



# Factors Influencing Teacher's Technostress Experienced in Using Emerging Technology: A Qualitative Study

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## Abstract

In this era of rapid technology growth, many countries have begun to adopt emerging technologies into their educational systems to improve learning outcomes. The aim of this study is to explore the factors influencing teachers' experiences of technostress while using new technology in academic classrooms and how it might be mitigated. Prior research has not focused on how technostress develops among individuals over time or how it can be mitigated in an individual context; the intention of this study is to contribute to the technostress literature in these particular areas. To address the research gap, we conducted a qualitative study that collected data through the use of an open-ended question questionnaire. Seventy teachers of different backgrounds and locations responded to the survey. We used thematic analysis to analyze their responses and reveal how lack of school support and their professional identities influence their levels of technostress. Technology characteristics, including the complexity and the benefits of a given technology, and privacy concerns play a crucial role in teachers' experiences of technostress. Moreover, we found that colleague support in using new technology and open educational resources each contributed to mitigating teachers' technostress levels. Our study extends technostress research to examine a new learning environment and context. This focus allowed us to highlight the need to develop open educational resources and better social support structures for teachers and to rethink the professional identities of developing teachers to mitigate their levels of technostress. Suggestions for further research that resulted from this work include using a mixed methods research approach in future studies and including more teachers in future work to determine the relationships among the factors identified by this study.

**Keywords** Technostress · Professional identity · Techno-overload · Emerging technology · TPACK

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## 1 Introduction

Emerging technologies and their ubiquity have accelerated the integration of technology into different aspects of our lives, and its increasing affordability will allow this to continue in the future. In educational systems, the use of emerging technology to enhance the learning process has increased exponentially due to incentives from government and non-governmental organizations to meet learners' education needs (Dunn & Kennedy, 2019). Many education systems worldwide use a variety of technology applications for student self-service and academic administration (Wang et al., 2018), massive open online courses (attendance, enrollment (Ofelia et al., 2017), and learning management systems (Barana et al., 2016). In addition, emerging technology assists in reducing distance challenges and paperwork (Agarwal & Mital, 2018; Vahedi et al., 2019) and improves learning processes (Mirzajani et al., 2016).

## 2 Palestinian Context of Using Technology

This study focuses on the unique case of Palestine, which has suffered from simultaneous political, economic, and natural crises that have affected different sectors, including the education system. The Ministry of Education (MoE) has implemented many technological initiatives such as smart learning (Shraim & Crompton, 2015) and the digitalization of education (Fragkaki, 2017; Khlaif & Farid, 2018) to mitigate the negative impact of these crises. These initiatives were implemented in different areas of Palestine with the intention to improve learning outcomes. The MoE has invested more than five million US dollars to improve the infrastructure of specific schools, train teachers, develop e-content, and provide 1,500 teachers with mini laptops and tablets; it has also implemented the use of Microsoft Teams to communicate with students during crises. While using technology for academic purposes is mandatory in Palestine, many teachers do not use it in their practice as the MoE requires and expects. It has been shown that teachers lack training on using technological tools such as Edpuzzle, Zoom, H5P, and Google Classroom (Khlaif et al., 2022, and research has shown that lack of training pushes teachers to be "of two minds" with regard to developing their personal and professional development. Palestinian teachers find it challenging to keep up with rapid updates in technology, digital privacy, and cultural issues (Khlaif et al., 2022). Furthermore, the rapid development of technology increases the challenges of using technology for academic purposes, given the effort necessary to learn new technology or to follow up on technology updates (Joo et al., 2016).

In this study we have used Microsoft Teams as the emerging/new technology as this is the technology that has been adopted by Palestine's MoE for online learning during crisis. However, teachers in Palestine also voluntarily use additional tools such as WhatsApp, a social media app on their smart phone devices, for rapid communication with their students.

