors creating fatigue for students and the relationship between fatigue and coping responses.

Second, the study contributes to technology overload research by addressing communication and information overload that students face when using WhatsApp for learning purposes. Furthermore, the study examines the effects of communication and information overload on the experience of fatigue and students' performance. Many studies have investigated the effect of information overload and its consequences on SNS users (e.g. Cao & Sun, 2018; Gao et al., 2018; Karr-Wisniewski & Lu, 2010; Zhang et al., 2016). However, despite the negative impacts of information overload, previous studies on technology overload rarely focus on causes of information overload, which has resulted in a lack of knowledge around how students using WhatsApp for learning purposes could face this issue. The results of this study thereby enrich technology overload literature by uncovering key factors that contribute to the problem of information overload in WhatsApp study groups.

Third, technostress research has identified techno-invasion as one of the core components of technostress (Tarafdar et al., 2007). The results of this study provide partial support for technostress research by showing that the educational use of WhatsApp can invade students' personal lives and lead to fatigue; however, in the context of distance learning, techno-invasion may not be a source of stress for students.

Fourth, this study contributes to the emergent stream of IS research investigating IT-related fatigue and its consequences on individuals (e.g. Dhir et al., 2019; Lee, Son & Kim, 2016; Ravindran, Kuan & Lian, 2014; Xiao & Mou, 2019). The results of this study enhance the understanding of the phenomenon of fatigue and provide insight into its causes in the context of academic use. Existing studies on social network fatigue and social media overload tend to focus mostly on Facebook (e.g. Bright, Kleiser & Grau, 2015; Cramer, Song & Drent, 2016; Luqman et al., 2017; Maier et al., 2015a; Maier et al., 2015b). Focusing only on Facebook could limit our knowledge on the phenomenon of fatigue experienced by social media users. Studies have also examined fatigue in the context of mobile applications in general without focusing on a specific platform (e.g. Cao & Sun, 2018; Yu et al., 2018; Zhu & Bao, 2018), which can also lead to a lack of understanding of fatigue caused by using a particular technology. Researchers suggest that the examination of techno-stressors in the context of a specific technology rather than general ICT use could result in a better understanding of the technostress phenomenon (Ayyagari, Grover & Purvis, 2011; Maier, Laumer & Eckhardt, 2015). In the light of this recommendation, this study focuses on WhatsApp and contributes to the limited literature on fatigue induced by mobile messaging apps by exploring stressors specific to the context of WhatsApp use. For example, the study explained how WhatsApp features lead to the invasion of privacy.

8.4.2 Contribution to IS literature on coping

The study contributes to the stream of IS research on coping by investigating coping strategies and their effects on students' performance. The transactional view of technostress indicates that techno-stressors can lead to psychological strain and adverse outcomes. Moreover, it suggests that coping is part of the technostress process (Tarafdar, Cooper & Stich, 2017). However, despite the role of coping in the stress process, there has been a lack of research in the IS field investigating how individuals cope with stress induced by IT use. A review of IS research on coping by Weinert (2018) suggests that more investigation is needed to understand how users cope with technostress. The present study addresses this gap in IS research by examining students' coping responses to fatigue induced by WhatsApp. The results show that stressors can lead to psychological fatigue, and trigger coping behaviours. In addition, the study extends the application of the CMUA, which has been often examined in the context of coping with new IT implementation, to the context of coping with fatigue and techno-stressors associated with academic use. The results confirmed the positive relationships between fatigue and coping strategies. Furthermore, the study examines the role of coping in the relationship between strain and outcome. Prior studies have investigated coping behaviours with IT use; however, outcomes of coping behaviours have often been overlooked in these studies. Researchers call for research that examines how coping behaviours can lead to different outcomes (Tarafdar, Cooper & Stich, 2017; Weinert, 2018). Consequently, this study addresses this gap in the literature and shows that coping responses lead to different impacts on performance. It demonstrates that disturbance handling strategies are associated with enhanced performance. Moreover, they weaken the negative influence of fatigue on performance, whereas self-preservation strategies are negatively related to performance.

8.4.3 Contribution to mobile-learning literature

The current study contributes to mobile-learning literature by examining the influence of the academic use of WhatsApp on students and their performance. Instead of addressing positive effects of MIM in education, the study focuses on the negative aspects of educational use, which have been largely ignored. In fact, the study is among the first to focus on stressors created by WhatsApp use in educational contexts. Although some studies have examined technology overload in the context of MIM and its effects on students' well-being and their academic performance (e.g. Shi et al., 2020; Whelan, Islam & Brooks, 2020a), nevertheless, they have focused on the personal use of MIM for purposes of entertainment rather than learning. A key contribution of the current study is that it provides an explanation of how academic use can lead to fatigue and examines the effect of fatigue on student performance. For example, the results enrich mobile-learning literature by providing insight into how WhatsApp groups, despite their educational value, can cause distraction and overload for students and thus negatively affect performance. Moreover, the results highlight the role of teachers' presence in study groups in reducing the overload and providing informational support. The study also contributes to distance-learning research by shedding light on the stress experienced by students caused by the educational use of technology during remote learning. Moreover, the study shows that continuous connection with study groups in distance learning can help students feel less fatigued by IT use.

8.5 Practical implications

The findings of this study have several implications for students who use MIM for educational purposes, teachers, universities and colleges, as well as for MIM service providers and designers. Although MIM applications offer many advantages for students, the results of the current study suggest that the negative effects of MIM on students and their performance should not be ignored. By addressing the causes of fatigue and coping strategies, the findings can help students who use WhatsApp to avoid stressors and develop coping strategies to deal with them and thus reduce fatigue associated with academic use. First, as the findings reveal that the increased usage and dependence on WhatsApp lead to communication and information overload, students should reduce their reliance on WhatsApp for study-related communication and information sharing in order to mitigate fatigue. In addition, students are advised to regulate the time spent on WhatsApp and consider strategies to moderate their usage in order to reduce exposure to stressors. To reduce information overload in study groups, students could use alternative technologies to exchange learning materials. For example, instead of using WhatsApp, they could use email or cloud storage services, such as Dropbox or Google Drive. Such technologies would enable them to share, organise and store learning materials and work on a collaborative project without being distracted by too many conversations or discussions. In addition, rules for participation in study groups could be clearly stated to help reduce unnecessary content or chatting. Group leaders could also help to reduce the overload and increase the effectiveness of study groups by managing the flow of information and facilitating discussions. Students may consider leaving unnecessary study groups in order to avoid the overload. To deal with constant connectivity and the invasion of one's personal life, students could limit their educational use of WhatsApp during personal or family time. They could reduce their connection with and interaction on study groups during weekends to allow themselves to relax and take a break from study-related work. In addition to the abovementioned recommendations, students should develop coping strategies to deal with fatigue and stressors induced by WhatsApp. The results of the examination into the effects of coping strategies suggest that students are advised to use strategies that deal directly with stressors, such as adjusting app features to reduce distraction, or by self-regulating their usage. They also may use other strategies, such as distancing from WhatsApp or disengaging from study groups; however, such strategies to deal with stressors might not be helpful to improve their academic performance.

Second, higher education faculty and teaching staff are advised to increase students' awareness of the consequences of information and communication overload. Lecturers should encourage students to use formal communication channels, such as Blackboard, to get all needed information and announcements regarding their courses and limit the negative impacts of information and communication overload. In addition, they could educate students on how to effectively use study groups on WhatsApp for enhancing their learning through constructive discussions. Furthermore, as the results suggest that the presence of the teacher in study groups can improve the usefulness of the groups, teachers could consider joining study groups in order to communicate directly with students, provide informational support and facilitate academic discussion. This can be particularly helpful for students in remote learning contexts. The findings highlighted the relationship between being distracted due to using WhatsApp in classrooms or while studying and the experience of WhatsApp fatigue. Thus, based on these findings, lecturers and faculty members need to be aware of how their students are using technology in classrooms. Students may not be aware of the negative effects multitasking can have on their learning. Hence, it is important to raise awareness among students by talking with them about the consequences of multitasking and the habit of constantly checking WhatsApp during lectures or while doing learning activities, and how these behaviours can have negative impacts on academic performance.

