Heliyon 9 (2023) e19069

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Mobile technology features and technostress in mandatory online teaching during the COVID-19 crisis

Zuheir N. Khlaif[a,*], Mageswaran Sanmugam[b], Muayad K. Hattab[c], Elias Bensalem[d], Abedulkarim Ayyoub[e], Ramesh C. Sharma[f], Amjad Joma[g], Jamil Itmazi[h], Ali Hassan Najmi[i], Mohamed A. Ahmed Mitwally[j], Ahmad Ammar Jawad[k], Mahmoud Ramadan[a], Tahani R.K. Bsharat[l]

[a] An Najah National University, Nablus, Palestine
[b] Centre for Instructional Technology & Multimedia, Universiti Sains Malaysia, Gelugor, Penang, Malaysia
[c] Faculty of Law, An Najah National University, Nablus, Palestine
[d] Northern Border University, Arar, Saudi Arabia
[e] Faculty of Economic and Social Sciences, An Najah National University, Nablus, Palestine
[f] Department of Computer Science and Engineering, Graphic Era Hill University, Dehradun, India
[g] Faculty of Art and Humanities, A'Sharqiyah University Ibra, Sultanate of Oman
[h] Palestine Ahliya University, Palestine
[i] King Abdulaziz University, Saudi Arabia
[j] The Designation, of Postdoctoral Fellow in the UNESCO Chair of ODL, University of South Africa, South Africa
[k] Department of Educational and Psychological Sciences, School of Education, Al-Qadisiyah University, Iraq
[l] Faculty of Major Language Studies, Universiti Sains Islam Malaysia, Malaysia

ARTICLE INFO

Keywords:
Remote learning
Occupied Palestine
COVID-19
Technostress
Academics

ABSTRACT

Technostress is defined as any unhealthy condition caused by dealing with modern technology in various harmful ways; examples of technostress include addiction and stress. Even though technostress has been extensively studied in the literature, little attention has been paid to investigating technostress among academics who work in exceptional circumstances, such as crises, and who might be experiencing different psychological states due to those circumstances. To fill the gap, this study aims to explore the factors influencing technostress among school teachers. The study examined technostress's level and factor graphics structure among 692 academics from different Arab countries during COVID-19. The technostress factors and their stories were explored and measured using sequential mixed methods and confirmatory and exploratory factor analysis. The study discusses various factors' direct and indirect effects on mobile technology integration in education and the theoretical and practical implications of managing technostress in online classes. A model of techno-stressors among Arab academics was found to include: schedule overload, complexity, uncertainty, uselessness, invasion, and compulsion. The direct effect of various factors on mobile technology integration in education is mainly positive, while indirect effects are more varied. The theoretical and practical implications of managing technostress in online classes include: considering the psychological and physiological impact of technostress on students' learning performance, decreasing overall satisfaction with the learning experience, and improving the overall quality of online courses. As a result of this study's

* Corresponding author.
E-mail address: zkhlaif@najah.edu (Z.N. Khlaif).

https://doi.org/10.1016/j.heliyon.2023.e19069
Received 10 January 2023; Received in revised form 3 August 2023; Accepted 9 August 2023
Available online 10 August 2023
2405-8440/

findings, a new perspective is provided on how academics in particular circumstances (in this study, the occupation of Palestine) may behave and feel toward technology in teaching.

1. Introduction

The widespread incorporation of Information and Communication Technologies (ICTs) in education has emerged as a universal trend in contemporary times. Across the globe, teachers at kindergarten and K-12 levels are progressively adopting these tools in their classrooms to enhance the learning experience [1]. This development is attributed to the surge of technological advancements in our day-to-day lives that have significantly reshaped various sectors, including education.

The integration of ICTs in the education sector offers a multitude of benefits. It promotes collaboration among colleagues, amplifies productivity, fosters transformation in institutional structures, and potentially reduces the workload for teachers [2]. The recent decade has seen teachers leveraging advanced technologies to revamp their teaching methodologies and techniques, providing students with a more enriched and interactive learning environment [3].

However, despite its numerous benefits, it is challenging to adopt these technologies in education. One of the primary issues revolves around teachers' need to acquire new skills and knowledge before incorporating new technologies into their teaching practices. This requirement not only adds to their existing workload but also consumes a significant amount of their time, thereby increasing their overall stress levels [2,4–6].

A phenomenon called 'technostress' is often experienced by teachers who are compelled to integrate ICTs into their teaching practices. A study conducted in Finland in 2016 confirmed that technostress was an overall experience among teachers, with different individuals experiencing varying stress levels [4].

Another challenge posed by integrating technology in education relates to the culture of 'bring-your-own-device.' While this might seem to facilitate learning, it could inadvertently contribute to inequality among learners due to discrepancies in the ownership of technological devices. This reality contradicts the entrenched values of equality in educational systems such as the Finnish model [4,7].

Moreover, the increased reliance on ICTs to facilitate teaching and learning often forces teachers to bring their work home. This, in turn, could negatively influence their work-life balance and overall well-being [8,9]. These challenges underscore the necessity to better understand the role and impact of ICTs in education, primarily the phenomenon of technostress, to enhance the experience of educators and students alike.

The recent COVID-19 pandemic has brought these challenges into sharper focus. The Palestinian Ministry of Education adopted a strategic measure of transitioning from traditional in-person teaching to online learning in response to the pandemic. This form of remote teaching, often termed 'emergency remote teaching' (ERT) [10,11] or 'emergency remote learte teaching' (ERT) or 'emergency remote learning' [12], is usually employed during emergencies or crises.

Despite its necessity during such times, ERT presents its unique challenges. Chief among these is the potential exacerbation of inequality among students due to disparities in access to devices and internet connectivity [13]. Additionally, the stress of rapidly adopting unfamiliar technologies during a crisis can lead to increased technostress for teachers, which can negatively impact their ability to effectively deliver learning content [11,14–16].

The shift to a digital-based teaching environment has also raised questions surrounding legal regulations and rights such as data protection, privacy protection, intellectual property, copyright, and legal ethics and securities [17]. Therefore, educational institutions, digital teams, educators, and students must understand their legal responsibilities and liabilities when utilizing these platforms. The need for clear policies and internal regulations that outline legal rights and responsibilities in the context of e-learning cannot be overemphasized [18].

The rapid integration of ICTs has further highlighted six crucial technological characteristics that can impact users: the pace of change, usefulness, anonymity, complexity, presenteeism, and reliability [19]. However, a dearth of studies explicitly identifies the technological characteristics that induce stress, leading to technostress [19]. The dimensions of 'pace of change' and 'complexity' are particularly relevant, with the rapid evolution and complexity of technologies often leading to heightened stress levels among educators.

Furthermore, the concept of 'space invasion,' where the omnipresence of technology intertwines people's space and time, leading to the expectation of constant availability, can further contribute to technostress. Addressing these technological characteristics is a critical step towards understanding and mitigating technostress. According to Ref. [20] Huang (2019), the perceived usefulness of technology does not significantly impact learner satisfaction. Additionally, certain boundary conditions, such as the value of integrating mobile technology into the learning process and its continued use, influence the perceived benefits of the technology [20,21]. These factors and institutional support can help identify the reasons behind teachers' reluctance to adopt mobile technology for teaching [20,22].