## 3 The Dark Side of Technology

Despite the unarguable benefits and affordability of emerging technologies for the learning process, interest in understanding the dark side of technology use has increased among researchers. For example, emerging technologies such as smartphones and social media have been found to remove the boundaries between end-users' work and personal lives, resulting in an intertwining of their social lives with their professional lives

(Salazar-Concha et al., 2021). In addition, researchers such as Tarafdar et al. (2019) and La Torre et al. (2019), have extensively studied individuals' struggles with new technology, defining it as "technostress." Studies define technostress as pressure brought on by the use of technology and the skills and knowledge necessary to integrate technology effectively in one's teaching practice, which can generate stress (Çoklar et al., 2017; Tarafdar et al., 2007).

The impact of technostress on end-users occurs in six areas of behavioral and psychological outcomes, including effects on productivity (Sarabadani et al., 2018), job satisfaction (Krauss, 2020), commitment to change (Zainun et al., 2020), continuing use of a technology (Joo et al., 2016), health (Golz et al., 2021), and business (Marchiori et al., 2020). Studies have also investigated the creators of technostress among end-users in different fields, including health (Califf et al., 2020), business (Wu et al., 2022), and higher education (Abd Aziz & Yazid, 2021), but there is a dearth of studies that investigate the factors that influence teachers' experience of technostress and how to mitigate it, particularly from the perspective of teaching in an environment in which using a given technology is mandatory (Joo et al., 2016; Özgür, 2020; Salo et al., 2022). The lack of studies on teachers' technostress while teaching in such an environment—and specifically, studies including teachers in middle school settings—was the motivation behind conducting this study, the goals of which are to fill the gap in the literature on the factors influencing teachers' technostress from the teachers' perspective and to understand teachers' reluctance to use emerging technology in their teaching practices. Our overall purpose is to explore the factors influencing middle school teachers' experiences of technostress while using new technology in the learning process and determine how it can be mitigated.

This study relied heavily on the lived experience of teachers who experienced technostress. Exploring the factors that influence teachers' technostress from their own perspectives will add to the body of literature from a new context and could reveal additional factors that influence the technostress experienced by teachers who teach in an environment that requires mandatory use of technology. This study's findings will aid decision-makers in Palestine and similar countries in developing programs that can mitigate the impact of factors that influence technostress and will positively influence teacher performance. The findings of this study will be disseminated through workshops that will support teachers' efforts to reduce technostress levels. To achieve this study's goals, we established three research questions to guide the research:

- What are the causes of Palestinian middle school teachers' technostress while using information and communication technologies (ICTs) in teaching?
- How do Palestinian teachers in middle school settings describe their experience of technostress while using ICTs in teaching?
- What approaches do Palestinian teachers currently use to mitigate the levels of technostress they face while using ICTs in teaching?

## 4 Literature Review

In recent times, teachers are urged to integrate technology in their classrooms, as they represent the agents of change in the educational system. While the success or failure of using a new technology depends on whether and how much teachers use it, teachers often struggle with a lack of time to implement these technologies due to the multitasking already

required of them (Joo et al., 2016), which requires significant time and effort. Despite these challenges, teachers do tend to use technology to attract students' attention to teaching materials (Dias & Victor, 2017).

Despite the bright side of using technology in the learning process, researchers have discovered its dark side, which is related to computer anxiety, stress, and pressure (Lee & Xiong, 2021) that negatively impact teachers' intentions to use new technology in their practice (Teo et al., 2019) and reduce their productivity (Qi, 2019). Over the past 6 years (between 2016 and 2022) more than 40 articles (Appendix 1) have investigated the factors that influence the levels of technostress among end-users in different contexts in the USA, Europe, South Asia, and Australia. The majority of these studies were quantitative studies, with only two having been qualitative; one of the studies used a mixed methods approach in the health sector (specifically, a nursing workplace). Only a few of these studies were conducted in a higher and public education context to include students, teachers, or both. Based on the information presented in Appendix (1), to the best of our knowledge, there have only been two studies in this area from Palestine and Saudi Arabia that have been published in peer-reviewed journals. Both of these published articles from the Arab world focus on the role of technostress and its impact on the participants' continued intention to use new technology such as augmented reality (Baabdullah et al., 2022) and mobile technology (Khlaif et al., 2022). It is worth noting that one study, Qi (2019), found that using mobile devices for academic purposes had no impact on technostress, which is inconsistent with previous findings (e.g., Camarena & Fusi, 2022; Abd Aziz & Yazid, 2021; Apple & Mills, 2022).