Third, higher education institutions can use the findings of the current study when making decisions regarding the adoption of MIM for learning. The findings can help to establish guidelines that limit the negative impacts of WhatsApp on students and leverage educational use. For example, guidelines should be put in place to limit over-reliance on technology. In addition, the findings can be used to educate and support students on how to cope with stress induced by the educational use of technology. Considering the harmful effects of technostress on students' psychological and physiological health, universities and colleges should organise regular workshops and counselling services to address the stressors students face due to educational use and provide them with coping strategies to deal with techno-stressors. For example, students can be trained on how to manage their usage time and effectively use ICT in learning. In addition, students should be advised on the importance of taking a break from technology when they feel stressed by technology use.

Fourth, the findings of this study also provide implications relevant to providers and designers of MIM. Studies have found that users who feel fatigued due to SNS use are more likely to decrease their use or stop using SNS and switch to alternative technology (Ravindran, Kuan & Lian, 2014; Maier et al., 2015b). The findings of this study also indicate that students tend to avoid using WhatsApp and instead use alternative MIM applications (e.g. iMessage, Snapchat) as a way to deal with stressors. Considering the fact that maintaining current users is important for MIM service providers in order to sustain their business, this study suggests that service providers need to implement measures to eliminate users' exposure to techno-stressors. They should put more effort into developing technical features in a way that helps users to avoid technology overload. Concerning information overload, the results show that one of the reasons that students face information overload is that information cannot be organised in a group chat according to topic, which makes it difficult to find needed information among many conversations. Thus, WhatsApp providers might reduce information overload by developing features that filter and organise information. For example, they may consider adding the hashtag function, which helps to categorise information in group chats. An example of a MIM application that has already utilised this functionality is Telegram[7], which enables users to use hashtags to search across chats for specific information. In addition, designers of WhatsApp may consider adding new features for prioritising messages and notifications so that users can focus on important messages and not get distracted by too many chats. These features might

[7] https://telegram.org/

also help users manage their usage time and reduce the urge to check WhatsApp messages regularly. The results also show that WhatsApp lacks features that enable users to protect their privacy. Considering the strong association between the perceived invasion of privacy and fatigue, WhatsApp designers and service providers should provide users with tools or features that enable them to protect their privacy, such as hiding their online presence. These features may help service providers not only reduce the risks of technostress but also improve the overall user experience, thereby retaining current users.

8.6 Limitations

This study has some limitations, which should be considered when interpreting the results of the study. First, this study was conducted in Saudi Arabia. Given that Saudi Arabia has a unique culture, the findings may be affected by the cultural characteristics of the participants. While the study provides insights into the factors creating fatigue due to educational use, it does not focus on societal and cultural factors that may influence how individuals in this country perceive fatigue and techno-stressors. Saudi Arabia is characterised as a collectivistic culture, which may place extra pressure on people in this country. For example, they may feel obligated to respond to messages on time and provide support to family and friends. The qualitative results also indicate that feeling pressured to respond was a factor contributing to communication overload. Moreover, Saudi society is characterised by a high power distance culture, which means that power is distributed unequally within the society. In the context of educational environments, a high power distance has an influence on student–teacher relationships (Hofstede, Hofstede & Minkov, 2005). This might place pressure on students when communicating with teachers via WhatsApp. For instance, students may feel obligated to respond to faculty members even at inconvenient times such as at night or during family time. Therefore, it is possible that the findings of this study may not be applicable to other countries with different cultural orientations. Considering cultural differences, future research is needed to test the conceptual model of the current study in different cultural contexts. Furthermore, this study focused only on academic use and did not explore fatigue experienced by students in non-educational use contexts. The quantitative results showed a negative association between non-academic use and fatigue. However, given that the quantitative data were collected during the COVID-19 lockdown, it is possible that the respondents were influenced by the situation. Moreover, it is still not clear how non-academic use influences

WhatsApp fatigue. Thus, further investigation is needed to explore the influence of social and cultural factors, so that a better understanding of fatigue created by WhatsApp can be developed.

Second, this study was carried out at one university and focused only on undergraduate students. The participants were from the same age group. Thus, the findings might be limited to undergraduate students and may not be generalised to other universities and students at different educational levels. For example, the results show that invasion of personal life was not a predictor of fatigue. However, in another study, the findings indicate that mobile learning via WhatsApp can lead to the loss of the boundary between academic and family life, especially for mature adult students with families (Rambe & Bere, 2013). Therefore, further work is required to extend the understanding of the technostress phenomenon in academic use contexts by exploring techno-stressors that face postgraduate students or older students who have jobs and parental responsibilities, as well as investigating their coping strategies.

Third, although the current study identifies the causes of information overload in study groups, in order to simplify the proposed model, these factors were not included. Thus, the association between the causes and information overload is yet to be verified, which can be established in future quantitative research.

Fourth, in terms of methodological limitations, this study is based on self-reported data, which may be subject to biases, such as social desirability and recall issues (Podsakoff et al., 2003). Nevertheless, the results did not demonstrate common method bias (see Section 7.11). The study used self-reporting measures and did not use objective measures of fatigue. However, the use of subjective measures was appropriate to capture psychological fatigue that reflects a subjective experience of an individual. In addition, subjective measures are considered reliable and valid to capture technostress and techno-stressors (Ayyagari, Grover & Purvis, 2011). Future research may consider using both psychological and physiological measures (blood pressure and hormones) to obtain robust results (Fischer & Riedl, 2017). Similarly, due to the inability to obtain results of actual academic performance, the study used self-reporting measures to assess students' perceived academic performance rather than their actual performance, therefore perceived performance may be affected by a certain degree of subjective bias. While the use of perceived performance has been considered acceptable and valid in the literature (see Section 6.5.4), it is recommended that researchers obtain actual performance data in order to allow a better explanation of the effect of academic use on students' performance.

Fifth, the quantitative study used data collected at one point in time to test the proposed model. Thus, the causality of the links proposed in the model cannot be established. Moreover, the interaction between coping and strain was measured by links directed from strain to coping strategies. Given the dynamic nature of the coping process, the relationship between strain and coping is reciprocal as each can influence the other (Cooper, Dewe & O'Driscoll, 2001). However, due to the nature of cross-sectional design, it was not possible to capture this interaction between coping strategies and strain. For example, the research model proposes that fatigue leads to coping strategies, however the opposite direction is also possible as coping strategies can influence the level of fatigue, which was not tested in this study. While this study examines the effect of strain on coping, future research could consider addressing the influence of students' coping strategies on stressors induced by educational use. Given the limitations of the cross-sectional design, future research could use longitudinal designs to provide support for the causality proposed in the study model and advance our understanding of the interaction between coping and stress-related variables over time.

Sixth, another limitation is concerned with the timing of data collection. The survey was conducted at the beginning of the shift to distance learning due to COVID-19. Therefore, in addition to stress caused by the pandemic, students potentially faced challenges associated with the sudden shift to remote learning, which might have influenced their responses. Even though the follow-up interviews helped to understand the academic use during this time, further research should replicate the study to enable confidence in the generalisability of the study findings.

8.7 Directions for future research

While the current study offers insights into technostress caused by the academic use of WhatsApp and its effect on students and their performance, further empirical work is needed to build on the study's findings and to address the limitations identified in the previous section. Besides the suggestions made previously, the study also suggests areas for future work.

Overall, the study argues that as students have become increasingly dependent on ICT in their learning, they are vulnerable to techno-stressors. Hence, researchers should give more attention to technostress caused by the academic use of ICT. While the current study focuses only on WhatsApp, future research should explore techno-stressors in the context of other popular platforms. For instance, as video-conferencing technology in virtual learning has become ubiquitous, researchers could explore how the use of video-conferencing technology, such as Zoom, leads to fatigue among students and explore possible remedies to mitigate fatigue. In addition, this study identified five techno-stressors that face students. The explanatory power of the proposed model was considered moderate, suggesting that there are other factors causing fatigue that have not been examined in this study. Further research is needed to investigate other techno-stressors in educational use contexts. For example, the study showed that WhatsApp is used to exchange information and knowledge and to provide help for other students. Nevertheless, students who provide significant levels of support to their peers may experience social overload (Maier et al., 2015b). Similar to this issue is collaborative overload, a state that occurs when individuals invest too much time and energy in collaboration and supporting others (Lansmann & Klein, 2018). As study groups are used for collaborative activities and teamwork, students might face the issue of collaborative overload. Future research could thus extend technostress research in educational use contexts by investigating collaborative overload and social overload issues in online learning environments and their consequences on students and performance.