Prior research has highlighted several factors that influence the acceptance and adoption of mobile technology, such as professional development, infrastructure, self-efficacy, gender, digital competency, and attitudes [23,24]. However, there seems to be a gap in understanding how technostress influences the continued intention to use mobile technology based on technological features. This knowledge gap motivates us to explore the role of technological features, their link with levels of technostress, and the intention to continue using new technology. Thus, the primary aim of this study is to investigate the influence of mobile technological features on the technostress experienced by teachers and its relationship with the continued intention to use mobile technology for academic purposes.

The study builds upon the finding that technostress negatively impacts teachers' intention to use new technology [25]. It will also explore the proposition that users stop using new technology when they experience stress due to technological changes [26,27], & [28].

In conclusion, this research promises to have a profound impact on the broader community by helping to illuminate the complexities of technostress among educators as they navigate the rapid integration of Information and Communication Technologies (ICTs) in teaching [29]. By uncovering how specific technological features influence technostress and teachers' intent to continue using new technology, this study has the potential to inform the development of educational policies, teacher training programs, and ICT usage strategies. The insights gained could enable educational institutions to mitigate technostress, ultimately enhancing teachers' well-being and the overall effectiveness of digital education. Moreover, addressing inequalities related to the accessibility of devices and internet connectivity will contribute to fostering a more equitable learning environment for students. Therefore, this research is poised to significantly enhance the quality of teaching and learning, thus improving educational outcomes for the community.

2. Research framework

2.1. Person-environment fit theory (P-E)

The researchers consider the P-E fit theory (proposed by Ref. [30] as the most appropriate framework for this study (Fig. 1).

It is believed that the P-E fit [31] is determined by the degree to which an environment's characteristics match an individual's [32]. In addition to abilities and preferences, individuals have specific characteristics. As environmental features are operationalized as features, such as norms or demands, a positive outcome is achieved when the corresponding individual and environmental dimensions interact to produce that specific match [32,33].

Contrary to the robust field of study on stress, technostress has, to date, not received much attention [34] (Tu et al., 2008). Additionally, prior research on technostress has focused chiefly on the relationship between the stressor and strain and the moderating elements between them [2,35]. Ayyagari and colleagues [19] suggest that the P-T model, which presents a novel theoretical perspective on technological features and technostress, looks at these characteristics as antecedents of stressors related to technostress. The P-T model's three subgroups of technological characteristics are usability, dynamic, and invasive features. Based on research on IS and stress, the P-T model establishes a logical link between technological traits and technostress. Without any precise feature definition, technology is viewed as a general idea. However, various technologies have frequently had distinctive qualities and are carried out with various functions. Therefore, the "one-size-fits-all" model must be further developed to represent features in particular circumstances. When using technology, several technical issues may cause dissatisfaction and technostress [36]. According to Ref. [37] Taser et al. (2021), technostress results from using technology and is linked to unpleasant emotions like anxiety [38]. Steelman and Soror (2017) described technostress that is comparable to this, defining it as a psychological condition brought on by a failure to address the present-day needs posed by technology. According to Ref. [22], technostress is any unhealthy condition caused by trying to deal with modern technology in various unhealthy ways, such as addiction and stress. Technostress is a psychological condition characterized by cognitive symptoms such as; difficulty focusing, impatience, and memory lapses [39]. Usually, this results in a mismatch between people and the local technological world [40] (Wang et al., 2020). According to Ref. [41], technostress is a phenomenon that causes tiredness and has a variety of adverse repercussions on both individuals and groups.

Previous research in education described technostress as the pressure brought on by using technology and the knowledge and abilities needed to successfully incorporate technology into teaching methods [42,43], & [44]. According to Ref. [45], technostress has a detrimental effect on the willingness of teachers to adopt and use ICT in their lessons. According to Ref. [46] Chou and Chou (2021), online instruction is correlated with technostress, self-efficacy, and school support. Additionally [47], Oksanen et al. (2021) demonstrated that increased levels of technostress could be predicted by the rise in social media communication in schools. In addition [48], stated that technological stress might result in low self-efficacy, unstable employment, work-home conflict, information overload, and privacy concerns [49].

Numerous studies have provided evidence of the use of technology in various higher education disciplines [50,51]. Studies on the compulsory adoption of technology and technostress in public and higher education institutions, such as during the COVID-19 pandemic when teachers were compelled to use technology for distance learning, are scarce. According to Ref. [52], technostress is not well understood. They characterized it as a phenomenon that examines "how and why" utilizing ICT places diverse demands on people, particularly in education. To the best of our knowledge, no study has looked into the impact of technology on academics in the Arab world. In particular, Palestine, the study's backdrop, is considered with unique considerations due to its occupation. According to Ref. [53], instructors in the occupied regions of Palestine experience exceptional conditions and difficulties in contrast to most of their surrounding nations. Therefore, it is essential to look at the technostress levels of Palestinian academics concerning COVID-19, as well

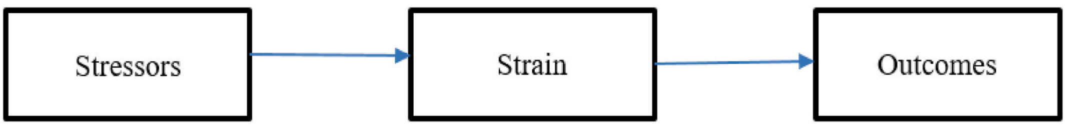

Fig. 1. The components of the P-E model.

as any potential influences. Since no other study has addressed this gap, this study can enrich the existing body of information. The results of this study can also be used to develop educational interventions that will lower levels of technostress among academics, particularly those currently employed, and improve their teaching experiences.

2.2. Technology-induced stress

One of the most critical research areas is stress, which has roots in ergonomics, organizational management, and psychology. Leading clinical psychologist Craig Brod coined the term "technostress," which he defines as "a modern sickness of adaptation caused by an incapacity to cope with the new Computerworld technology healthily" [54]. Thus, one type of stress caused by ICTs is known as technostress, which reflects users' negative attitudes toward ICTs when they cannot adjust to them [34]. Additionally, prior research on technostress has primarily focused on the relationship between the stressor and strain and the moderating elements between them [35,52]. Research into the causes of technostress is, however, scarce. On the other side, a recent study by Ref. [19] suggests that the P-T model, which presents a novel theoretical perspective on technological features and technostress, looks at these characteristics as antecedents of stressors related to technostress. The P-T model's three subgroups of technological characteristics are usability, dynamic, and invasive features. From the preceding literature regarding stress, five techno stressors are chosen and modified for the context of widespread ICT use. Without any precise feature definition, technology is viewed as a general idea. However, various technologies frequently have distinctive qualities and carry out a variety of functions. Therefore, the "one-size-fits-all" model must be further developed to represent features in particular circumstances. We offer a paradigm with conceptual specification and operational measurement to adapt further the evaluation of ICT features inside CMC technology features. The P-T model links technological features to technological stressors in its assumptions, implicitly reflecting and evaluating the misfit between users and technologies. Going a step further, we look at the misfit process—the core of the P-E model—and try to improve our understanding of how to evaluate technology by looking at how it affects stress.

2.3. Research model

Based on the study framework and previous studies [5,7,55], we proposed the following model to explain the relationship between technological features and technostress. Fig. 2 presents the suggested conceptual model of the study.

2.4. Research questions

Based on the above discussion, our study addressed the following research questions:

RQ1. What are the factors influencing technostress among teachers in public schools?

RQ2. What is the technostress level among teachers in public schools?

RQ3. How does teaching online during a crisis impact technostress?

