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Exploring the Effect of Using WhatsApp for Education During Covid-19 on University Students' Performance: A Technostress Perspective

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Abstract

The use of mobile instant messaging (MIM), such as WhatsApp for learning can provide students with many benefits. With the recent switch to distance learning due to the COVID-19 outbreak, there is an ever growing reliance on information and communication technology for online teaching and learning. However, the increased use of MIM can also have consequences for students. This paper aims to explore the negative side of using WhatsApp during the shift to remote learning due to COVID-19. It investigates factors associated with WhatsApp use that cause fatigue among university students. Based on a review of the literature, it examines the effects of information and communication overload, invasion of life, and invasion of privacy on fatigue. It also examines the influence of fatigue on students' performance. The data was collected via online questionnaires from 1188 undergraduate students in Saudi Arabia. The results indicate that the use of WhatsApp for learning creates fatigue among students. The reasons for the experience of fatigue are information and communication overload and invasion of privacy. The results also show that fatigue is negatively associated with students' performance. The findings suggest that negative outcomes of MIM should be taken into account when designing distance learning.

Keywords: Technostress, Information overload, Communication overload, fatigue, academic performance, WhatsApp, COVID-19

1.0 Introduction

The use of mobile instant messaging (MIM) applications, such as WhatsApp, WeChat and Facebook messengers, has grown enormously in recent years. In 2020, the most popular global MIM was WhatsApp with two billion users worldwide (Clement, 2020). Due to the prevalence of WhatsApp among young adults, it has been increasingly adopted in higher education for teaching and learning (Pimmer et al., 2019). Importantly, with the recent switch to distance learning due to the COVID-19 outbreak, there is an ever growing reliance on information and communication technology (ICT) for online teaching and learning, and WhatsApp provides students with many benefits in this regard. It enables flexible learning through anytime and anywhere access to information and learning materials (Tang & Hew, 2017). It also enables students to engage in collaborative learning and knowledge exchange (Rambe & Bere, 2013). Moreover, it allows students to stay connected with other students and facilitates online communication with lecturers, which can be useful during distance learning (So, 2016). However, despite the advantages of using MIM for education, such technology also might have consequences on students and their performance (Hsiao, Shu & Huang, 2017; Malik et al., 2020). Research has indicated that the excessive use and the increased dependence on ICT can lead to adverse outcomes such as technostress (Shu, Tu, & Wang, 2011), a term that refers to stress that individuals experience due to the use of ICT (Tarafdar et al., 2007). Research argues that the use of ICT exposes individuals to excessive amounts of information and communication, which requires them to spend a considerable amount of time and energy on ICT use (Tarafdar et al., 2011). Such exposure to too much information beyond individuals' abilities to process has also been shown to lead to mental and physical fatigue (Zhang, et al., 2016). 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 may expose students to issues related to information and communication overload. However, while several studies have focused on the benefits of WhatsApp in learning, only a limited number of studies have explored its negative effects on students. This study thus attempts to shed light on the extent to which WhatsApp creates fatigue among students. Addressing this issue has become more relevant during the shift to remote learning, given the increased reliance on MIM for learning and non-learning purposes during this time. The unplanned and rapid transition to distance learning during the COVID-19 outbreak has brought with it many challenges and difficulties for students. In addition to the emotional stress caused by the pandemic itself, the increased use of MIM for learning purpose might have created an additional source of stress. It has been suggested that online teaching and learning is the future of education (Darby, 2020); however, while online learning can be a solution when face-to-face teaching becomes impossible or difficult, such as in the current situation of COVID-19, the consequences of the increased adoption of information technology for learning and their influence on learning outcomes need to be addressed. In this study, we focus on WhatsApp as it is one of the most widely used MIMs and its educational benefits have been recognized in the literature (Pimmer et al., 2019; Rambe & Bere, 2013; Tang & Hew, 2017). However, despite the growing adoption of WhatsApp in education, there is still a lack of understanding of how academic use of WhatsApp can lead to fatigue. Therefore, this study aims to investigate factors that cause fatigue among university students when using WhatsApp

for remote learning purposes and examines the effect of fatigue on perceived performance. The following two research questions are addressed in this study: (1) What are the technology-related stressors that cause fatigue when students use WhatsApp for learning purposes? (2) What is the influence of fatigue associated with WhatsApp use on students' perceived performance?

2.0 Theoretical Background

2.1 The Transactional Model of Stress

The transactional model of stress constitutes the theoretical foundation of many studies on technostress. This model suggests that a person experiences stress when they encounter demands or events in the environment that are perceived by the person as exceeding their abilities or resources (Lazarus & Folkman, 1984). In other words, stress occurs due to imbalance between the characteristics of the person and the environment (Cooper et al., 2001). According to this model, technostress develops when the use of ICT creates demands (e.g. cognitive and social requirements) and such demands are appraised by ICT users as taxing their resources (e.g. cognitive abilities, technical skills) and threatening their well-being (Tarafdar et al., 2011). Components of the transactional model of stress includes *stressors*, which are events or stimuli encounter by individuals, *strain*, which reflects individuals' physiological and behavioural psychological responses to stressors and *outcomes*, which are the consequences of strain (Cooper et al., 2001). Technostress research has adopted the transactional theory of stress to examine the relationship between technology-related stressors and stress-related outcomes at organizational and individual levels (Tarafdar et al., 2011). Techno-stressors – also known as technostress creators – are technology-related factors or conditions that are appraised by the individual as damaging and causing stress (Tarafdar et al., 2007).