## 5 Teachers' Technostress

Dong et al. (2020) defined teachers' technostress as a modern disease that affects teachers' ability to cope healthily with the rise of using new technologies in teaching practices. According to Estrada-Muñoz et al. (2021), technostress can refer to an individual's or organization's inability to use technology in a healthy way. Panisoara et al. (2020) defined technostress as "a problem of improper adaptation caused by the failure of people to cope with technology and the changes in requirements related to the use of technology, which generate psychological and physical stress towards the latter." Wang et al. (2020) defined technostress from a psychological perspective, stating that it is a reaction between environment and individuals that could generate positive or negative attitudes toward the new environment. Finally, Estrada-Muñoz et al. (2021) define it as a condition resulting from a lack of ability to use technology healthily, due to age, workload, and perception of work environment. These definitions of technostress share common features, including the inability to use technology, inability to cope with the stress and pressure of using new technology, psychological issues, and referring to technostress as a disease. For the purpose of this study, we define technostress as the stress, pressure, or discomfort a teacher experiences while using new technology (i.e., devices, platforms, changes to their teaching mode, or any digital media) in the learning and teaching process.

While previous researchers have documented technology integration in higher education in different fields (Nepo, 2017; Wood et al., 2018), there have been few studies that have examined mandatory technology adoption and technostress in public and higher education institutional settings. The findings of previous studies in different contexts have revealed that due to the continuous emergence and upgrades of ICT devices and applications, users

are required to spend more time and effort to learn how new technologies work and how to use them (Maier et al., 2015; Joo et al., 2016; Qi, 2019; Tarafdar et al., 2010). Moreover, stress due to using new technology has been shown to have a negative influence on instructors' intentions to accept and integrate ICT in teaching (Baabdullah et al., 2022; Joo et al., 2016; Khlaif et al., 2022). However, few studies have provided insight into the factors that influence technostress in instructors and how it may be effectively reduced (Saló et al., 2022).

## 6 Factors Influencing Technostress

Few studies have explored the reasons behind teachers' experiences of technostress in various contexts, including higher and public education (Joo et al., 2016; Çoklar et al., 2017; Chou & Chou, 2021; Baabdullah et al., 2022). In addition, researchers have developed a variety of technostress scales for detecting technostress levels (Çoklar et al., 2017; Li & Wang, 2021; Özgür, 2020). Califf and Brooks (2020) classified the creators of technostress as techno-overload, techno-uncertainty, techno-invasion, techno-insecurity, and techno-complexity; other scholars consider these to be the levels of technostress that end-users experience with a given technology (Tarafdar et al., 2007). Techno-overload refers to the feeling that people must work harder and faster than usual while handling technological activities from different emerging tools (Pflügner et al., 2021). Techno-insecurity is the feeling of threat that workers may lose their jobs to individuals who are more highly technologically qualified. Techno-invasion occurs when people feel they must remain connected anywhere and anytime, which results in a blurring of the thin line between work and personal contexts. Finally, techno-complexity refers to a lack of technological skills accompanied by a technology's complexity, which requires teachers to invest more time and effort to accomplish their tasks.

Researchers have reported additional factors that create various levels of technostress experienced by teachers, including technological pedagogical content knowledge (TPACK; Waluyo & Nuraini, 2021), self-efficacy (Chou and Chou, 2021; Dong et al., 2020), experience with technology (Salem, 2018; Upadhyaya & Virinda, 2020), and organization culture and commitments (Balduzzi et al., 2020; Camarena & Fusi, 2022). Studies have also reported that TPACK is the ideal model for guiding teachers in using new technology in teaching processes (Dong et al., 2020; Soler-Costa et al., 2021).