3. Research design

In this study, we used an exploratory sequential mixed-method approach to answer the research questions. In sequential mixed method research, the findings of the first phase (the qualitative approach) were used as the background to developing the study's second phase (the quantitative approach) [56]. The researchers used semi-structured questions to collect data from 18 faculty members from different countries, recruiting them through the snowball method. Moreover, two focus group sessions were conducted with 19 faculty members from other countries, none of whom had participated in the semi-structured interviews. Therefore, the total

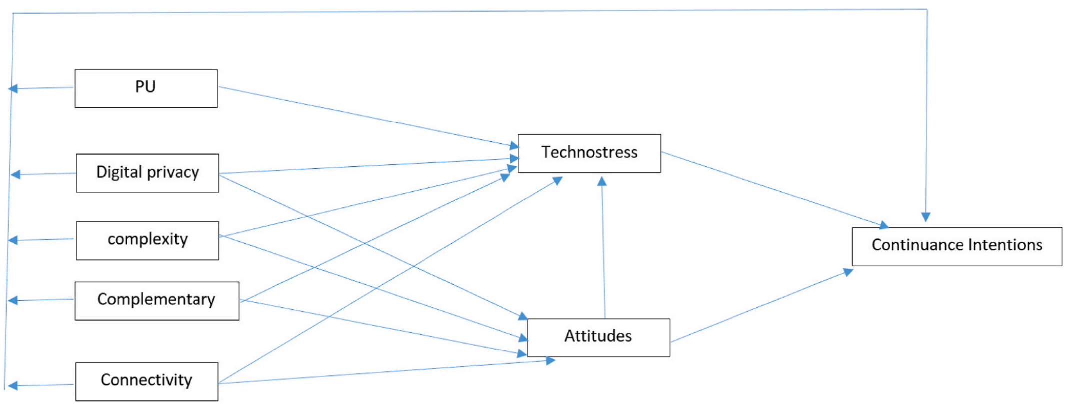

Fig. 2. Hypothesized model.

number of participants in the first phase was 37.

The purpose of the focus group and semi-structured interviews was to explore technological features that influence the technostress experience of faculty members when using new mobile technology in their teaching within a higher education setting. Moreover, the findings of the first phase were used to develop the items of the quantitative data collection tool. The second phase was the quantitative phase, which used a survey developed from the findings of the qualitative phase and the study framework. In the quantitative phase, the researchers collected data using an online survey. The last stage was building and testing the proposed model using statistical analysis, SPSS, and AMOS, to find the relationship among the constructs.

3.1. First phase: qualitative phase

In this phase, we applied two qualitative tools to gather participant data: semi-structured interviews and focus group discussions.

3.1.1. Semi-structured interviews

Firstly, the researchers developed the exploratory interview questions based on the P-E fit theory to guide the data collection process and the findings of previous studies (e.g., Refs. [19,55]. Secondly, the interview protocol was developed (Appendix A), which included general information about the study, the researchers, and the purpose of the study. The second part contained the interview questions. A snowball method was used to recruit participants from different countries. The main criteria for inviting and selecting the participants were using new technology in teaching within a mandatory environment. Participation in the study was voluntary. Semi-structured interviews with the participants continued until the researchers reached saturation point regarding the emergence of new themes. Semi-structured interviews were 20–30 min in duration using Zoom. The researchers asked the participants about their lived experience of using technology and how its features influenced them to use it in teaching. All interview questions are presented in the interview protocol. The participants' information is shown in Table 1 below.

It is evident from Table 1 that the number of female respondents was slightly higher than that of male respondents. Most of them belonged to the age group 31 to 35, and a majority of the respondents were Ph.D. holders. Regarding country representation, the sample was more or less equally distributed.

3.1.2. Focus group sessions

The second qualitative data collection tool was used to conduct two focus group sessions to discuss mobile technology features and technostress with 19 participants from different countries. The criteria for choosing the participants in the focus group sessions were: their use of mobile technology in teaching in higher education, their non-participation in the interview process, their willingness to share their experience of using mobile technology, and their availability to join in the discussion. Each session of the focus group was 90 min duration. Two researchers controlled the discussion in the focus group sessions, and after obtaining the participants' permission, the discussion was recorded.

Thematic analysis was used to analyze the qualitative data, following the procedures reported by Ref. [57]. Analysing the steps included: transcribing the interview audio files, reading all the transcript files individually line by line, looking for ideas and concepts related to technological features and technostress, and grouping these concepts and ideas into themes and subthemes.

The researchers found two main themes in the qualitative data analysis: faculty members' perspectives towards using mobile technology in online teaching during the crisis and the main features of mobile technology that increased the levels of technostress among faculty members and were considered to be stressors. The first theme describes the attitude of faculty members towards using mobile technology in online teaching. Most participants held positive attitudes toward using mobile technology in online teaching.

Table 1
Demographic information of participants in the qualitative phase (N = 37).

Variable	Category	Frequency	Percentage (%)
Gender	Male	17	45.9
	Female	20	54.1
Age	>30	7	18.9
	31–35	10	27.1
	36–40	4	10.8
	41–45	5	13.5
	46–50	4	10.8
	<50	7	18.9
Education Level	Has PhD	19	51.4
	Has Masters	4	10.8
	Ph. D student	8	21.6
	Master's Student	6	16.2
Country	Libya	6	16.2
	Palestine	4	10.8
	Saudi Arabia	6	16.2
	Iraq	5	13.5
	Egypt	5	13.5
	Jordan	6	16.2
	Sultanate of Oman	5	13.5

This theme helped the researchers identify faculty members' attitudes and the features of mobile technology. This then reflected on the Design of the quantitative data collection tool as well as the second theme used to develop the dimensions of the tool and the items of each construct from the participants' talk.

The findings of the first phase were quantized by counting the frequency of each feature. The quantization of the qualitative conclusions enabled us to find the most common features of mobile technology used by the study participants. Table 2 shows the frequency of the most influential mobile technological features.

Table 2 shows that perceived usefulness is the most influential factor, closely followed by complexity. Other significant factors for technostress and continuance intentions were: digital privacy, complementary, and mobile system upgrading. Connectivity received the lowest preference.

3.2. *Phase II: quantitative phase*

3.2.1. *Design and development of the survey*

Building the dimensions of the survey and the items of each dimension was based on: the findings of previous studies, the qualitative phase findings, and the study's P-E fit framework. The constructs were: perceived usefulness, complexity, complementary, digital privacy, regular updating/upgrading, connectivity, technostress, and continuance intentions. Thirteen out of 31 items were adapted and noted from examining related previous studies. Therefore, a pool of items was created from the participants who participated in the qualitative phase, and then we re-phrased the items of each construct.

3.2.1.1. Procedures for building the survey. The researchers had a meeting to discuss the findings of the first phase. They agreed to include the highest frequency features: perceived usefulness, complexity, complementary, digital privacy, regular updating/upgrading, connectivity, technostress, and continuance intentions. The lowest factors, such as reliability and the type of technology, were excluded. Secondly, the researchers created a pool of items from the participants' voices. Thirdly, a cognitive interview was conducted with five faculty members to check the items in terms of wording. Finally, a pilot study was conducted to determine the instrument's reliability and validity. An exploratory factor analysis (EFA) was conducted to find the loading factors of each item on the constructs and the number of elements. Using SPSS, the researchers conducted the maximum likelihood (ML) extraction method, followed by Promax rotation, in the process of EFA, as this assumed correlations among the constructs and yielded better results than standard varimax rotation [58]. The researchers excluded the items loaded on two constructs or those with a loading factor less than 0.40. The number of factors was found using an eigenvalue greater than one and a screen plot. The findings of EFA analysis presented in Table 3. The final version of the survey was composed of eight constructs with 27 items (Appendix A).