In this study, technology overload, invasion of personal life and invasion of privacy are identified as techno-stressors. The use of ICT leads to overload when individuals feel unable to deal with the amount of information and communication they receive via ICT (Batista & Marques, 2017). Invasion of personal life refers to situations created by ICT in which individuals can be reached at any time and in any location, leading to the incursion of work into individuals' private lives (Tarafdar et al., 2011). ICT can cause users to feel that their privacy is being invaded due to the fact that many ICT platforms force users to permit to their usage activities being tracked and monitored (Ayyagari, Grover & Purvis, 2011). Techno-stressors can trigger psychological reactions among individuals, such as feeling fatigue from using ICT. Such strain can then lead to further negative outcomes, such as decreased satisfaction with ICT use and reduced ICT user performance at work (Tarafdar et al., 2011). This study adopts the stressors-strain-outcome framework to understand the fatigue created by the use of WhatsApp.

2.2 Technology Overload

Technology overload refers to individuals' evaluation and perception of the amount of work created by ICT usage exceeding their ability to cope (Ayyagari, Grover & Purvis, 2011). Tarafdar et al. (2007) indicate that individuals often experience technology overload because

ICT forces them to work faster and for longer periods. Karr-Wisniewski & Lu (2010) define technology overload as the phenomenon that occurs at the point where the use of ICT surpasses the optimum level and results in negative outcomes. They have identified three dimensions of technology overload: information overload, communication overload and system feature overload. Individuals experience information overload, also known as cognitive overload, when there is more information than their ability to process it (Eppler & Mengis, 2004). Information and communication technologies, such as email, MIM and social networking sites (SNS) make it possible for individuals to become exposed to too much information, which then requires individuals to exert more effort and work more rapidly in order to deal with the increased amount of information (Cao & Sun, 2018). Prior research has focused largely on the phenomenon of information overload and less attention has been given to communication overload. Despite the fact that the two concepts are interrelated, they do refer to different phenomena (Batista & Marques, 2017). Information overload occurs when users are unable to deal with a large volume of information (Eppler & Mengis, 2004), while communication overload is another issue created by advanced ICTs that impose demands on individuals related to receiving and responding to messages and maintaining a connection with friends and other people online (LaRose et al., 2014). In short, communication overload occurs when individuals become unable to deal with the increasing demands of communication (Cao & Sun, 2018). Since information is increasingly exchanged through means such as MIM and social media, users must cope with both the increased levels of information and increased volumes of communication messages, the content of which requires analysis, organization, filtering for relevance, and consideration of response (Batista & Marques, 2017). Addressing communication overload and information overload problems are particularly relevant in the case of WhatsApp use, as the exchange of messages can create both information and communication overload, as will be discussed later.

2.3 Social Media Fatigue

Over the past decade, information systems (IS) research has focused on exploring the fatigue created by social media usage. Ravindran et al. (2014) proposed the term social network fatigue to explain reasons for Facebook users experiencing fatigue. They define social media 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*.' Fatigue can lead to consequences such as dissatisfaction with ICT use and regret (Cao & Sun, 2018). 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 been increasingly interested in its sources, especially in the context of private and non-educational use of social media. This study extends existing research on fatigue caused by ICT use by examining this phenomenon in the context of academic use.

3.0 Conceptual Model of Research and Hypotheses

This study has adopted the transactional model of stress to develop a research model that explains the phenomenon of fatigue in the context of the educational use of WhatsApp. The research model presented in Figure 1, consists of the following *stressors*: information overload, communication overload, invasion of personal life and invasion of privacy. *Fatigue* refers to a form of psychological strain, and *outcome* is the consequence of fatigue on perceived performance.

3.1 Information Overload and Fatigue

WhatsApp facilitates the sharing of study-related information, news and materials in different forms, including texts, photos, video, audio and documents. It also enables students to join study groups to exchange knowledge, discuss study-related matters, and work on projects. As information sharing is easy and fast via WhatsApp, students can exchange a large amount of information and engage in many conversations on a daily basis. This can cause students to feel that they need to read study group messages in order to stay informed and not to miss important information. However, with the increased number of messages that contain irrelevant discussions and general chat, it can be difficult to focus on important and relevant information (Eppler & Mengis, 2004). In other words, students face information overload when they feel that the amount of information and conversations in study groups exceeds their information processing capabilities (Hew, Cheung & Ng, 2010; Jones, Ravid & Rafaeli, 2004). Having too many study groups also increases the likelihood that students receive too much information that may be duplicated, such as when the same information or news is sent from two or more different groups. Furthermore, technology design can contribute to information overload (Eppler & Mengis, 2004). Conversations and discussions in WhatsApp groups cannot be organized as threads, which causes difficulty for user to follow discussions thematically. The exposure to excessive amounts of disorganized information can then lead to dysfunctional consequences, including feelings of stress, pressure, anxiety and mental and emotional fatigue (Bucher, Fieseler & Suphan, 2013; Eppler & Mengis, 2004; Matthes et al., 2020). In the context of social media use, research has found that the exposure to too much information on social media creates fatigue among users (Cao & Sun, 2018; Zhang et al., 2016). We also argue that constant exposure to increasing amount of information, conversations and chatting in WhatsApp groups can lead to fatigue. Therefore, our hypothesis is as follows:

H1. Information overload is positively related to fatigue

3.2 Communication Overload and Fatigue

WhatsApp is one of the most widely used mobile instance messaging applications. The increased dependence on the app to perform daily communication can lead to the issue of communication overload (Shu, Tu & Wang, 2011). For instance, as students use WhatsApp for learning and non-learning purposes, they may send and receive too many messages and notifications from friends, family, students and acquaintances. They may then need to spend significant amounts of time on the app texting and responding to others. With the increased amount of incoming messages, individuals have been found to feel unable to effectively

process and respond to such messages (Stephens et al., 2017). In addition, receiving many messages and notifications while attempting to engage in learning activities can create situations where students feel distracted by technology and unable to focus on learning tasks (Cao & Sun, 2018). This is particularly true perceptible message notifications trigger frequent checking of the mobile device, leading to frequent interruptions in learning activities.