Furthermore, this study focuses on the effects of techno-stressors on psychological strain and students' performance. Other negative outcomes of techno-stressors on learning outcomes and student well-being should be explored in future research. For example, researchers could explore the effects of information and communication overload in study groups on teamwork performance or satisfaction with group work. In this regard, researchers could conduct experimental studies and examine the influence of overload in a study group on group performance and the course grades of the group members. In addition, the effect of the teacher's presence in a study group on perceived information overload could be examined. This study concentrates on academic use in general. Future research could focus on stress created by a specific academic activity. For example, as a group leader has more responsibilities, research may focus on techno-stressors that face students who have a group-leader role. This study considers only the perspective of students; another area that may be explored with regard to information overload in study groups is teachers' perspectives. Future research may look at techno-stressors encountered by teachers who join study groups online.

Coping has been identified in terms of two strategies that students use to deal with different types of stressors, thus they are considered generic strategies. Future studies could provide an in-depth explanation of students' coping mechanisms by focusing on a particular IT-related stressor. For example, information overload literature suggests different coping strategies to deal with information overload, such as filtering and withdrawing (Savolainen, 2007). Researchers could thus focus on a specific stressor that faces students and explore different coping responses that are used to deal with such stressors. Doing so would result in a better understanding of coping strategies with technostress.

The current study focuses on the negative side of technostress, which is techno-distress. Stress theory suggests that there are different types of responses to stress: distress and eustress (Selye, 1974). While distress represents a negative response to a stressful situation, eustress reflects a positive and healthy outcome of stressful situations and stress responses (Kupriyanov & Zhdanov, 2014; Le Fevre, Matheny & Kol, 2003). An individual experiences eustress when they appraise a stressful demand as a challenge (Lazarus & Folkman, 1984). This study concentrates on the negative response to stressors, which is psychological fatigue, and its negative impact on performance. Technostress research suggests that not all techno-stressors are damaging; they can also promote positive attitudes and motivate individuals (Salo et al., 2018; Tarafdar, Cooper & Stich, 2017). For example, in the context of WhatsApp, study groups may be viewed by students as opportunities to enhance their learning and gain knowledge through collaboration and interaction with other students, thus leading to positive stress. Based on this, future research could explore how demands created by the academic use of ICT are appraised as involving challenges or threats and consequently lead to positive or negative outcomes. Such research would advance our understanding of how stressors associated with academic use lead to different stress responses as well as positive and negative outcomes.

8.8 Chapter summary

The current study represents an attempt to address fatigue experienced by students due to WhatsApp usage. The study applies the concept of technostress and stress and coping theories to the context of academic use. The results of the study have contributed to the understanding as well as to the limited knowledge on stress induced by the academic use of ICT. The study uses a combination of qualitative and quantitative methods to answer the research questions and to develop an in-depth understanding of the techno-stressors that lead to fatigue and coping responses to fatigue and stressors. This chapter summarises the major findings of both quantitative and qualitative studies and presents the theoretical contributions the study has made to technostress and coping literature, and to mobile-learning literature. The study provides several practical implications for students, teachers and institutions in higher education as well as for WhatsApp service providers. These implications can help to reduce the stress created by the educational use of MIM and consequently might help students to achieve better learning outcomes. The study has limitations with regards to the generalisability of the findings and other methodological limitations, which have been addressed in this chapter. The study also offers a number of suggestions to advance technostress research. Overall, the study suggests that as the adoption of ICT in education grows, more attention should be given to address the negative side of educational use from a technostress perspective. While this research study provides valuable insights that progress our understanding of how students using WhatsApp for mobile learning suffer from fatigue, future work is needed to advance our understanding of various techno-stressors and coping responses in the academic usage contexts.

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Appendix A

Interview guide

Personal information
- Can you tell me about yourself (age, current academic level, academic discipline and school)?
General information about WhatsApp usage
- How long have you been a WhatsApp user? - Why do you use WhatsApp? - How do you describe your usage of WhatsApp? are usually you active? - On the average, how many hours a day do you spend on WhatsApp? - How often do you check WhatsApp messages? - When you receive a new message/chat how soon you feel you need to respond?
WhatsApp groups
- How many WhatsApp groups are you member in? - How would you classify these groups?
Educational use of WhatsApp
- To what extent do you use WhatsApp for educational purposes? - What other mobile instant messaging apps do you use for learning purposes? - How do you use WhatsApp for learning? - How do you evaluate WhatsApp for educational use? - How many study groups do you join in a semester? - What are the advantages and disadvantages of study groups? - To what extent do study groups help you to improve your academic performance?
Fatigue creators
- How many messages/chat you receive in a day? - How would you describe the amount of messages you receive from study groups? - What do you think could be the reasons for information overload in WhatsApp groups? - When you receive lots of messages how do you deal with that? - How often do you check WhatsApp messages while in class or studying?

- Do you receive study-related messages outside school time (during night / weekend)? How do you feel about that? - How do you feel about being connected with study groups outside school time? - What factors do you think may create fatigue when using WhatsApp for learning? - Have you experienced physical or mental fatigue due to using WhatsApp for education? What do you think were the main reasons for the experience of fatigue?
Coping response
- Could you describe event(s) when you felt/ annoyed/ frustrated/ tired due to WhatsApp usage and how did you respond to such experiences? - What would you do in situations when you feel annoyed or tired from WhatsApp? - Have you temporarily stopped or taken a break from using WhatsApp? What was the reason? - Have you left study groups? What was the reason?

Interview guide Arabic version

دليل المقابلة

البيانات الشخصية
- تحدث عن نفسك (العمر ، المستوى الأكاديمي الحالي ، التخصص والكلية)
معلومات عامة حول استخدام الواتس اب
- لماذا تستخدم الواتس اب؟ - كيف تصف استخدامك للواتس اب ؟ هل أنت مستخدم نشط ؟ - في المتوسط ، كم ساعة في اليوم تقضيها على الواتس اب؟ - كم مرة في اليوم تتحقق من رسائل الواتس اب ؟ - عندما تتلقى رسالة / دردشة جديدة ، ما مدى شعورك بالحاجة إلى الرد ؟
مجموعات الواتس اب
- كم عدد مجموعات الواتس اب التي لديك حاليا؟ - ما هي طبيعة هذي المجموعات (مجموعات دراسية، عائليه، أصدقاء)؟
الاستخدام التعليمي للواتس اب
- إلى أي مدى تستخدم واتس اب للأغراض التعليمية ؟ - ما هي تطبيقات المراسلة الفورية الأخرى التي تستخدمها لأغراض التعلم؟

- كيف تستخدم واتس اب للتعلم ؟
- ما هو تقييمك للاستخدام التعليمي للواتس اب ؟
- كم عدد مجموعات الدراسة التي تنضم إليها خلال الفصل الدراسي ؟
- برأيك ما هي مزايا وعيوب مجموعات الدراسة ؟
- إلى أي مدى تساعدك مجموعات الدراسة على تحسين أدائك الأكاديمي ؟