3.3. *Third phase: model building and testing*

In this phase, the researchers tested the causal relationship between the factors influencing technostress and the continuance intentions of faculty members to use mobile technology (Fig. 2).

Using Microsoft Forms, an online survey was distributed to the participants to collect data. Participants were invited to provide their responses by posting the link on social media groups. The researchers used their networks to distribute the survey to their colleagues. The invitation letter included the link to the online survey, information about the study, the definition of mobile technology, and examples of mobile technology. Participation in the survey was voluntary without any compensation. A total of 720 responses were obtained. Twenty-eight responses were deleted from data analysis because more than 10% of the data was missing. Therefore, the research in this study was based on the data from 692 responses. Table 4 presents the participants' demographic information.

Table 4 shows that a majority (62%) of the respondents to the survey were male. Regarding the stream, the representation of medical and engineering sciences was higher (58%).

To find the goodness of fit indices, the direct, indirect, and total effects of the constructs and their influence on the continuance intention to use mobile technology in online teaching (SPSS and AMOS 26) were used in the statistical analysis and building of the

Table 2
Frequency distribution of the most influential mobile technological features on technostress and continuance intentions.

Factor	F
Perceived usefulness	62
Complexity	59
Digital Privacy	54
Complementary	48
Updating/upgrading	47
Technostress	45
Continuance intention	40
Attitudes	35
Connectivity	20

Table 3
Loading factors of items on the constructs from EFA analysis.

item	loading	Variance
PU1	0.814	25.881
PU2	0.986	
PU3	0.974	
PU4	0.970	
PU5	0.887	
Compx1	0.822	19.101
Compx2	0.766	
Compx3	0.700	
Upg1	0.721	5.708
Upg2	0.753	
Upg3	0.831	
Complim1	0.842	4.807
Complim2	0.765	
Complim3	0.714	
DP1	0.797	4.216
DP2	0.923	
DP3	0.919	
DP4	0.887	
Technost1	0.691	3.648
Technost2	0.865	
Technost3	0.751	
ATT1	0.875	3.405
ATT2	0.856	
ATT3	0.837	
Conn1	0.696	3.34
Conn2	0.839	
Conn3	0.900	
CI1	0.822	3.23
CI2	0.927	
CI3	0.704	
total variance		73.337

Table 4
Demographic characteristics of participants (N = 692).

Variable	Category	Frequency	Percentage (%)
Gender	Male	428	62
	Female	264	38
College	Social and Educational Sciences	292	42
	Medical and Engineering Sciences	400	58

model.

3.4. Ethical considerations

The researchers received approval to conduct this study from the IRB committee at An- Najah National University under number ANNU-T007-2022. Moreover, the participants in this study signed a consent form that was part of the interview protocol and the focus group sessions. A short paragraph at the beginning of the survey was added, informing participants about the purpose of the study, that participation in the study was voluntary, and that their responses would remain anonymous. The following sentence was added at the end of the paragraph: "If you agree, we consider that you have signed the form. If not, you can stop participating in the study".

3.5. Data analysis

Depending on the study phase, the researchers used different procedures and tools in the data analysis process. For the qualitative data analysis, the researchers used inductive thematic analysis to ascertain the technological features that influenced technostress, as reported by the participants. For the development of the survey, the researchers used SPSS to analyze and discover the normality of the data to check whether it was suitable for exploratory factor analysis (EFA). Finally, the researchers used AMOS to estimate the path analysis coefficients between the variables in the tested model and to discover the goodness of fit indices.

The assumptions of multiple regressions, such as the distributed normality through Skew, Kurtosis, and multi-collinearity, were checked. SPSS ver 26 was used for a descriptive analysis of the collected data and to test the measurement's reliability and validity. Exploratory factor analysis (EFA) was also carried out for data analysis.

4. Results

The discriminant validity of the test's findings, calculated using SPSS, is shown in Table 5.

The most commonly used method for analyzing the discriminant validity of a test's findings is to compare the correlations between the different test items. This involves examining the correlations among the test items and comparing them with the correlations between the test items and the criterion measure. Suppose a test is found to have good discriminant validity. In that case, the correlations among the test items should be significantly lower than those between the test items and the criterion measure. The discriminant validity of the test's findings is compared with the correlation coefficients of each construct with the other constructs. This was done by making a matrix for each construct: Perceived Usefulness, Complexity, Complementary, Digital privacy, Technostress, Attitudes, Connectivity, and Continuance intention.

It is evident from Table 4 that the highest value is for continuance intention and digital privacy, followed by technostress and complimentary. Other constructs are also above 0.5, which indicates a high positive correlation.

4.1. *Estimations of the model*

The measurement model is a mathematical model used in psychological research designed to quantify the relationship between a set of variables. The model is usually expressed in terms of a set of equations or a matrix of correlations and is used to assess the strength of relationships between variables and the predictive value of variables for other variables. It is typically used to analyze survey data or other observational data. Table 6 below presents the results of the measurement model.

The results align with the discriminant validity (Table 4), with the highest value being for continuance intention and digital privacy, followed by technostress and complimentary.

4.2. *Path coefficients*

Based on Fig. 2, the independent variables were: perceived usefulness, digital privacy, complexity, complementary, connectivity, attitudes, and technostress. Fig. 3 below shows the estimations of the coefficients between the variables influencing continuance intention to use mobile technology.

Furthermore, goodness fit indices met the standardized estimation. These estimations are presented in Table 7.

Based on Tables 5 and 6, these estimations indicate that the hypothesized model and its measurements explain how mobile technological features affect technostress and continuance intention to use mobile technology in teaching in higher education. Moreover, we found each construct's direct, indirect, and total effects on others. Table 8 presents each construct's direct, indirect, and total effects.

5. Discussion

Several factors impact the experience of technostress among teachers in schools, ranging from personal skills to systemic support. Firstly, a teacher's technological skill level shapes their technostress levels. Teachers with limited technology skills may find themselves feeling anxious and overwhelmed when interacting with unfamiliar technologies, according to Ref. [44]. Another influencing factor is the extent of technology used in the classroom. If teachers are required to employ various technologies for instructional purposes, they can feel overwhelmed and stressed, as [60] noted. However, when teachers feel backed by their school, peers, or technology specialists in their technological endeavors, they're likely to experience lower levels of technostress [61].

Access to professional development opportunities can also mitigate technostress. Those teachers who have chances to learn more about technology can better manage their technostress, as per [62]. Nevertheless, time remains a significant factor. Teachers with insufficient time to learn, plan, and incorporate technology in their teaching might be more prone to technostress.

Lastly, the overall school ecosystem plays an important role. The attitudes of administrators and colleagues towards technology can significantly influence a teacher's experience of technostress. Schools that foster a positive environment around technology use are likely better equipped to help teachers cope with technostress [63].

This study delved into understanding the degree of technostress among public school teachers. Quantifying the exact level of technostress is challenging due to the varying levels of technology use among teachers and schools. Nevertheless, it is increasingly

Table 5
Discriminant validity of the test's findings.