In work environments, research indicates that communication overload occurs when ICTs create excessive interruptions to the extent that employees become less productive (Karr-Wisniewski, & Lu, 2010). Because of limited human cognitive capacity, individuals can deal with a certain level of communication, but once this level is exceeded, they experience stress (Ayyagari, Grover & Purvis 2011). Thus, in the context of educational use, students who are constantly interrupted by WhatsApp messages and notifications may experience difficulties on concentration on learning tasks (Hsiao, Shu & Huang, 2017). In addition, they could spent a significant amount of time texting and processing messages, and consequently, they could feel overwhelmed and experience fatigue (Cao & Sun, 2018; Lee Son & Kim, 2016). Thus, we propose the following hypothesis:

H2. Communication overload is positively related to fatigue

3.3 Invasion of Life

Ubiquitous connectivity via WhatsApp enables students to engage in conversations with other students and discuss study-related matter regardless of time and space considerations. Constant connectivity can thus provide students with a flexible tool for interactions and connection with others outside classrooms, which is certainly useful for distance learning where face-to-face meeting and communication are impossible. However, constant connectivity can extend study-related work into personal time (Barber & Santuzzi, 2015). Invasion of life 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). Moreover, being connected all time with study groups on WhatsApp can create situations where students feel that they can never be free from ongoing study-related conversations and discussions (Tarafdar et al., 2011). For instance, students can receive messages from study groups at times when they may normally not want to work, such as late in the evening or during weekends and holidays. Technostress research has found a relationship between invasion of life and strain (Ayyagari, Grover & Purvis, 2011; Lee, Lee & Suh, 2016; Xiao & Mou, 2019), thus, this study proposes that students who feel that the educational use of WhatsApp invade their personal life will be more likely to feel fatigued. Therefore, the following hypothesis is proposed:

H3. Invasion of personal life is positively related to fatigue

3.4 Invasion of Privacy

Advanced ICTs have created a growing concern regarding user privacy (Gao et al., 2018) because ICT users' activities online can be easily monitored and tracked through ICT features (Malik et al., 2020). For example, WhatsApp enables the presence of a user online to be recognized by other contacts. The app also provides information about whether the message

has been delivered and read by recipients and who has read the message (in WhatsApp groups). Creating awareness of the presence of the user and allowing their usage activities to be visible to others can enhance the effectiveness of online communications (Dennis & Kinney, 1998; Treem & Leonardi, 2013). However, it also can promote monitoring and lead to a loss of privacy (Fox & Moreland, 2015; Xiao, Mou & Huang, 2019). For instance, having an 'online' status WhatsApp can create expectations regarding the availability of the user and lead to pressure related to immediate response (Gibbs, Rozaidi & Eisenberg, 2013). In this study, students perceive that WhatsApp invades their privacy when they feel their usage is monitored and they are unable to hide their usage activities. Technostress research has also found that social media users experience fatigue because they feel that they are under social surveillance (Bright, Kleiser & Grau, 2015; Xiao & Mou, 2019). Not only this, by invasion of privacy can lead to negative emotions such as disappointment, weariness, anger and fatigue (Ravindran et al., 2014). Thus, we propose that students who perceive that WhatsApp invades their privacy through enabling others to monitor their usage will be more likely to feel fatigue. Therefore, our hypothesis is as follows:

H4. Invasion of privacy is positively related to fatigue

3.5 Fatigue and Perceived Performance

The educational use of MIM can help students to improve their academic performance and achieve learning outcomes (Pimmer et al., 2019; So, 2016). However, the increased dependency on these platforms for various learning-related activities could lead to adverse outcomes (Cao et al., 2018). Karr-Wisniewski and Lu (2010) argue that there is a U-inverted relationship between ICT usage and productivity and increased use of ICT can be counterproductive. Other studies have found technostress to be associated with reduced employee performance and productivity at work (Lee, Lee & Suh, 2016; Tarafdar, Tu & Ragu-Nathan, 2010). Research has also found a relationship between exhaustion resulting from excessive social media use and decreased student academic performance (Cao et al., 2018; Yu, Shi & Cao, 2019). Perceived performance 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 this study, the negative outcomes of WhatsApp use; namely, information and communication overload, invasion of personal life and invasion of privacy, may lead to reduced performance. Information and communication overload can negatively affect students' ability to effectively complete learning activities (Aharony & Zion, 2019) because they often cause distractions and lead to multitasking, as students need to constantly switch their attention between learning activities and checking WhatsApp messages (Hsiao, Shu & Huang, 2017). The fatigue created by the use of WhatsApp could thus weaken the mental resources required for students to perform their academic work, thus reducing their performance (Wang, Tan and Li, 2020). Therefore, we propose that students who feel fatigued will perceive WhatsApp as negatively affecting their performance. Our hypothesis is therefore the following:

H5. Fatigue is negatively related to students' perceived performance

3.6 Control Variables

Five control variables that can influence the perception of fatigue are included in the research model: negative affectivity, non-academic usage, numbers of study groups, the gender of users, and daily usage time. *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 et al., 2001), and we have thus controlled for this in our study. Non-academic usage refers to the extent to which students use WhatsApp for communication not related to learning. Students may experience fatigue when using WhatsApp for reasons not associated with academic usage. It has been noted in prior research that individuals who use social media a lot to communicate with friends and other people experience higher level of fatigue (Maier et al., 2015b; Luqman el al., 2017). Therefore, we control for non-academic usage in this study. Academic use of WhatsApp, which reflects the extent to which students use the platform to perform academic-related activities, can influence perceived performance; therefore, it is considered a control variable.