عوامل تسبب الإرهاق

- كم عدد الرسائل / المحادثات التي تتلقاها في الواتس اب في اليوم ؟
- كيف تصف كمية الرسائل التي تتلقاها من مجموعات الدراسة ؟
- برأيك ما هي أسباب زيادة المعلومات و المحادثات في المجموعات الدراسية في الواتس اب؟
- عندما تصلك الكثير من الرسائل كيف تتعامل مع ذلك؟
- كم مرة تتحقق من رسائل الواتس اب أثناء وجودك في الفصل أو أثناء قيامك بمهام تعليميه مثل المذاكرة أو حل الواجبات؟
- هل تتلقى رسائل متعلقة بالدراسة خارج أوقات الدوام المدرسي (أثناء الليل / عطلة نهاية الأسبوع)؟ كيف تشعر حيال ذلك؟
- ما هو شعورك حيال الارتباط بمجموعات الدراسة خارج وقت المدرسة ؟
- ما هي العوامل التي تؤدي إلى الإرهاق أو التعب عند استخدام الواتس اب لأغراض اكاديميه ؟
- هل عانيت من إرهاق جسدي أو نفسي بسبب استخدام الواتس للتعليم؟ ما هي برأيك الأسباب الرئيسية للشعور بالإرهاق؟

التغلب على ارهاق الواتس اب

- هل يمكنك وصف موقف شعرت فيه بالانزعاج أو بالإحباط أو بالتعب بسبب استخدام الواتس اب وكيف تعاملت مع هذا الموقف ؟
- ماذا تفعل غالبا في المواقف التي تشعر فيها بالضيق أو التعب من الواتس اب ؟
- -هل سبق أن توقفت مؤقتًا عن استخدام الواتس اب؟ ما هو السبب ؟
- - هل سبق أن غادرت مجموعات دراسية ؟ ماذا كان السبب؟

Appendix B

Interview participant information sheet and consent form

Nottingham University
Business School
UK | CHINA | MALAYSIA

Information for Research Participants

Thank you for agreeing to participate in a PhD research project. Your participation in this research is voluntary, and you may change your mind about being involved in the research at any time, and without giving a reason. This information sheet is designed to give you full details of the research project, its goals, the research team, and what you will be asked to do as part of the research. If you have any questions that are not answered by this information sheet, please ask.
This research has been reviewed and given favourable opinion by the Nottingham University Business School Research Ethics Committee.

Study title: The use of WhatsApp for online learning and the experience of fatigue among university students
Researcher: Hafsa Al abdullateef. PhD student at University of Nottingham, Business school

What is this study about?
The purpose of this study is to understand the effect of using WhatsApp for learning purposes on students' well-being and their academic performance. It explores factors associated with WhatsApp use that create fatigue among university students and their coping behaviours to reduce fatigue.

What will taking part involve?
This study will conduct interviews to collect data from participants. After you give your consent to participate in the study, you will be invited to take part in an interview, which could be about 40-60 minutes. The interview will be conducted (via Zoom). During the interview, you will be asked questions about your experience with WhatsApp for learning. The questions will include topics such as your academic usage of WhatsApp, how you evaluate WhatsApp for learning, what makes you feel fatigued and overwhelmed when using WhatsApp and how do you deal with fatigue. Your participation in the interview involves your consent to be audio-recorded, which also will be stored for transcribing.

Do you have to take part?
Your participation in this study is completely voluntary and you have the right to refuse participation, you also have the right to refuse any question and withdraw at any time without any consequence whatsoever.

Why have I been chosen?
This study focuses undergraduate students and their experience with WhatsApp in education. The study is conducted on Imam Abdulrahman Bin Faisal University (IAU). Undergraduate students in this university are invited to take part. If you are a current undergraduate student at IAU, has completed at least a semester and use WhatsApp for learning you could be a potential participant in the study.

What will happen to the information I provide?

Participating in the research is not anticipated to cause you any disadvantages or discomfort. the study will not collect data on sensitive topics, and all your information will be treated confidentially. This study aims to develop a deep understanding of negative outcomes of using WhatsApp for learning. The findings of this study might help in developing mechanisms to reduce sources of fatigue and overload. It might help students to enhance their experience with WhatsApp and improve their well-being by avoiding sources of fatigue.

All information which is collected about you during the course of the research will be kept on a password protected database and is strictly confidential. You will be given an ID code which will be used instead of your name. Some of your words from the interviews may be used in the thesis and other outputs (e.g. publications and presentations) but any identifiable information you may give will be removed and anonymized.
This study will ensure the confidentiality and anonymity of the participant through the following steps:

- The data will be collected, analysed by the principal investigator.
- Your identity will be anonymised and will not appear in the research results.
- The data will be recorded and stored on password-protected personal computer and accessed only by the principal investigator and supervisors.
- Your data will not be shared with any parties without your consent.
- Your data will be used only for academic purposes.
- Your personal data (e.g. email address, telephone number) will be kept for up to 12 months after the end of the study so that we are able to contact you about the findings of the study (unless you advise us that you do not wish to be contacted).

All other research data will be kept securely for 4 years. After this time, your data will be disposed of securely. Under freedom of information legalisation, you are entitled to access the information you have provided at any time.

What will be the outputs of the research?

The results of this study will be used in writing the PhD thesis. The results might be published in an academic conference and journal. You will not be identified in any report or publication. If you wish to be given a copy of any reports resulting from the research, please ask us to put you on our circulation list.

Appendix B

Contact details

Researcher: Hafsa AL abdullateef
Email: Hafsa.alabdullateef@nottingham.ac.uk

Supervisors:

Thomas Chesney
Business school, University of Nottingham, Nottingham, UK
Email: Thomas.chesney@nottingham.ac.uk
Robert Pasley
Business school, University of Nottingham, Nottingham, UK
Email: Robert.pasley@nottingham.ac.uk

Complaint procedure
If you wish to complain about the way in which the research is being conducted or have any concerns about the research then in the first instance please contact the *[Principal Investigator or supervisor]*.
Or contact the School's Research Ethics Officer:
Davide Pero
Nottingham University Business School
Jubilee Campus
Nottingham NG8 1BB
Phone: 0115 84 67763
Email: davide.pero@nottingham.ac.uk

Consent form

Please tick the appropriate boxes

I confirm that I have read and understood the information above.	☐
I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐
I understand that the anonymised transcript of the interview will be stored.	☐
I understand that the interview data will remain confidential	☐
I understand that information I provide and my anonymised words will be used for PhD study, academic conferences and publications.	☐
I consent to being a participant in the project.	☐
I consent to the interview being audio recorded as part of the project.	☐

Name of participant [IN CAPITALS] ______________________________
Signature of Participant: ______________________________ Date: ________________

Interview participant information sheet and consent form Arabic version

معلومات للمشاركين في الدراسة

شكرا لموافقتك على المشاركة في مشروع بحث الدكتوراه. مشاركتك في هذا البحث تطوعية ، ويمكنك تغيير رأيك بشأن المشاركة في البحث في أي وقت ودون ذكر الأسباب. تم تصميم ورقة المعلومات هذه لتزويدك بتفاصيل كاملة عن مشروع البحث وأهدافه وفريق البحث وما سيُطلب منك القيام به. إذا كانت لديك أي أسئلة لم يتم الرد عليها في ورقة المعلومات هذه ، فيرجى طرحها.

تمت مراجعة هذا البحث والموافقة عليه من قبل لجنة أخلاقيات البحث في كلية إدارة الأعمال بجامعة نوتنغهام.

عنوان الدراسة: استخدام الواتس اب لأغراض تعليمية وتجربة الارهاق لدى طلبة الجامعة

الباحثة: حفصة العبداللطيف. طالبة دكتوراه في جامعة نوتنغهام ، كلية إدارة الأعمال

معلومات حول الدراسة

الغرض من هذه الدراسة هو فهم تأثير استخدام تطبيق واتس اب لأغراض التعلم على رفاهية الطلاب وأدائهم الأكاديمي.

يستكشف هذا البحث العوامل المرتبطة باستخدام الواتس اب التي تسبب التعب بين طلاب الجامعة وسلوكيات التأقلم الخاصة بهم لتقليل هذا التعب.

ماذا ستشمل المشاركة في هذا البحث؟

ستجري هذه الدراسة مقابلات لجمع البيانات من المشاركين. بعد منح موافقتك على المشاركة في الدراسة ، ستتم دعوتك للمشاركة في مقابلة ، والتي قد تستغرق حوالي 40-60 دقيقة. سيتم إجراء المقابلة (عبر زووم أثناء المقابلة ، سيتم طرح أسئلة عليك حول تجربتك مع الواتس اب. ستشمل الأسئلة موضوعات مثل استخدامك الأكاديمي لتطبيق الواتس اب ، وكيفية تقييمك لتطبيق الواتس اب للتعلم ، وما العوامل التي تجعلك تشعر بالإرهاق او التعب عند استخدام الواتس اب وكيف تتعامل مع التعب.