Construct	M	SD	PU	COMPX	COMPLIM	DP	TECHNOST	ATT	CONN	CI
PU	4.29	0.66	0.77							
COMPX	2.83	1.03	−0.08	0.79						
COMPLIM	4.03	0.66		0.547	0.854					
DP	3.36	0.90	0.54		0.104	0.9				
TECHNOST	4.21	0.66		0.658		0.55	0.87			
ATT	3.21	0.79	0.57	−0.428		0.29		0.79		
CONN	2.79	1.03	0.24	0.336	0.326	0.31	0.476	−0.324	0.79	
CI	3.49	0.67	0.4		0.124		−0.414	0.348	0.754	0.9

Table 6
Results for the measurement model.

	α	CR	AVE
PU	0.9	0.90	0.6
COMPX	0.8	0.84	0.62
COMPLIM	0.8	0.82	0.73
DP	0.9	0.86	0.81
TECHNOST	0.9	0.85	0.75
ATT	0.8	0.73	0.56
CONN	0.9	0.79	0.63
CI	0.9	0.87	0.81

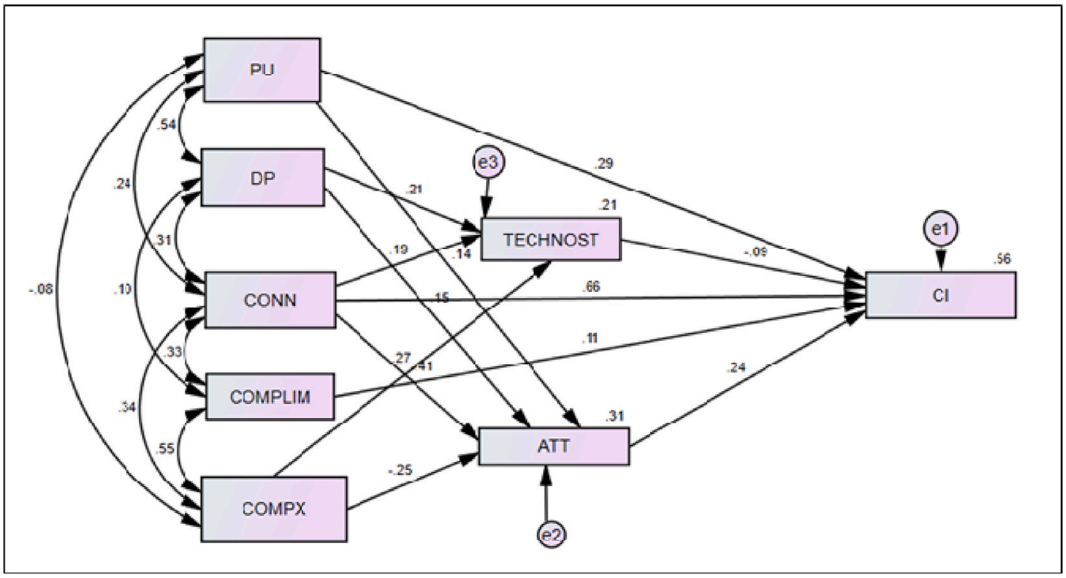

Fig. 3. Estimations of the coefficients between the variables influencing continuance intention to use mobile technology.

Table 7
The goodness fit indices of the model [59] (Schuberth et al., 2022).

Goodness-of-fit index (GFI)	0.995	greater than 0.9
Adjusted GFI (AGFI)	0.976	greater than 0.8
Incremental fit index (IFI)	0.996	greater than 0.9
Tucker–Lewis index (TLI)	0.986	greater than 0.9
Comparative fit index (CFI)	0.996	greater than 0.9
Root mean square error of approximation (RMSEA)	0.035	less than 0.08
$\chi 2$/df	1.84	less than three
OR P FOR $\chi 2$	0.066	>0.05

recognized as a growing issue for teachers, especially those in under-resourced public schools. As classrooms become more technology-oriented, teachers are often burdened with the mounting pressure of integrating technology into their teaching methods. Moreover, they might lack the requisite training and support to utilize technology effectively [64]. Kim and colleagues [65] reported that technostress often triggers cognitive overload and significant stress in teachers, which may impact their performance.

Furthermore, this study also examined the impact of online teaching during a crisis on technostress. Online instruction in crisis situations can exacerbate technostress for both teachers and students. The additional technical demands, such as learning new online tools and software, can heighten teachers' stress levels. Likewise, students also experience technostress due to the unfamiliar online tools they're required to use. The absence of physical interaction complicates monitoring student progress and providing support, potentially leading to feelings of isolation and heightened technostress [66].

The direct effects of various factors on integrating mobile technology in education are predominantly positive. Mobile devices are a prevalent part of students' lives, making it convenient for educators to incorporate these tools into teaching. This facilitates broader access to learning materials, deeper engagement with coursework, and better teacher-student communication. Moreover, mobile technology in the classroom can enhance student engagement and collaboration and enable personalized instruction.

Table 8
Direct, Indirect and Total effects of various factors on mobile technology integration.

Variables			
Endogenous (Dependent) Variable Continuance Intention			
Exogenous (Independent) Variables	Direct Effects	Indirect Effects	Total Effects
Technostress	−0.09	–	−0.09
Attitudes	0.24	–	0.24
Perceived Usefulness	0.29	0.03	0.32
Digital Privacy	–	0.02	0.02
Connectivity	0.66	−0.17	0.54
Complementary	0.11	–	0.11
Complexity	–	−0.09	−0.09
Endogenous (Dependent) Variable Technostress Exogenous (Independent) Variables			
Perceived Usefulness	–	–	–
Digital Privacy	0.21	–	0.21
Connectivity	0.19	–	0.19
Complementary	–	–	–
Complexity	0.27		0.27
Attitudes	–	–	–
Endogenous (Dependent) Variable Attitudes Exogenous (Independent) Variables			
Perceived Usefulness	0.14	–	0.14
Digital Privacy	0.15	–	0.15
Connectivity	−0.41	–	−0.41
Complementary	–	–	–
Complexity	−0.25	–	−0.25

However, the indirect effects of technology integration are more varied. While technology can boost collaboration, creativity, and problem-solving skills, it can also cause increased distractions and reduced face-to-face interaction. The need to stay connected can also increase stress levels.

In totality, incorporating mobile technology in education is mainly beneficial. When used aptly, mobile devices can enhance student access to learning materials, improve engagement, foster creativity, and stimulate problem-solving. Yet, it is essential to remember that these devices can also lead to distractions and potentially hamper face-to-face interaction. As such, educators must strive for a balanced approach toward integrating mobile technology in classrooms.

5.1. Limitations of the study

Despite its significant contributions, this study has several limitations. Firstly, its geographical focus is primarily on Arab countries, potentially limiting the generalizability of the findings to other cultural and educational contexts. Furthermore, it only provides insights into short-term technostress effects, not taking into account the longitudinal impacts on health, job satisfaction, and productivity of academic staff.

The relationship between technostress and student learning outcomes is noted but not extensively explored. This leaves a knowledge gap about the impact of technostress on the effectiveness of teaching and learning. The study also falls short in comparing technostress levels across different educational settings like primary, secondary, and tertiary education.

The study highlights the role of teacher training in managing technostress but does not elaborate on the structure and content of such programs. Thus, a clear pathway for the development of professional training interventions is lacking.

Additionally, despite acknowledging the influence of individual tech skills, extent of technology usage, systemic support, professional development opportunities, and time management on technostress, it does not adequately delve into each of these factors. In particular, the study doesn't detail the specific tech abilities that could alleviate technostress or suggest optimal levels of technology integration to balance enhancement of learning outcomes and technostress reduction.