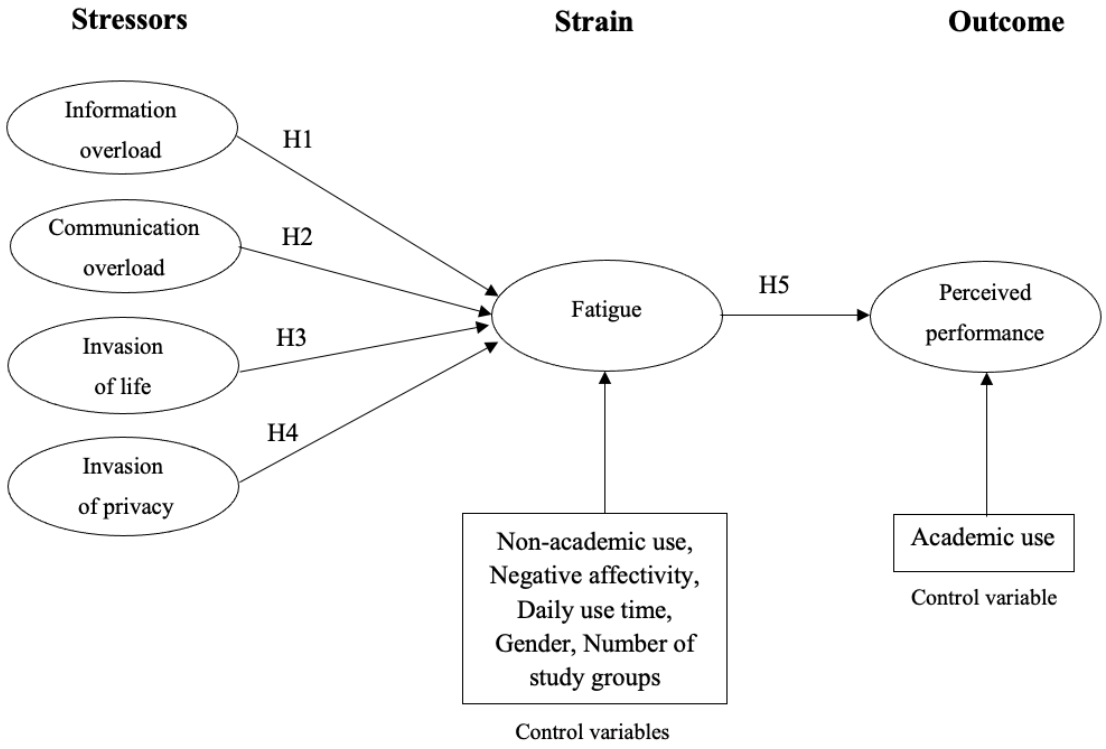

Figure 1. Research model

4.0 Research Method

4.1 Study context and Participants

The participants were undergraduate students at Imam Abdulrahman Bin Faisal University (IAU), one of the largest universities in Saudi Arabia, with around 30,000 students (75% female and 25% male)[1]. Face-to-face teaching at IAU was suspended once the Saudi government announced a national lockdown and moved to remote learning. A variety of information technology was adopted for online teaching and learning at the university, including Blackboard, Zoom, university email, social media and WhatsApp. WhatsApp was adopted by students as an informal channel for communication and information sharing. WhatsApp study groups were created and administered by students. For each module in a semester, students joined at least one study group to share study-related news and materials, engage in academic discussions and organize and coordinate group work. During remote learning, the communication between lecturers and students was via the main communication channels (i.e. university email, Blackboard, and Zoom), however, some lecturers allowed communication via WhatsApp and joined study groups in order to communicate with a group of students in a fast and easy way.

Undergraduate students were selected because the use of mobile messaging apps for learning has been increasingly prevalent among them (Tang & Hew, 2017), yet the consequences of such usage have not been fully explored. Focusing on undergraduate students can help to develop a context-specific theory regarding fatigue experienced by students and associated with the educational use of WhatsApp.

4.2 Data Collection

To examine the research model, data was collected through an online questionnaire. This method was appropriate for the current study because it allowed the testing of the research hypotheses using data collected from a large sample. Probability sampling approach was used. An invitation to the survey was sent to a list of student emails. This step was done with the help of the public relations and media office at IAU. To increase the response rate reminders were sent via emails and the university Twitter account. The data collection procedure took place between March and April 2020 during the COVID-19 lockdown, when education in Saudi Arabia shifted to remote learning. After excluding incomplete responses and disqualified respondents, 1188 responses were obtained and used for the analysis. The sample included 287 male and 901 female, with the majority aged between 18 and 21. The reason for more female than male students in the sample was due to the fact that female students constituted 75% of the population.

Table 1 presents the sample characteristics in detail.

Variable	Category	Frequency	%
Gender	Male	287	24.2
	Female	901	75.8

[1] https://www.iau.edu.sa/en/about-us/uod-observatory/students-dashboard/active-students-dashbord-0

Age	< 18	5	.4
	18 - 21	732	61.6
	22 - 25	401	33.8
	26 - 29	14	1.2
	30 - 34	13	1.1
Academic year	First year	261	22.0
	Second year	191	16.1
	Third year	271	22.8
	Fourth year	316	26.6
	Fifth year	97	8.2
	Sixth year	52	4.4
Daily hours spent on the app	Less than 30 minutes	84	7.1
	30 min to 1 hour	181	15.2
	More than 1 hour to 2 hours	261	22.0
	More than 2 hours to 3 hours	258	21.7
	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 group	655	55.1
	6 - 10 group	372	31.3
	11 - 15 group	83	7.0
	16 - 20 group	24	2.0
	21 - 25 group	13	1.1
	26 - 30 group	3	.3
	> 30 group	11	.9
Number of non-study groups	No group	91	7.7
	1 - 5 group	882	74.2
	6 - 10 group	157	13.2
	11 - 15 group	35	2.9
	16 - 20 group	7	.6
	21 - 25 group	7	.6
	26 - 30 group	2	.2
	> 30 group	7	.6

Table 1. Demographics of participants

4.3 Measures

To ensure content validity, the constructs in the research model were measured using items adapted from previous research. The items used in this study along with their sources are listed in Appendix A. Items were measured on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”, and the wording of the items was modified to fit the study’s context. The items were translated to the Arabic language and reviewed by five students who spoke both Arabic and English fluently. Non-academic use of WhatsApp was measured using three items developed for this study and tested in the pilot study. Academic use and non-academic use items were measured on a 5-point frequency scale ranging from never to always.