تتضمن مشاركتك في المقابلة موافقتك على التسجيل الصوتي ، والذي سيتم أيضًا تخزينه.

هل عليك المشاركة في الدراسة؟

مشاركتك في هذه الدراسة تطوعية تمامًا ولديك الحق في رفض المشاركة ، كما يحق لك رفض أي سؤال والانسحاب في أي وقت دون أي عواقب على الإطلاق.

لماذا تم اختياري؟

تركز هذه الدراسة على الطلاب الجامعيين وتجربتهم مع الواتس اب في التعليم. أجريت الدراسة على جامعة الإمام عبدالرحمن بن فيصل. طلاب البكالوريوس في هذه الجامعة مدعوون للمشاركة. إذا كنت طالبًا جامعيًا حاليًا في هذي الجامعة، وقد أكملت فصلًا دراسيًا على الأقل تستخدم الواتس لأغراض تعليمية ، فقد تكون مشاركًا محتملًا في الدراسة.

ماذا سيحدث للمعلومات التي أقدمها؟

لن تقوم الدراسة بجمع بيانات حول مواضيع حساسة ، وسيتم التعامل مع جميع معلوماتك بسرية تامة. تهدف هذه الدراسة إلى تطوير فهم عميق للنتائج السلبية لاستخدام الواتس اب للتعلم. قد تساعد نتائج هذه الدراسة في تطوير آليات لتقليل مصادر التعب والحمل الزائد. قد يساعد الطلاب على تعزيز تجربتهم مع الواتس وتحسين رفاههم من خلال تجنب مصادر التعب.

سيتم الاحتفاظ بجميع المعلومات التي يتم جمعها عنك أثناء إجراء البحث في قاعدة بيانات محمية بكلمة مرور وسرية للغاية. سيتم إعطاؤك رمز تعريف الذي سيتم استخدامه بدلاً من اسمك. قد يتم استخدام بعض كلماتك من المقابلات في تقرير البحث والمخرجات الأخرى (مثل المنشورات والعروض التقديمية) ولكن ستتم إزالة أي معلومات تعريفية وسيتم إخفاء هويتك.

ستضمن هذه الدراسة السرية وعدم الكشف عن هويته للمشارك من خلال الخطوات التالية:

سيتم جمع البيانات وتحليلها من قبل الباحث الرئيسي.
سيتم إخفاء هويتك ولن تظهر في نتائج البحث.
سيتم تسجيل البيانات وتخزينها على جهاز كمبيوتر شخصي محمي بكلمة مرور ولن يتم الوصول إليها إلا من قبل الباحث والمشرفين الرئيسيين.
لن تتم مشاركة بياناتك مع أي أطراف أخرى دون موافقتك.
سيتم استخدام بياناتك للأغراض الأكاديمية فقط.
سيتم الاحتفاظ ببياناتك الشخصية (مثل عنوان البريد الإلكتروني ورقم الهاتف) لمدة تصل إلى 12 شهرًا بعد انتهاء الدراسة حتى نتمكن من الاتصال بك بشأن نتائج الدراسة (ما لم تخبرنا أنك لا ترغب في ذلك. ليتم الاتصال بك).
سيتم الاحتفاظ بجميع بيانات البحث الأخرى بشكل آمن لمدة 4 سنوات. بعد هذا الوقت ، سيتم التخلص من بياناتك بشكل آمن. يحق لك الوصول إلى المعلومات التي قدمتها في أي وقت.

ماذا ستكون مخرجات البحث؟

سيتم استخدام نتائج هذه الدراسة في كتابة رسالة الدكتوراه. يمكن نشر النتائج في مؤتمر ومجلة أكاديمية. لن يتم تحديد هويتك في أي تقرير أو منشور. إذا كنت ترغب في الحصول على نسخة من أي تقارير ناتجة عن هذا البحث ، فيرجى اخبارنا بذلك.

للتواصل:
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المشرفون:
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كلية إدارة الأعمال ، جامعة نوتنغهام ، نوتنغهام ، المملكة المتحدة
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روبرت باسلي
كلية إدارة الأعمال ، جامعة نوتنغهام ، نوتنغهام ، المملكة المتحدة
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إذا كنت ترغب في تقديم شكوى بشأن الطريقة التي يتم بها إجراء البحث أو كانت لديك أية مخاوف بشأن البحث ، فيرجى في المقام الأول الاتصال بـ الباحث الرئيسي أو المشرف أو اتصل بمسؤول أخلاقيات البحث:
دافيد بيرو
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نموذج الموافقة

يرجى وضع علامة في المربعات المناسبة

أؤكد أنني قد قرأت وفهمت المعلومات الواردة أعلاه.	☐
لقد تمكنت من طرح أسئلة حول الدراسة وتم الرد على أسئلتي بما يرضي.	☐
أوافق طواعية على أن أكون مشاركًا في هذه الدراسة وأفهم أنه يمكنني رفض الإجابة على الأسئلة ويمكنني الانسحاب من الدراسة في أي وقت ، دون الحاجة إلى إبداء الأسباب.	☐
أفهم أنه سيتم تخزين نسخة من المقابلة مع إخفاء الهوية.	☐
أفهم أن بيانات المقابلة ستبقى سرية.	☐
أفهم أن المعلومات التي أقدمها وأن كلماتي سيتم استخدامها لدراسة الدكتوراه والمؤتمرات والمنشورات الأكاديمية .	☐
أوافق على أن أكون مشاركًا في الدراسة	☐
أوافق على تسجيل المقابلة صوتيًا كجزء من الدراسة .	☐

اسم المشارك:.............................

توقيع المشارك: ....

التاريخ:....................................

Appendix C

Online Questionnaire

Introduction

Thank you for agreeing to participate in this survey. The purpose of this study is to understand the effect of using WhatsApp for learning purposes on students' well-being and their academic performance. The study is conducted at Imam Abdulrahman Bin Faisal University (IAU). If you are a current undergraduate student at IAU, have completed at least a semester and use WhatsApp for learning you are invited to fill a questionnaire that will take about 12 – 15 minutes to complete. Your participation in this research is voluntary, and you may change your mind about being involved in the research at any time, and without giving a reason. All responses are confidential and anonymous and will be used for research purpose only. All the information collected from you will not be given to any third party and it will be safely stored and secured. This research has been reviewed and given favourable opinion by the Nottingham University Business School Research Ethics Committee. If you have any concerns or complains about the research then please contact:
Hafsa AL abdullateef, Hafsa.alabdullateef@nottingham.ac.uk, or contact Prof Thomas Chesney, Business school, University of Nottingham, Nottingham, UK Thomas.chesney@nottingham.ac.uk

Part 1

A. Please indicate, during the current semester how often do you use WhatsApp for the following academic activities both in and out of the class

	Always	**Often**	**Sometimes**	**Rarely**	**Never**
Accessing study-related information, announcements and materials.	☐	☐	☐	☐	☐
Sharing study-related information, announcements and materials.	☐	☐	☐	☐	☐
Discussing study-related matters with other students.	☐	☐	☐	☐	☐
Collaborating on course projects with other students.	☐	☐	☐	☐	☐
Exam preparation.	☐	☐	☐	☐	☐

Appendix C

B. Please indicate, during the current semester how often do you use WhatsApp for the following non-academic activities both in and out of the class

	Always	**Often**	**Sometimes**	**Rarely**	**Never**
Reading and sending direct messages.	☐	☐	☐	☐	☐
Sending messages containing videos, photos, information or broadcasts.	☐	☐	☐	☐	☐
Chatting in WhatsApp groups.	☐	☐	☐	☐	☐
Reading group messages.	☐	☐	☐	☐	☐

Part 2

A. Below is a set of statements regarding your experience with WhatsApp. Please, indicate to what extent you agree you agree or disagree with each statement.