Lastly, the study doesn't thoroughly examine the impact of technostress in crisis situations like online teaching during a pandemic, and the role of mobile technology use, both crucial elements in the contemporary educational landscape. Therefore, although insightful, the study leaves several areas unaddressed for future research.

5.2. Theoretical and practical implications

There are numerous theoretical implications of managing technostress in online classes [19]. Firstly, it is essential to consider technostress's psychological and physiological effects on a student's learning performance. Technostress can lead to physical and mental health issues such as headaches, depression, anxiety, and sleep disturbances. By reducing technostress, students can be better equipped to focus on their studies and improve their academic performance. Secondly, technostress can lead to a decrease in overall satisfaction with the learning experience. By managing technostress, students are more likely to have a positive experience with online learning and be more likely to remain enrolled in their courses. Further, technostress can have a negative effect on the overall quality of online courses. By reducing technostress, educators can ensure that their online courses are more efficient, user-friendly, and enjoyable for their students.

There are also practical implications to managing technostress in online classes. There is a need to ensure that students have access to the necessary resources and technology for the class and provide user-friendly tutorials and guidance for any unfamiliar software. Teachers can allow flexible requirements and deadlines to accommodate students who may need extra time to become comfortable with the technology. Students must be encouraged to take breaks and be mindful of their physical and mental health when using technology. Monitoring students' time on technology-related tasks can ensure that it does not become overwhelming. Students need to be provided with access to a safe platform to share their concerns and ask for help if needed. Implementing strategies to reduce the cognitive load caused by technology, such as breaking down tasks into smaller pieces and providing visual aids, is an effective strategy. Institutions or teachers must offer additional support to students who struggle with technology or feel overwhelmed. Creating an inviting and supportive virtual learning environment would positively impact students' academic attainment.

5.3. Future research recommendations

Based on the findings of the study, the following future research recommendations can be made:

1. Replication: Future studies can replicate this study in different contexts, such as in other regions and with varying samples size, to determine the generalizability of the results.
2. Long-term Effects of Technostress: The study provides insights into the short-term effects of technostress, but it would be helpful to explore the long-term effects of technostress on the health, job satisfaction, and productivity of academic staff. A longitudinal study would provide a better understanding of the long-term effects of technostress.
3. Technostress and Student Learning Outcomes: The study discusses technostress's psychological and physiological effects on students' learning performance. However, further research is required to explore the relationship between technostress and student learning outcomes.
4. Comparison of Technostress in Different Educational Settings: The study focused on academics from different Arab countries, but it would be useful to compare technostress levels among academic staff in different educational settings, such as primary, secondary, and tertiary education.
5. Technostress and Teacher Training: The study highlights the importance of managing technostress in online classes, and it would be interesting to explore the role of teacher training in managing technostress. Teacher training programs could be designed to help academic staff manage technostress effectively.
6. Cultural Factors and Technostress: The study focused on Arab academic staff, but it would be useful to explore the role of cultural factors in technostress among academic staff from different cultural backgrounds. Cultural factors could influence the level and nature of technostress experienced by academic staff.

Building upon the findings of this study, the first recommendation for future research is a more in-depth exploration of the individual skill levels of teachers concerning technology. As pointed out by Ref. [44] Tarafdar et al. (2010), those with limited technological skills often experience higher levels of technostress. Understanding the specific abilities that alleviate technostress and promoting those through professional development could be an effective intervention.

Secondly, the extent of technology usage in the classroom should be studied. As noted by Ref. [59] Burke (2009), the quantity and variety of technology required in teaching can be overwhelming for teachers, resulting in increased technostress. Future research should aim to determine optimal levels of technology integration that enhance teaching and learning outcomes while minimizing technostress.

The supportive role of peers and administrators within the educational ecosystem was identified as a key factor in managing technostress [60] (Goddard, 2011). Future research should examine the mechanisms through which support systems within schools can be designed to be more effective in providing technological guidance and reducing technostress.

Another crucial area for future research is professional development opportunities for teachers. As per [61] Genc & Genc (2013), teachers with access to continuous learning opportunities related to technology use can better cope with technostress. Future investigations should focus on determining the most effective modes and formats of professional development to aid teachers in this area.

Additionally, future research should examine the influence of time on technostress. With the increasing integration of technology in education, teachers are often challenged to learn new tools, plan lessons involving technology, and ensure its effective use in the classroom, all within a limited time. Investigating how time management strategies can be implemented in schools to help teachers deal with this issue would be worthwhile.

Lastly, understanding the impact of technostress on online teaching during crises should be a priority for future studies. As stated by Ref. [65] Bozkurt & Sharma (2021), the technical demands of teaching online, coupled with the absence of physical interaction, can significantly elevate technostress levels. Further studies should focus on developing strategies to minimize technostress in such situations and ensure adequate support is provided to teachers and students.

Finally, while incorporating mobile technology in education has many benefits, its potential drawbacks should not be ignored.

Future research should identify ways to maintain a balanced approach toward integrating mobile technology in classrooms, ensuring it enhances learning while not becoming a source of distraction or stress.

5.4. Conclusion

Technostress, a phenomenon associated with the utilization of technology in teaching, is gaining recognition as a critical concern in education, especially in the context of increasing digitalization of classrooms and online learning. This study underscored several factors that influence technostress among teachers. These encompass individual technological proficiency, the extent of technology usage in classrooms, systemic support from the school environment, availability of professional development opportunities, and time management considerations.

Teachers with limited technological skills are found to be more prone to technostress, emphasizing the importance of targeted professional development programs that enhance their tech competencies. The extent and variety of technology used in classrooms are another key determinant of technostress levels. While technology integration can augment the learning process, an overload could lead to stress and anxiety, necessitating a balanced approach.

Importantly, a supportive school environment is found to alleviate technostress. Assistance from peers, administrators, and technology specialists within the school ecosystem can significantly improve teachers' technological endeavors and reduce their stress levels. Thus, fostering a positive and supportive culture around technology use in schools is crucial.

Furthermore, the study brings attention to the compounded effect of technostress in crisis situations, such as during online teaching amidst a pandemic. The additional technical demands, alongside the challenges of monitoring student progress remotely, can heighten technostress levels for teachers and students alike.

Despite potential drawbacks like distractions and reduced face-to-face interaction, the integration of mobile technology in education is generally beneficial, leading to broader access to learning materials, improved engagement, and personalized instruction. However, the key is to balance the use of such technology to maximize benefits while minimizing associated stress.

Ultimately, to alleviate technostress, a multifaceted approach is needed, encompassing skill development, strategic technology integration, fostering supportive environments, and ensuring optimal time management. Further research is essential to delve deeper into these factors and to formulate effective strategies to mitigate technostress, enhancing the overall quality and effectiveness of technology-assisted teaching and learning.

The study's strengths lie in its comprehensive exploration of the multifaceted issue of technostress among teachers. It effectively identifies and examines numerous contributing factors, including individual technological proficiency, extent of technology usage, systemic support, professional development opportunities, and time management. The study also expands its analysis beyond the classroom, investigating the impact of technostress in crisis situations like online teaching during a pandemic. Its examination of the direct and indirect effects of incorporating mobile technology in education offers nuanced insights. The study's inclusion of theoretical implications and practical applications, alongside suggesting avenues for future research, provides a well-rounded investigation into technostress in education.

Author contribution statement

Zuheir N Khlaif: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Mageswaran Sanmugam; Jamil Itmazi; Abedalkarim Ayyoub: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Muayad K Hattab: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Elias Bensalem; Mohamed A Mitwally: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Ramesh Chander sharma: Performed the experiments; Wrote the paper.