5 Data Analysis

The research model was validated and tested using structural equation modelling (SEM); specifically, partial Least Squares (PLS) via SmartPLS 3.0 software. PLS is a widely used method in IS literature (Benitez et al., 2020; Gefen et al., 2012) and was selected because it enables a simultaneous test of multiple relationships between constructs (Urbach & Ahlemann, 2010). It is considered appropriate for exploratory research and does not require normally distributed data (Hair et al., 2017).

5.1 Reliability and Validity of the Measurement Model

Internal consistency reliability was assessed by examining the values of composite reliability (CR). The results presented in Table 2 showed that all values of CR for all constructs were above the threshold value of 0.7 (Hair et al., 2017). Convergent validity was established by examining factor loadings and the average variance extracted (AVE). The factor loadings shown in Table 2 demonstrate that all items have a high loading on their corresponding constructs and all loadings are greater than the cut-off value of 0.5 (Hair et al., 2010; Urbach & Ahlemann, 2010). Table 2 also shows that AVE values are above the suggested threshold value of 0.5 (Hair et al., 2017). Discriminant validity was assessed using cross-loading and the Fornell-Larker criterion (Fornell & Larcker, 1981; Hair et al., 2017). Cross-loading suggests that the correlation between an item and its associated construct should greater than the correlation between the item and any other constructs (Henseler, Ringle & Sarstedt, 2015). The results (see Appendix B.1) show that all items have higher loadings on their constructs, which indicates there are no cross-loading issues in this study. The Fornell-Larker criterion indicates that the square root of AVE of each construct should be higher than inter-construct correlations (Fornell & Larcker, 1981). As shown in Table 3, this criterion was met, which indicates support for discriminant validity.

Construct	items	Loadings	Mean	S.D
Communication overload CR = 0.772 AVE = 0.540	CO1	0.528	4.19	0.94
	CO2	0.799	3.10	1.18
	CO3	0.838	3.16	1.23
Information overload CR = 0.857 AVE = 0.6	IO1	0.825	3.75	1.12
	IO2	0.776	3.53	1.09
	IO3	0.743	3.76	1.16
	IO4	0.751	4.02	1.03
Invasion of life CR = 0.843 AVE = 0.645	IL1	0.918	3.84	1.14
	IL2	0.795	4.03	1.03
	IL3	0.678	3.76	1.14
Invasion of privacy CR = 0.91 AVE = 0.771	IP1	0.875	3.09	1.38
	IP2	0.902	2.96	1.36
	IP2	0.857	2.88	1.33
Fatigue CR = 0.902 AVE = 0.698	FT1	0.858	3.10	1.25
	FT2	0.794	3.48	1.18
	FT3	0.855	3.07	1.26
	FT4	0.832	3.34	1.24

Perceived performance CR = 0.868 AVE = 0.686	PER1	0.819	3.76	1.01
	PER2	0.871	3.75	0.97
	PER3	0.793	3.83	1.01
Negative affectivity CR = 0.854 AVE = 0.596	NA1	0.813	3.71	1.16
	NA2	0.850	3.55	1.22
	NA3	0.652	3.72	1.18
	NA4	0.761	3.35	1.32
Academic use CR = 0.857 AVE= 0.545	AU1	0.749	4.61	0.77
	AU2	0.745	4.27	1.03
	AU3	0.734	4.62	0.79
	AU4	0.709	4.50	0.90
	AU5	0.752	4.14	1.05
Non-academic use CR = 0.828 AVE = 0.622	NAU1	0.615	4.26	1.01
	NAU2	0.788	3.80	1.19
	NAU3	0.931	3.95	1.07

Table 2. Composite reliability (CR), average variance extracted (AVE) and factor loadings

	CO	IO	IL	IP	FT	PER	NA	AU	NAU
CO	**0.735**								
IO	0.392	**0.774**							
IL	0.274	0.061	**0.803**						
IP	0.302	0.334	0.110	**0.878**					
FT	0.414	0.463	0.104	0.433	**0.835**				
EP	0.047	-0.197	0.284	-0.087	-0.189	**0.828**			
NA	0.283	0.316	0.159	0.259	0.341	-0.009	**0.772**		
AU	0.149	-0.049	0.339	-0.035	-0.029	0.387	0.034	**0.738**	
NAU	0.146	-0.064	0.173	0.001	-0.125	0.225	-0.020	0.285	**0.789**

Table 3. Correlation matrix and square root of AVE

5.2 Common Method Bias

As this study used self-reported data from a single source, the data might have been affected by common method bias (CMB), which can inflate or deflate estimates, leading to misleading conclusions (Nock, 2015). CMB was assessed by using Harman's single factor test (Podsakoff et al., 2003). The results showed that only (17.739%) of the variance in the data was explained by one factor. There was no dominant factor that accounted for the majority of the variance, which indicates that CMB was not an issue in this study.