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
I receive too many messages (chat, private messages), notifications and announcements through WhatsApp.	☐	☐	☐	☐	☐
I generally send too many messages and posts through WhatsApp.	☐	☐	☐	☐	☐
I waste a lot of my time responding to WhatsApp messages.	☐	☐	☐	☐	☐
I end up spending more time on WhatsApp than planned.	☐	☐	☐	☐	☐
I am often distracted by the excessive amount of information shared in study groups.	☐	☐	☐	☐	☐
It is difficult for me to focus on the essential information in study groups.	☐	☐	☐	☐	☐
The amount of messages in study groups makes me overlook important information.	☐	☐	☐	☐	☐
Because of too much information/chatting/discussion in study groups, I find it difficult to read all messages and posts.	☐	☐	☐	☐	☐
WhatsApp notifications often distract me while studying.	☐	☐	☐	☐	☐
I feel WhatsApp during lectures distracts my attention.	☐	☐	☐	☐	☐

I feel using WhatsApp while studying inhibits my concentration on study work.	☐	☐	☐	☐	☐
Because of the use of WhatsApp for study-related purposes, I have to be in touch with my study-related work even during the weekend.	☐	☐	☐	☐	☐
I have to sacrifice my vacation and weekend time to keep current with study-related work.	☐	☐	☐	☐	☐
I feel I have to be always connected with study groups.	☐	☐	☐	☐	☐
I spend less time with my family due to academic use of WhatsApp.	☐	☐	☐	☐	☐
I feel uncomfortable that my use of WhatsApp can be easily monitored.	☐	☐	☐	☐	☐
I feel my privacy can be compromised because information about my use of WhatsApp (‘online status’, ‘last seen’) can be accessed by others.	☐	☐	☐	☐	☐
I feel my privacy on WhatsApp can be invaded because my reading activities can be monitored.	☐	☐	☐	☐	☐
Sometimes, I feel tired when using WhatsApp.	☐	☐	☐	☐	☐
Sometimes, I feel bored when using WhatsApp.	☐	☐	☐	☐	☐
Sometimes, I feel drained from using WhatsApp.	☐	☐	☐	☐	☐
Sometimes, I feel worn out from using WhatsApp.	☐	☐	☐	☐	☐
Using WhatsApp would improve my academic performance.	☐	☐	☐	☐	☐
Using WhatsApp would enhance my effectiveness in learning.	☐	☐	☐	☐	☐
Using WhatsApp enables me to accomplish study tasks more quickly.	☐	☐	☐	☐	☐

B. Please indicate to what extent the following statements apply to you in your daily life

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
I often find myself worrying about something.	☐	☐	☐	☐	☐
I suffer from nervousness.	☐	☐	☐	☐	☐
My mood often goes up and down.	☐	☐	☐	☐	☐
I often lose sleep over my worries.	☐	☐	☐	☐	☐

Part 3

A. In situations when you feel that the use of WhatsApp becomes unpleasant or annoying, please indicate to which extent your thoughts and actions correspond to the following statements.

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
I would change notification settings to decide which groups I want to turn notifications off for.	☐	☐	☐	☐	☐
I would I disable unnecessary WhatsApp notifications.	☐	☐	☐	☐	☐
I would adjust the privacy settings of the app.	☐	☐	☐	☐	☐
I keep the app up to date to provide more control over the notifications.	☐	☐	☐	☐	☐
I try to keep away from the app.	☐	☐	☐	☐	☐
I separate myself as much as possible from WhatsApp.	☐	☐	☐	☐	☐
I turn to other activities to take my mind off WhatsApp.	☐	☐	☐	☐	☐
I avoid entering some WhatsApp groups.	☐	☐	☐	☐	☐
I try to ignore some groups’ messages.	☐	☐	☐	☐	☐

Part 4

Personal information

1. What is your sex?
    - Male
    - Female

2. What is your age?
    - < 18
    - 18 – 21
    - 22 – 25
    - 26 – 29
    - 30 – 34
    - > 34

3. Are a current student at Imam Abdulrahman Bin Faisal University?
    - Yes
    - No, I am a graduate student
    - No, I am a student at a different university

4. Current educational level
    - Diploma
    - Undergraduate
    - Postgraduate (Master or PhD)

5. Current academic year
    - First year
    - Second year
    - Third year
    - Fourth year
    - Fifth year
    - Sixth year

6. What school/collage are you currently in?
    - College of Applied Studies and Community Service
    - College of Art
    - College of Medicine
    - College of Science
    - College of Business Administration
    - College of Computer Science and Information Technology
    - College of Education
    - College of Design

- College of Engineering
- Other

7. How many hour(s) per day do you send on WhatsApp?
   - Less than 30 minutes
   - 30 mins to 1 hour
   - More than 1 hour to 2 hours
   - More than 2 hours to 3 hours
   - More than 3 hours to 4 hours
   - More than 4 hours to 5 hours
   - More than 5 hours to 6 hours
   - More than 6 hours

8. How many study groups do you have?

   - No group
   - 1 – 5 groups
   - 6 – 10 groups
   - 11 – 15 groups
   - 16 – 20 groups
   - 21 – 25 groups
   - 26 – 30 groups
   - More than 30 groups

9. How many non-study groups do you have?

   - No group
   - 1 – 5 groups
   - 6 – 10 groups
   - 11 – 15 groups
   - 16 – 20 groups
   - 21 – 25 groups
   - 26 – 30 groups
   - More than 30 groups

Thank you for taking the time to complete this survey

Online Questionnaire Arabic version

استبيان

شكرا لموافقتك على المشاركة في هذا الاستبيان. الغرض من هذه الدراسة هو فهم تأثير استخدام تطبيق الواتس اب لأغراض تعليمية على رفاهية الطلاب وأدائهم الأكاديمي. أجريت الدراسة على جامعة الإمام عبدالرحمن بن فيصل. إذا كنت طالبًا جامعيًا حاليًا في هذه الجامعة، وقد أكملت فصلًا دراسيًا على الأقل وتستخدم واتس اب للتعلم ، فأنت مدعو للمشاركة هي هذا الاستبيان والذي سيستغرق إكماله حوالي 12 - 15 دقيقة. مشاركتك تطوعية ، ويمكنك تغيير رأيك بشأن المشاركة في البحث في أي وقت ودون إبداء الأسباب. جميع الردود ستعامل بسرية وسيتم إخفاء هوية المشاركين وستستخدم لأغراض البحث فقط. لن يتم مشاركة المعلومات التي تم جمعها منك مع أي طرف ثالث وسيتم تخزين المعلومات بأمان. تمت مراجعة هذا البحث وإبداء رأي إيجابي من قبل لجنة أخلاقيات البحث في كلية إدارة الأعمال بجامعة نوتنغهام. إذا كانت لديك أي مخاوف أو شكوى بشأن البحث ، فيرجى الاتصال بـ:
حفصة عبد اللطيف ، Hafsa.alabdullateef@nottingham.ac.uk ، أو اتصل بالبروفيسور توماس شيسني ، كلية إدارة الأعمال ، جامعة نوتنغهام ، المملكة المتحدة Thomas.chesney@nottingham.ac.uk

الجزء الأول

أ. من فضلك حدد إلى أي مدى تستخدم تطبيق الواتس اب للأنشطة الأكاديمية التالية سواء داخل قاعات الدراسة أو خارجها خلال الفصل الدراسي الحالي.

	دائما	غالبا	بعض الأحيان	نادراً	لا أفعل أبدا
الوصول إلى المعلومات والإعلانات والمواد المتعلقة بالدراسة.	☐	☐	☐	☐	☐
تبادل المعلومات والإعلانات المتعلقة بالدراسة	☐	☐	☐	☐	☐
مناقشة الأمور المتعلقة بالدراسة مع الطلاب الآخرين.	☐	☐	☐	☐	☐
التعاون في مشاريع الدورة مع الطلاب الآخرين.	☐	☐	☐	☐	☐
التحضير للامتحانات.	☐	☐	☐	☐	☐

ب. من فضلك حدد إلى أي مدى تستخدم تطبيق الواتس اب للأنشطة غير الأكاديمية التالية سواء داخل قاعات الدراسة أو خارجها خلال الفصل الدراسي الحالي.