Amjad Jomaa; Ali H Nijmi; Ahmad Ammar Jawad: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Mahmoud A. Ramadan; Tahani Bshrarat: Analyzed and interpreted the data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] S.T. Oh, S. Park, A study of the connected smart worker's techno-stress, Procedia Comput. Sci. 91 (Itqm) (2016) 725–733, https://doi.org/10.1016/j.procs.2016.07.065.
[2] M. Tarafdar, E.B. Pullins, T.S. Ragu-Nathan, Technostress: negative effect on performance and possible mitigations, Inf. Syst. J. 25 (2) (2015) 103–132, https://doi.org/10.1111/isj.12042.
[3] Carmen Botella, Silvia Rueda, Emilia López-Iñesta, Paula Marzal, Gender diversity in stem disciplines: a multiple factor problem, Entropy 21 (1) (2019) 30, https://doi.org/10.3390/e21010030.
[4] A. Syvänen, J.P. Mäkiniemi, S. Syrjä, K. Heikkilä-Tammi, J. Viteli, When does the educational use of ICT become a source of technostress for Finnish teachers? In Seminar Net 12 (No. 2) (2016).
[5] H. Ozgur, Relationships between teachers' technostress, technological pedagogical content knowledge (TPACK), school support and demographic variables: a structural equation modeling, Comput. Hum. Behav. 112 (2020), 106468.
[6] M.L. Roubi, A.H. Najmi, Z.N. Khlaif, A. Benlahcene, The Arabic version of the technostress scale for primary school teachers: factorial validity and measurement invariance, Cypriot Journal of Educational Sciences 17 (2022) 3806–3820.
[7] Z.N. Khlaif, F. Khalili, S. Affouneh, A. Tlili, How remote leaning during crisis affect technostress levels experienced by academicians, Educ. Inf. Technol. (2023) 1–26.
[8] S. Domínguez-Lloria, S. Fernández-Aguayo, J.A. Marín-Marín, M. Alvariñas-Villaverde, Effectiveness of a collaborative platform for the mastery of competencies in the distance learning modality during COVID-19, Sustainability 13 (11) (2021) 5854.
[9] F. Gaudioso, O. Turel, C. Galimberti, The mediating roles of strain facets and coping strategies in translating techno-stressors into adverse job outcomes, Comput. Hum. Behav. 69 (2017) 189–196, https://doi.org/10.1016/j.chb.2016.12.041.
[10] A. Bozkurt, R.C. Sharma, Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic, Asian Journal of Distance Education 15 (1) (2020) i–vi. Retrieved from, https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/447.
[11] Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020).The Difference Between Emergency Remote Teaching and Online Learning. EDUCAUSE Review, 27. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning.
[12] L.S. Schlesselman, Perspective from a teaching and learning center during emergency remote teaching, Am. J. Pharmaceut. Educ. 84 (9) (2020) 11–29, https://doi.org/10.5688/ajpe8142. https://www.ajpe.org/content/early/2020/05/14/ajpe8142.
[13] Z.N. Khlaif, M. Sanmugam, A. Ayyoub, Impact of technostress on continuance intentions to use mobile technology, The Asia-Pacific Education Researcher (2022) 1–12.
[14] F.A. Albrahim, Online teaching skills and competencies, Turkish Online Journal of Educational Technology-TOJET 19 (1) (2020) 9–20.
[15] J.K. Green, M.S. Burrow, L. Carvalho, Designing for transition: supporting professors and students cope with emergency remote education, Postdigit. Sci. Educ. 2 (2020) 906–922, https://doi.org/10.1007/s42438-020-00185-6.
[16] A.M. Rodríguez-García, J.A. Marín-Marín, J.A. López-Núñez, A.J. Moreno-Guerrero, Do age and educational stage influence No-Mobile-Phone phobia? Int. J. Environ. Res. Publ. Health 18 (9) (2021) 4450.
[17] U. Demiray, R.C. Sharma, Ethical practices and implications in distance education: an introduction, in: U. Demiray, R. Sharma (Eds.), Ethical Practices and Implications in Distance Learning, 2009, pp. 1–9, https://doi.org/10.4018/978-1-59904-867-3.ch001. IGI Global.
[18] M.A. Priatna, E.C. Djamal, Precipitation prediction using recurrent neural networks and long short-term memory, Telkomnika (Telecommunication Computing Electronics and Control) 18 (5) (2020) 2525–2532.
[19] R. Ayyagari, V. Grover, R. Purvis, Teknostress: technological antecedents and implications, MIS Q. 35 (4) (2011) 831–858.
[20] Y. Huang, Examining students' continued use of desktop services: perspectives from expectation-confirmation and social influence, Comput. Hum. Behav. 96 (2019) 23–31.
[21] B.A. Kumar, S.S. Chand, Mobile learning adoption: a systematic review, Educ. Inf. Technol. 24 (1) (2019) 471–487, https://doi.org/10.1007/s10639-018-9783-6.
[22] S.F. Verkijika, Digital textbooks are useful but not everyone wants them: the role of technostress, Comput. Educ. 140 (2019), https://doi.org/10.1016/j.compedu.2019.05.017.
[23] M. Al-Emran, I. Arpaci, S.A. Salloum, An empirical examination of continuous intention to use m-learning: an integrated model, Educ. Inf. Technol. 25 (4) (2020) 2899–2918.
[24] Z. Khlaif, Teachers' perceptions of factors affecting their adoption and acceptance of mobile technology in K-12 settings, Comput. Sch. 35 (1) (2018) 49–67.
[25] Y.J. Joo, K.Y. Lim, N.H. Kim, The effects of secondary teachers' technostress on the intention to use technology in South Korea, Comput. Educ. 95 (2016) 114–122.
[26] Z.N. Khlaif, F. Khalili, S. Affouneh, A. Tlili, How remote leaning during crisis affect technostress levels experienced by academicians, Educ. Inf. Technol. (2023) 1–26.
[27] Y. Yang, X. Wang, Modeling the intention to use machine translation for student translators: an extension of technology acceptance model, Comput. Educ. 133 (2019) 116–126.
[28] I.O. Panisoara, I. Lazar, G. Panisoara, R. Chirca, A.S. Ursu, Motivation and continuance intention towards online instruction among teachers during the COVID-19 pandemic: the mediating effect of burnout and technostress, Int. J. Environ. Res. Publ. Health 17 (21) (2020) 8002.
[29] S. Mahanta, R.C. Sharma, Challenges, prospects, and strategies of emergency online education at secondary level in the Assam state of India during COVID-19 pandemic, Education and Self Development 17 (4) (2022) 34–51, https://doi.org/10.26907/esd.17.4.04.
[30] J.D. Kaplan, Dialogues of Plato, Washington Square Press, New York, 1950.
[31] X. Wang, S.C. Tan, L. Li, Technostress in university students' technology-enhanced learning: an investigation from multidimensional person-environment misfit, Comput. Hum. Behav. 105 (2020), 106208.
[32] A.L. Kristof-Brown, R.D. Zimmerman, E.C. Johnson, Consequences OF INDIVIDUALS' FIT at work: a meta-analysis of person–job, person–organization, person–group, and person–supervisor fit, Person. Psychol. 58 (2) (2005) 281–342.
[33] C. Ostroff, Multiple Perspectives of Fit across Levels of Analysis, Doctoral dissertation, Psychology Press, 2007.
[34] Q. Tu, M. Tarafdar, T. Ragu-Nathan, B.S. Ragu-Nathan, Improving end-user satisfaction through techno-stress prevention: some empirical evidences, 14th Americas Conference on Information Systems, AMCIS 6 (2008) 236, 2008.
[35] T.S. Ragu-Nathan, Monideepa Tarafdar, S. Bhanu, Ragu-Nathan, Qiang Tu, The consequences of technostress for end users in organizations: conceptual development and empirical validation, Inf. Syst. Res. 19 (4) (2008) 417–433.
[36] M. Stadin, M. Nordin, A. Broström, L.L. Magnusson Hanson, H. Westerlund, E.I. Fransson, Technostress operationalised as information and communication technology (ICT) demands among managers and other occupational groups – results from the Swedish Longitudinal Occupational Survey of Health (SLOSH), Comput. Hum. Behav. 114 (2021), 106486, https://doi.org/10.1016/j.chb.2020.106486.
[37] D. Taser, E. Aydin, A. Torgaloz, Y. Rofcanin, An examination of remote e-working and flow experience: the role of technostress and loneliness, Comput. Hum. Behav. 127 (2021) 1–10, https://doi.org/10.1016/j.chb.2021.107020.
[38] Z.R. Steelman, A.A. Soror, Why do you keep doing that? The biasing effects of mental states on IT continued usage intentions, Comput. Hum. Behav. 73 (2017) 209–223.
[39] G. La Torre, V. De Leonardis, M. Chiappetta, Technostress: how does it affect the productivity and life of an individual? Results of an observational study, Publ. Health 189 (2020) 60–65, https://doi.org/10.1016/j.puhe.2020.09.013.
[40] X. Wang, S.C. Tan, L. Li, Measuring university students' technostress in technology-enhanced learning: scale development and validation, Australas. J. Educ. Technol. 36 (4) (2020) 96–112, https://doi.org/10.14742/ajet.5329.