5.3 Structural Model

To test the structural model, three criteria were used: variance explained (R^2), and path coefficient (β) and its statistical significance (p) (Hair et al., 2017; Henseler, Ringle & Sarstedt, 2009). The results of the hypothesis test are shown in figure 2. R^2 values of fatigue and perceived performance indicate that the constructs in the model explain approximately 38% of the variance in fatigue, and 18% of the variance in perceived performance. The bootstrap resampling method with 2000 resamples was used to estimate the significance of the path

coefficients. The results show that three stressors had significant positive relationships with fatigue. Information overload (β = 0.236, t = 8.381, p = < 0.001), communication overload (β = 0.232, t = 7.551, p = < 0.001), and invasion of privacy (β = 0.248, t = 8.749, p = < 0.001), thus H1, H2 and H4 were supported. However, the relationship between invasion of life and fatigue was not significant, failing to support H3. Fatigue had a significant negative relationship with perceived performance (β = - 0.177, t = 6.161, p = < 0.001), supporting H5. In terms of control variables, negative affectivity had a positive influence fatigue (β = 0.134, t = 4.970, p = < 0.001), while non-academic use had a significant negative relationship with fatigue (β = - 0.134, t = 5.127, p = < 0.001), and academic use was significantly associated with perceived performance (β = 0.382, t = 13.658, p = < 0.001). Other control variables (daily usage time, number of study groups, gender) had no significant relationship with fatigue. Due the fact that the sample included more female than male participants, a multigroup analysis was performed (Hair et al., 2017) in order to control for potential gender differences in our study. 287 female responses were randomly selected to be compared against male responses in the sample. The results of the multigroup analysis (see Appendix B.2) indicated that there were no differences between female and male students with regards to the relationships between independent and dependent variables in the research model.

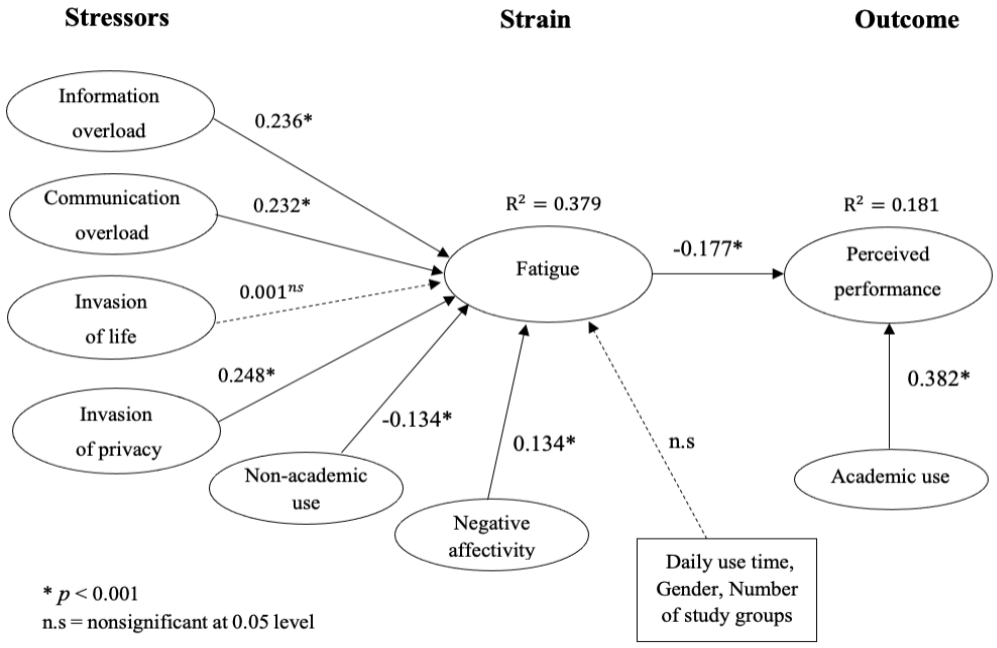

Figure 2. PLS results

6 Discussion

The aim of this study was to explore factors that lead to fatigue when using WhatsApp for educational purposes and examine the negative effect of fatigue on perceived performance. The study aimed to shed light on the negative aspects of using MIM, especially for distance learning. The data was collected during the COVID-19 lockdown in Saudi Arabia between

March and April 2020, at a time when education moved to distance teaching. The findings of this study reveal that a consequence of MIM use for learning is students suffering from fatigue, which leads to the perception of decreased performance. The reasons for the experience of fatigue were information and communication overload and invasion of privacy. These findings are consistent with past studies, which found that the exposure to too much information and receiving to many notifications and messages via social media creates fatigue among users (Lee, Son & Kim, 2016; Zhang et al., 2016). In the context of the educational use of MIM, So (2016) indicates that delivering learning materials via WhatsApp is an effective approach for enhancing learning outside school hours. Additionally, Rambe and Bere (2013) suggest that WhatsApp can reduce cognitive load. However, the findings here show that sharing too much information in study groups leads to information overload and fatigue. Students experienced overload perhaps due to heavy reliance on WhatsApp for information sharing and study-related communication during distance learning. As face-to-face communication was not possible, the only way to communicate with lecturers and other students was via ICTs including WhatsApp. The findings also showed that invasion of privacy was a reason for the experience of fatigue. However, in contrast to past studies on technostress (Tarafdar et al., 2011; Tarafdar et al., 2007; Xiao & Mou, 2019), no relationship between invasion of personal life and fatigue was found in this study. This finding suggests that being constantly connected to study groups and with other students via WhatsApp was not perceived by students as negative. Likewise, Rambe and Bere (2013) and So (2016) found that receiving learning materials via WhatsApp outside school hours did not interfere with students' private lives. A possible explanation for this result is that, due to the lack of face-to-face meetings during the lockdown, students might have felt they needed to be more connected with their peers and lecturers in order to stay informed of any news or updates concerning their studies. In addition, being connected at all times and in all locations probably facilitated their group-based work in a distance learning context; thus, they perceived continual connection via WhatsApp during these time as helpful and not stressful. Research has indicated that the use of MIM can help students in online courses overcome negative feelings of stress, isolation and loneliness (Pimmer, et al., 2019; Tang and Hew, 2017). The findings also suggest that the use of WhatsApp for non-educational purposes during the lockdown, such as chatting with friends and family, reduced fatigue. Due to social distancing measures and the inability to meet others in-person during the lockdown, students could have been experiencing feelings of anxiety and isolation. Communication via WhatsApp during these stressful times perhaps helped them to cope with the situation and feel less pressured by WhatsApp use. This study also examined the effect of fatigue on performance. There have been different results published in the literature regarding the influence of MIM on learning outcomes (Tang & Hew, 2017). The findings of this study contribute to existing studies on MIM in education and suggest that fatigue created by the use of MIM for learning purposes could lead to adverse results and reduce student perceptions of performance.