	دائما	غالبا	بعض الأحيان	نادراً	لا أفعل أبدا
قراءة وإرسال الرسائل المباشرة.	☐	☐	☐	☐	☐
إرسال رسائل تحتوي على مقاطع فيديو أو صور أو معلومات.	☐	☐	☐	☐	☐
الدردشة في مجموعات الواتس اب.	☐	☐	☐	☐	☐
قراءة الرسائل الجماعية.	☐	☐	☐	☐	☐
قراءة وإرسال الرسائل المباشرة.	☐	☐	☐	☐	☐

الجزء الثاني

أ. فيما يلي مجموعة من العبارات المتعلقة بتجربتك مع استخدام الواتس اب في التعليم. من فضلك ، وضح إلى أي مدى توافق أو لا توافق على العبارات التالية.

	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
تصلني الكثير من الرسائل والاشعارات من خلال تطبيق الواتس اب	☐	☐	☐	☐	☐
بشكل عام أقوم بإرسال الكثير من الرسائل والردود عن طريق الواتس اب	☐	☐	☐	☐	☐
يضيع الكثير من وقتي بسبب الرد على محادثات الواتس اب.	☐	☐	☐	☐	☐
أقضى وقت على التطبيق أطول مما اخطط له.	☐	☐	☐	☐	☐
غالبا تشتتني كمية المعلومات أو المحادثات المرسلة في المجموعات الدراسية.	☐	☐	☐	☐	☐
يصعب التركيز على المعلومات الأساسية في المجموعات الدراسية أحيانا.	☐	☐	☐	☐	☐
كثرة المحادثات في المجموعات الدراسية تجعلني أغفل المعلومات المهمة.	☐	☐	☐	☐	☐
بسبب كثره المعلومات / المحادثات / المناقشات في المجموعات الدراسية ، أجد من الصعب قراءة كل الرسائل المرسلة.	☐	☐	☐	☐	☐
غالبا ما تشتت إشعارات الواتس اب انتباهي وقت الدراسة.	☐	☐	☐	☐	☐
أشعر أن استخدام الواتس اب خلال وقت المحاضرات يشتت تركيزي.	☐	☐	☐	☐	☐
أشعر أن استخدام الواتس اب (اثناء دراستي) يمنعني من التركيز.	☐	☐	☐	☐	☐
بسبب استخدام الواتس اب للأمور المتعلقة بالجامعة والدراسة لا بد أن أكون متواصل مع زملاء الجامعة حتى خلال عطلة نهاية الأسبوع.	☐	☐	☐	☐	☐
لا بد أن أتواصل مع مجموعات الدراسة خلال عطلة نهاية الأسبوع لأكون على علم بما يستجد من أمور الدراسة.	☐	☐	☐	☐	☐
أشعر أنني يجب أن أكون متواصل بشكل دائم مع مجموعات الدراسة او زملاء الجامعة.	☐	☐	☐	☐	☐
بسبب استخدام الواتس اب للأمور المتعلقة بالجامعة والدراسة أجد أني أقضي وقت أقل مع عائلتي.	☐	☐	☐	☐	☐
يزعجني أن الاخرين يمكنهم مراقبة اتصالي بالواتس اب.	☐	☐	☐	☐	☐
أشعر أن الاخرين يمكنهم التدخل في خصوصيتي من خلال معرفة ظهوري واتصالي بالواتس اب.	☐	☐	☐	☐	☐
أشعر أن التطبيق يسمح للآخرين بالتطفل علي خصوصيتي من خلال مراقبة قراءتي أو عدم قراءتي للرسائل.	☐	☐	☐	☐	☐
أحيانا، أشعر بالتعب من استخدام الواتس اب.	☐	☐	☐	☐	☐
أحيانا أشعر بالملل من استخدام الواتس اب.	☐	☐	☐	☐	☐
أحيانا، أشعر بالإرهاق من استخدام الواتس اب.	☐	☐	☐	☐	☐
أحيانا، اشعر بالضجر من استخدام الواتس اب.	☐	☐	☐	☐	☐
استخدام الواتس اب يساعد على تحسين مستوى ادائي الجامعي.	☐	☐	☐	☐	☐

استخدام الواتس اب يحسن فعاليتي في التعلم	☐	☐	☐	☐	☐
تطبيق الواتس اب يساعدني علي انجاز المهام الدراسية بشكل اسرع	☐	☐	☐	☐	☐
استخدام الواتس اب يساعد على تحسين مستوى ادائي الجامعي	☐	☐	☐	☐	☐

ب. من فضلك حدد إلى أي مدى تنطبق العبارات التالية عليك في تعاملك مع المواقف اليومية بشكل عام.

	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
كثيرا ما أقلق بشأن شيء ما	☐	☐	☐	☐	☐
أنا أصاب بالتوتر بسهولة	☐	☐	☐	☐	☐
غالبا، أنا شخص متقلب المزاج	☐	☐	☐	☐	☐
كثيرا ما أصاب بالأرق بسبب القلق	☐	☐	☐	☐	☐
كثيرا ما أقلق بشأن شيء ما	☐	☐	☐	☐	☐

الجزء الثالث

أ. في المواقف التي تشعر فيها أن استخدام الواتس أصبح غير مريح بالنسبة لك أو عندما تصبح متضايق من استخدامك للتطبيق حدد إلى أي مدى تقوم بما يلي للتخلص مما يزعجك أو يضايقك.

	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
أقوم بتعطيل إشعارات الـواتس اب الغير ضرورية.	☐	☐	☐	☐	☐
أقوم بتغيير إعدادات الإشعارات لتحديد المجموعات التي أريد إيقاف تشغيل الإشعارات لها.	☐	☐	☐	☐	☐
أهتم بجعل التطبيق محدثاً لآخر تحديث لتوفير مزيد من التحكم في الإشعارات و باقي الخصائص.	☐	☐	☐	☐	☐
أقوم بضبط إعدادات الخصوصية للتطبيق.	☐	☐	☐	☐	☐
أفصل نفسي قدر الإمكان عن التطبيق.	☐	☐	☐	☐	☐
أحاول ألا أكون قلقًا بشأن ما يحدث في الواتس اب.	☐	☐	☐	☐	☐
أحاول أن أتجنب دخول بعض المجموعات.	☐	☐	☐	☐	☐
أحاول الابتعاد عن الواتس اب.	☐	☐	☐	☐	☐
أحاول تجاهل رسائل بعض المجموعات	☐	☐	☐	☐	☐

الجزء الرابع

البيانات الشخصية

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- أنثى

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- ١٨ – ٢١
- ٢٢ – ٢٥
- ٢٦ – ٢٩
- ٣٠ – ٣٤
- أكبر من ٣٤

٣. هل تدرس حاليا في جامعة الإمام عبدالرحمن بن فيصل؟
- نعم
- لا، أنا خريج
- لا، جامعة أخرى

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- سنة ثالثة
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- سنة سادسة

٦. الكلية التي تدرس فيها حاليا
- كلية الدراسات التطبيقية وخدمة المجتمع
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- كلية علوم الحاسب وتقنية المعلومات
- كلية التربية
- كلية التصاميم
- كلية الهندسة
- أخرى ......