[41] C. Torres, Adaptation and validation of technostress creators and technostress inhibitors inventories in a Spanish-speaking Latin American country, Technol. Soc. 66 (2021) 1–14, 10.1016/j.techsoc.2021.101660.

[42] A.N. Çoklar, R. Bozyiğit, Determination of technology attitudes and technostress levels of geography teacher candidates, lnternational Journal of Geography and Geography Education (44) (2021) 102–111.

[43] R.K. Jena, Technostress in ICT enabled collaborative learning environment: an empirical study among Indian academician, Comput. Hum. Behav. 51 (Part B) (2015) 1116–1123, https://doi.org/10.1016/j.chb.2015.03.020.

[44] M. Tarafdar, Q. Tu, T. Ragu-Nathan, Impact of technostress on end-user satisfaction and performance, J. Manag. Inform. Syst. 27 (2010) 303–334, https://doi.org/10.2753/MIS0742-1222270311.

[45] B.K. Joo, J.G. Park, T. Lim, Structural determinants of psychological well-being for knowledge workers in South Korea, Person. Rev. 45 (5) (2016) 1069–1086.

[46] H.-L. Chou, C. Chou, A multigroup analysis of factors underlying teachers' technostress and their continuance intention toward online teaching, Comput. Educ. 175 (2021) 1–12.

[47] A. Oksanen, R. Oksa, N. Savela, et al., COVID-19 crisis and digital stressors at work: a longitudinal study on the Finnish working population, Comput. Hum. Behav. 122 (2021) 1–10, https://doi.org/10.1016/j.chb.2021.106853.

[48] C. Qi, A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance, Behav. Inf. Technol. 38 (12) (2019) 1337–1354, https://doi.org/10.1080/0144929X.2019.1585476.

[49] S. Guo, T. Xiang, X. Li, Towards efficient privacy-preserving face recognition in the cloud, Signal Process. 164 (2019) 320–328.

[50] K. Nepo, The use of technology to improve education, in: Child & Youth Care Forum vol. 46, Springer US, 2017, April, pp. 207–221.

[51] S.G. Wood, J.H. Moxley, E.L. Tighe, R.K. Wagner, Does use of text-to-speech and related read-aloud tools improve reading comprehension for students with reading disabilities? A meta-analysis, J. Learn. Disabil. 51 (1) (2018) 73–84.

[52] A. Tarafdar, A. Sinha, R.E. Masto, Biodegradation of anthracene by a newly isolated bacterial strain, Bacillus thuringiensis AT. ISM. 1, isolated from a fly ash deposition site, Lett. Appl. Microbiol. 65 (4) (2017) 327–334.

[53] J. Traxler, Z. Khaif, A. Nevill, S. Affouneh, S. Salha, A. Zuhd, F. Trayek, Living under occupation: Palestinian teachers' experiences and their digital responses, Res. Learn. Technol. 27 (2019).

[54] C. Brod, Technostress: the Human Cost of the Computer Revolution, Addison Wesley Publishing, Boston, MA, 1984.

[55] Z.N. Khlaif, M. Sanmugam, A.I. Joma, A. Odeh, K. Barham, Factors Influencing Teacher's Technostress Experienced in Using Emerging Technology: A Qualitative Study, Knowledge and Learning, Technology, 2022, pp. 1–35.

[56] J.W. Creswell, V.L.P. Clark, Designing and Conducting Mixed Methods Research, Sage Publications, Thousand Oaks, CA, 2007.

[57] V. Braun, V. Clarke, Using thematic analysis in psychology, Qual. Res. Psychol. 3 (2) (2006) 77–101, https://doi.org/10.1191/1478088706qp063oa.

[58] Joseph Dien, Daniel Beal, Patrick Berg, Optimizing principal components analysis of event-related potentials: matrix type, factor loading weighting, extraction, and rotations, Clin. Neurophysiol. : official journal of the International Federation of Clinical Neurophysiology 116 (2005) 1808–1825, https://doi.org/10.1016/j.clinph.2004.11.025.

[59] F. Schuberth, M.E. Rademaker, J. Henseler, Assessing the overall fit of composite models estimated by partial least squares path modeling, Eur. J. Market. 57 (6) (2022) 1678–1702.

[60] M.S. Burke, The incidence of technological stress among baccalaureate nurse educators using technology during course preparation and delivery, Nurse Educ. Today 29 (1) (2009) 57–64.

[61] M.S. Goddard, Sleep quality, technostress, and maladaptive use of technology: predictors of depression among college students, Doctoral Dissertation, The University Of Memphis (2011).

[62] M. Genç, T. Genç, Monitoring the skills of teachers' vocational development by themselves; fatih project sample, Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi 14 (2) (2013) 61–78.

[63] C.M. Karuppan, Advanced manufacturing technology and stress: technology and management support policies, Int. J. Technol. Manag. 14 (2–4) (1997) 254–264.

[64] S.S.G. Shepherd, Relationship between computer skills and technostress, in: Proceeding of the 2004 ASCUE Conference, How does this affect me?, Myrtle Beach, South Caroline, 2004, pp. 225–231.

[65] S.Y. Kim, H. Park, H. Kim, J. Kim, K. Seo, Technostress causes cognitive overload in high-stress people: eye tracking analysis in a virtual kiosk test, Inf. Process. Manag. 59 (6) (2022), 103093, https://doi.org/10.1016/j.ipm.2022.103093.

[66] A. Bozkurt, R.C. Sharma, On the verge of a new renaissance: care and empathy oriented, human-centered pandemic pedagogy, Asian Journal of Distance Education 16 (1) (2021) i–vii. Retrieved from, https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/576.