6.1 Theoretical Contributions

This study makes the following theoretical contributions. First, existing studies on technostress have mainly focused on technostress experienced by employees in work contexts (see Tarafdar, Cooper & Stich, 2019). Research has also explored the issue of fatigue in the context of private

use of social networking sites (see La Torre et al., 2019). However, little attention has been given to the issue of technostress in the context educational usage of MIM. This study extends technostress research by examining fatigue experienced by students when using WhatsApp. In contrast to past studies on technostress, this study indicates that constant connectivity with study groups and with other students is not always a source of stress, but rather it can be helpful during distance learning. Second, this study contributes to distance learning research by highlighting the issue of technostress that students faced during the transition to temporary remote learning. It extends existing literature on mobile learning by exploring negative aspects of using MIM in education. Distinct from previous studies that focused on the educational benefits of MIM, this study suggests that the increased reliance on WhatsApp for educational use can lead to negative outcomes such as fatigue and reduced performance. Third, the findings contribute to existing stress and coping research. They show that maintaining communication via MIM with friends, family and others during crises, such as the COVID-19 pandemic, may help students feel less fatigued from MIM use.

6.2 Practical Implications

The findings of this study have several implications for practice. The findings suggest that the negative effects of using WhatsApp for education on students should not be ignored. Students should reduce their reliance on WhatsApp for study-related communication and information sharing in order to mitigate fatigue. To reduce information overload, they could use alternative educational technologies that enable them to share, organize and store learning materials without being distracted by too many conversations or discussions. In addition, students could set rules for participation in study groups, which would help reduce unnecessary content or chatting. Group leaders can also manage the flow of information and facilitate discussions. Lecturers are advised to increase students' awareness of the consequences of information and communication overload and help them to effectively use study groups for enhancing their learning through constructive discussions. Universities and colleges may consider the findings of this study when adopting MIM for teaching and learning. The findings suggest that WhatsApp can be used to help students stay connected and informed during distance learning, however, overreliance on the app should be reduced. As WhatsApp lacks features that enable user to protect their privacy, WhatsApp designers and service providers should provide users with tools or functions that enable them to protect their privacy, such as hiding their online presence, as doing so may help to reduce fatigue. As non-academic use of WhatsApp can help students to cope with stress, students are also advised to maintain connection with family and friends during difficult times such as the current COVID-19 situation.

7 Conclusions, Limitations and Future Research

This study was conducted to examine fatigue created by WhatsApp use among university students during the COVID-19 pandemic. The findings suggest that negative outcomes of MIM should be taken into account when designing distance learning. That said, the study has a number of limitations. First, stressors were identified in this study as information overload, communication overload, invasion of personal life and invasion of privacy. The explanatory power of the research model was considered moderate, which suggests that there are other

factors that cause fatigue. Further research could investigate other reasons for students feeling stress due to their educational use of MIM. For example, it has been suggested that students who provide significant levels of support to their peers may experience social overload (Maier et al., 2015b). Future research could thus explore the influence of social overload on fatigue and student performance in online learning environments. Second, the context of this study was Saudi Arabia in which WhatsApp was the most used mobile messaging app. The study focused on fatigue associated with educational use, however, it did not consider social and cultural factors that may influence the perception of information and communication overload on WhatsApp. For example, Saudi Arabia is characterized by a collectivistic culture, thus people in this country may feel obligated to respond to messages on time and provide support to family and friends, which can place additional stress on people. We suggest that future research may explore the social and cultural aspects of WhatsApp use and how they possibly contribute to the experience of fatigue. Third, this study examined the consequence of fatigue on performance. Other negative outcomes of technostress on learning outcomes and student well-being should be explored in future research; for instance, the influence of technostress on student satisfaction with the technology or satisfaction with group work. Fourth, this study was conducted at the beginning of the shift to distance learning. Therefore, students potentially faced challenges associated with the situation, which might have influenced their responses. It is thus possible that the findings of this study may not be generalizable to other contexts. Further research should be conducted to enable confidence in the generalizability of our findings.