٧. متوسط الوقت الذي تقضيه على الواتس اب خلال أيام الدراسة

- اقل من ٣٠ دقيقة يوميا
- ٣٠ دقيقة الى ساعة يوميا
- أكثر من ساعة الى ساعتين يوميا
- أكثر من ساعتين الى ٣ ساعات يوميا
- أكثر من ٣ ساعات الى ٤ ساعات يوميا
- أكثر من ٤ ساعات الى ٥ ساعات يوميا
- أكثر من ٥ ساعات إلى ٦ ساعات يوميا
- أكثر من ٦ ساعات يوميا

٨. عدد المجموعات الدراسية الفعالة التي يصلك منها رسائل بشكل يومي أو اسبوعي على الأقل

- لا توجد لدي مجموعات دراسية
- ١ – ٥ مجموعات
- ٦ – ١٠ مجموعات
- ١١ – ١٥ مجموعة
- ١٦ – ٢٠ مجموعة
- ٢١ – ٢٥ مجموعة
- ٢٦ – ٣٠ مجموعة
- أكثر من ٣٠ مجموعة

٩. عدد المجموعات الغير دراسية الفعالة التي يصلك منها رسائل بشكل يومي أو اسبوعي على الأقل

- لا توجد
- ١ – ٥ مجموعات
- ٦ – ١٠ مجموعات
- ١١ – ١٥ مجموعة
- ١٦ – ٢٠ مجموعة
- ٢١ – ٢٥ مجموعة
- ٢٦ – ٣٠ مجموعة
- أكثر من ٣٠ مجموعة

شكرا لتخصصيك وقت لإكمال هذا الاستبيان

Appendix D

Characteristics of sample in the pilot study

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	51	22.2	22.2	22.2
	Female	179	77.8	77.8	100.0
	Total	230	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
	18 - 21	152	66.1	66.1	66.5
	22 - 25	62	27.0	27.0	93.0
	26 - 29	9	3.9	3.9	97.0
	30 - 34	3	1.3	1.3	98.3
	> 34	4	1.7	1.7	100.0
	Total	230	100.0	100.0	

Current educational level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	23	10.0	10.0	10.0
	Foundation Year	48	20.9	20.9	30.9
	Undergraduate	151	65.7	65.7	96.5
	Postgraduate	8	3.5	3.5	100.0
	Total	230	100.0	100.0	

Appendix D

Current academic year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	First Year	55	23.9	23.9	23.9
	Second Year	50	21.7	21.7	45.7
	Third Year	64	27.8	27.8	73.5
	Fourth Year	32	13.9	13.9	87.4
	Fifth Year	19	8.3	8.3	95.7
	Sixth Year	10	4.3	4.3	100.0
	Total	230	100.0	100.0	

Number of study groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - 5	143	62.2	62.2	62.2
	6 - 10	67	29.1	29.1	91.3
	11 - 15	17	7.4	7.4	98.7
	16 - 20	2	.9	.9	99.6
	21 - 25	1	.4	.4	100.0
	Total	230	100.0	100.0	

Daily time spent on WhatsApp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30 min	34	14.8	14.8	14.8
	30 min to 1 hour	48	20.9	20.9	35.7
	> 1 to 2 hours	50	21.7	21.7	57.4
	> 2 to 3 hours	35	15.2	15.2	72.6
	> 3 to 4 hours	24	10.4	10.4	83.0
	> 4 to 5 hours	16	7.0	7.0	90.0
	> 5 to 6 hours	5	2.2	2.2	92.2
	> 6 hours	18	7.8	7.8	100.0
	Total	230	100.0	100.0	

Appendix E

The results of Harman's single factor test for CMB

Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %	Rotation Sums of Squared Loadings Total	Rotation Sums of Squared Loadings % of Variance	Rotation Sums of Squared Loadings Cumulative %
1	**7.398**	**15.740**	**15.740**	**7.398**	**15.740**	**15.740**	**2.863**	**6.091**	**6.091**
2	4.745	10.095	25.835	4.745	10.095	25.835	2.766	5.886	11.977
3	3.115	6.627	32.462	3.115	6.627	32.462	2.725	5.797	17.774
4	2.002	4.260	36.722	2.002	4.260	36.722	2.702	5.750	23.524
5	1.893	4.027	40.749	1.893	4.027	40.749	2.533	5.388	28.913
6	1.792	3.812	44.561	1.792	3.812	44.561	2.492	5.301	34.214
7	1.643	3.495	48.056	1.643	3.495	48.056	2.486	5.289	39.504
8	1.494	3.178	51.234	1.494	3.178	51.234	2.401	5.108	44.611
9	1.335	2.841	54.075	1.335	2.841	54.075	2.251	4.789	49.400
10	1.187	2.525	56.600	1.187	2.525	56.600	2.225	4.735	54.135
11	1.148	2.443	59.043	1.148	2.443	59.043	2.103	4.475	58.609
12	1.004	2.136	61.179	1.004	2.136	61.179	1.208	2.570	61.179

Extraction Method: Principal Component Analysis.

Appendix F

Measurement invariance assessment

The procedure of measurement invariance of composite models (MICOM) includes three steps: the assessment of (1) configural invariance, (2) compositional invariance and (3) equality of composite mean values and variances (Henseler, Ringle & Sarstedt, 2016). Either full or partial measurement invariance should be established in order to proceed with multi group analysis (MGA) (Henseler, Ringle & Sarstedt, 2016). Full measurement invariance means that the three steps are confirmed while partial measurement invariance is established when both configural invariance and compositional invariance (step 1 and 2) are confirmed (Cheah et al., 2020). The configural invariance step ensures the use of (1) identical indicators in both groups when checking the reliability and validity, (2) identical data treatment and (3) similar PLS algorithm settings. Configural invariance was automatically established when running MICOM in SmartPLS (Cheah et al., 2020). The compositional invariance step assesses whether a composite is formed in the same manner across the groups (Hair et al., 2017a). Compositional invariance was tested by using the MICOM test in SmartPLS, which examines whether the composite scores significantly differ across groups. To establish compositional invariance, the correlation between the composite scores of the first and second groups should not be significantly lower than one (Cheah et al., 2020). The results of the MICOM test indicate that such a condition was confirmed as all the correlations in the original correlation column were not significant (see Table 1), thus compositional invariance was confirmed. The next step was to assess the equality of composite mean values and variances across the groups. In this step, the mean and variance of each construct should fall within the 95% confidence interval (Cheah et al., 2020). The results in Table 2 show that most of the means values (in the mean - original difference column) do not fall between the 2.5% and 97.5% boundaries. Likewise, some variance original difference values (in the variance - original difference column) do not fall within the 95% confidence interval therefore, composite equality was not met. By establishing configural invariance and compositional invariance in step 1 and 2, partial measurement invariance was confirmed, therefore MGA was executed.

Appendix F

Table 1: MICOM (step 2)

	Original Correlation	Correlation Permutation Mean	5.00%	Permutation p-Values
Communication overload	0.981	0.990	0.967	0.148
Distraction	0.996	0.996	0.988	0.314
Information overload	1	0.996	0.986	0.860
Invasion of personal life	0.951	0.978	0.914	0.125
Invasion of privacy	0.998	0.999	0.996	0.241
Fatigue	0.999	0.999	0.997	0.229
Disturbance handling	0.959	0.981	0.941	0.114
Self-preservation	0.968	0.982	0.951	0.166
Perceived performance	0.999	0.998	0.995	0.628
Academic use	0.992	0.994	0.979	0.259
Non-academic use	0.976	0.724	0.139	0.901
Negative affectivity	0.999	0.999	0.994	0.534

Table 2: MICOM (step 3)

	Mean - Original Difference (GF - GM)	2.50%	97.50%	Variance - Original Difference (GF – GM)	2.50%	97.50%
Communication overload	0.256	-0.153	0.171	0.037	-0.195	0.193
Distraction	0.189	-0.162	0.162	0.01	-0.229	0.226
Information overload	0.279	-0.168	0.168	-0.039	-0.215	0.216
Invasion of personal life	0.258	-0.154	0.166	-0.05	-0.245	0.249
Invasion of privacy	-0.128	-0.164	0.170	-0.056	-0.162	0.167
Fatigue	0.286	-0.177	0.171	0.001	-0.188	0.19
Disturbance handling	0.305	-0.168	0.181	-0.349	-0.3	0.281
Self-preservation	0.292	-0.159	0.161	-0.338	-0.245	0.244
Perceived performance	-0.009	-0.16	0.171	0.078	-0.248	0.25
Academic use	0.262	-0.175	0.173	-0.523	-0.332	0.358
Non-academic use	-0.099	-0.158	0.154	-0.035	-0.237	0.253
Negative affectivity	0.363	-0.157	0.173	-0.006	-0.198	0.192