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Appendix A. List of adapted constructs and items

Variables	Items		Sources
Information overload	IO1	I am often distracted by the excessive amount of information shared on study groups.	Zhang et al (2016)
	IO2	It is difficult for me to focus on the essential information on study groups.	Luqman et al (2017)
	IO3	The amount of messages on study groups makes me overlook important information.	
	IO4	Because of too much information/ chatting on study groups, I feel difficult to read every piece of information.	
Communication overload	CO1	I receive too many messages (chat, private messages), notifications and announcements through WhatsApp.	Cao & Sun (2018)
	CO2	I waste a lot of my time responding to WhatsApp messages.	
	CO3	I end up spending more time on the WhatsApp than planned.	
Invasion of life		Because of the use of WhatsApp for study-elated purposes:	Tarafdar et al. (2007)
	IL1	I have to be in touch with my study-related work even during the weekend.	
	IL2	I have to sacrifice my vacation and weekend time to keep current on study-related work.	
	IL3	I feel I have to be always connected with study groups	
Invasion of privacy	IP1	I feel uncomfortable that my use of WhatsApp can be easily monitored.	Ayyagari, Grover & Purvis (2011)
	IP2	I feel my privacy can be compromised because information about my use of WhatsApp can be accessed by others.	
	IP3	I feel my privacy can be invaded because my reading activities can be monitored.	
Fatigue	FT1	I feel tired when using WhatsApp.	Zhang et al (2016)
	FT2	I feel bored when using WhatsApp.	
	FT3	I feel drained from using WhatsApp.	
	FT4	I feel worn out from using WhatsApp.	
Perceived performance	PER1	Using WhatsApp improve my academic performance.	Miloševic et al., (2015)
	PER2	Using WhatsApp enhance my effectiveness on learning.	
	PER3	Using WhatsApp enables me to accomplish study tasks more quickly.	
Negative affectivity	NA1	I often find myself worrying about something.	Agho Price & Mueller (1992)
	NA2	I suffer from nervousness.	
	NA3	My mood often goes up and down.	
	NA4	I often lose sleep over my worries.	
Academic use		During the current semester, how often do you use WhatsApp for the following academic activities	Qi, 2019).
	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		During the current semester, how often do you use WhatsApp for the following non-academic activities	Developed for this study
	NAU1	Reading and sending direct messages.	
	NAU2	Chatting in WhatsApp groups.	
	NAU3	Reading group messages.	

Appendix B.1 Cross loading

	CO	PER	FT	IL	IO	IP	NA	AU	NAU
CO1	0.528	0.118	0.177	0.213	0.215	0.141	0.124	0.193	0.192
CO2	0.799	0.081	0.334	0.246	0.245	0.252	0.248	0.061	0.138
CO3	0.838	-0.046	0.364	0.171	0.388	0.253	0.229	0.129	0.046
PER1	0.061	0.819	-0.13	0.218	-0.162	-0.091	-0.021	0.300	0.169
PER2	0.035	0.871	-0.17	0.206	-0.166	-0.085	-0.002	0.320	0.194
PER3	0.026	0.793	-0.163	0.28	-0.162	-0.044	-0.002	0.338	0.193
FT1	0.45	-0.141	0.858	0.106	0.396	0.385	0.299	0.034	-0.07
FT2	0.187	-0.196	0.794	0.034	0.378	0.31	0.243	-0.105	-0.161
FT3	0.431	-0.106	0.855	0.117	0.372	0.385	0.312	0.033	-0.067
FT4	0.291	-0.196	0.832	0.083	0.402	0.36	0.28	-0.074	-0.131
IL1	0.229	0.19	0.115	0.918	0.058	0.117	0.134	0.278	0.138
IL2	0.214	0.272	0.066	0.795	0.041	0.071	0.144	0.284	0.123
IL3	0.257	0.316	0.042	0.678	0.046	0.058	0.115	0.300	0.196
IO1	0.321	-0.16	0.413	0.042	0.825	0.26	0.279	-0.041	-0.043
IO2	0.339	-0.165	0.363	0.036	0.776	0.31	0.281	-0.035	-0.028
IO3	0.283	-0.157	0.3	0.037	0.743	0.228	0.215	-0.087	-0.053
IO4	0.268	-0.129	0.344	0.073	0.751	0.233	0.195	0.005	-0.079
IP1	0.267	-0.051	0.369	0.111	0.295	0.875	0.215	-0.013	0.009
IP2	0.26	-0.078	0.378	0.101	0.277	0.902	0.20	-0.021	-0.006
IP3	0.268	-0.098	0.391	0.080	0.306	0.857	0.265	-0.057	-0.001
NA1	0.259	-0.024	0.313	0.161	0.275	0.217	0.813	0.016	-0.019
NA2	0.247	-0.015	0.267	0.158	0.270	0.226	0.850	0.050	-0.009
NA3	0.158	0.008	0.21	0.024	0.193	0.135	0.652	0.031	-0.053
NA4	0.193	0.012	0.248	0.124	0.228	0.212	0.761	0.010	0.013
AU1	0.074	0.260	-0.042	0.218	-0.051	-0.079	-0.011	0.749	0.168
AU2	0.176	0.243	-0.012	0.284	-0.040	-0.008	0.015	0.745	0.236
AU3	0.149	0.265	0.001	0.273	-0.002	-0.004	0.024	0.734	0.257
AU4	0.088	0.234	0.013	0.260	-0.018	-0.010	0.037	0.709	0.174
AU5	0.080	0.378	-0.049	0.230	-0.059	-0.027	0.050	0.752	0.214
NAU1	0.175	0.100	-0.026	0.089	0.063	0.047	0.039	0.171	0.615
NAU2	0.213	0.182	-0.072	0.193	-0.002	0.025	-0.002	0.270	0.788
NAU3	0.069	0.214	-0.14	0.135	-0.104	-0.021	-0.035	0.243	0.931

B.2. Multigroup analysis (Male Vs. Female)

Path	Path Coefficients-diff (Male - Female)	t-Value (|Male vs Female|)	p-Value (Male vs F ale)
Information overload -> Fatigue	0.09	1.129	0.259
Communication overload -> Fatigue	-0.066	0.768	0.443
Invasion of personal life -> Fatigue	0.069	0.651	0.515
Invasion of privacy -> Fatigue	-0.029	0.36	0.719
Fatigue -> Perceived performance	-0.136	1.709	0.088
Academic use -> Perceived performance	0.015	0.222	0.824
Negative affectivity-> Fatigue	0.015	0.192	0.848
Non-academic use -> Fatigue	-0.005	0.059	0.953