Moreover, researchers have developed models for studying the relationship among the factors that influence teachers' experiences of technostress. According to Waluyo and Nuraini (2021), teachers must have TPACK, which will enable them to integrate technology into learning, to change the way they teach. They must actively participate in this process, as the available source of learning should be used actively for it to be integrated appropriately. Furthermore, TPACK represents the intersection of the three bodies of technological knowledge, pedagogy, and content, which can affect and limit the context of learning and teaching. The determining factor of TPACK components is their integration in ICT; this can contribute significantly to the paradigm change for learning as a framework for analyzing teacher knowledge of integrating technology in learning (Dong et al., 2020; Özgür, 2020; Soler-Costa et al., 2021).

The other creator of technostress identified in the literature is "self-efficacy," which refers to the concept that teachers' technology use skills crucially affect their attitudes toward integrating technology into education. Furthermore, high computer self-efficacy has

been shown to contribute to users' abilities to solve difficulties caused by computer technology, which can reduce their degree of perceived technostress and moderate the negative effect of technostress on innovation (Dong et al., 2020).

With regard to organization culture and commitment, organizations tend to employ several approaches to counteract technostressors. The perceived quality of personal experience occurs in three different domains: hedonic (using technology to generate positive experiences), eudaemonic (designing technology to support individuals in reaching "engaging and self-actualizing experiences"), and social/interpersonal (using technology to help improve connectedness between individuals or groups; Brivio, et al., 2018).

Additional factors have recently emerged in the research, including the perceived usefulness of using a new technology (Khlaif et al., 2022), IT mindfulness (Shirish et al., 2021), involvement facilitation (Li & Wang, 2021), mindfulness (Tuan, 2022), and time management (Salo et al., 2022). Despite the emergence of new factors in the literature, there remains a contradiction between these findings and the findings of new studies that reported the same findings or investigated existing factors in a new context.

## 7 Research Design

We used a qualitative research approach to determine the causes of technostress experienced by middle school teachers in settings where they must use mandatory ICT in their teaching practice. A qualitative approach enables an understanding of a phenomenon from the lived experience of a group of people (Mohajan, 2018). The research design we chose was a case study, which allows a qualitative approach that facilitates an understanding of a complex phenomenon experienced in a specific context; this enables researchers to understand a real-life phenomenon (Yin, 2003).

### 7.1 Participants

The study's participants included 70 teachers from various locations in Palestine, who had various backgrounds and experiences of using ICT in teaching different topics and grades. All of the teachers were required to use ICTs in teaching, and they used different tools, such as tablets, interactive whiteboards, LCDs, and platforms for designing technological interactive activities, (e.g., Zoom, Microsoft Teams), and others for uploading educational resources in their practices. Before adopting Microsoft Teams, the teachers had used different tools of their own choice without training. After teachers were trained by the MoE to use Microsoft Teams, all teachers were required to use it as an official technological tool to teach their students online.

### 7.2 Recruitment

We used maximum variation sampling to recruit the participants. This approach allows researchers to choose participants with different individual characteristics in order to understand a phenomenon by examining a range of different cases (Emmel, 2013). The criteria for choosing the participants called for teachers who used different technological tools for academic purposes and teach in middle school settings with a high level of performance (i.e., had high scores in their annual academic performance reports). We requested that the MoE's educational technology department nominate teachers who teach in managerial

**Table 1** Presents the demographic information about the participants

Variable	Number	Percentage (%)
Gender		
Male	30	42.8
Female	40	57.2
ICT experience (Years)		
1–5	24	34.4
6–10	30	42.8
More than 10	16	22.8
Age (Years)		
25–30	27	38.6
31–36	13	18.6
37–42	16	22.8
More than 42	14	20
School location		
Village	25	35.7
City	28	40
Refugee camp	17	24.3

areas from different locations with different experiences of technology use. The department provided a list of 100 teachers from different schools. Permission to contact the teachers came from the MoE's Scientific Research Directorate and the Supervisor and Teacher's Training Directorate. We sent the teachers an email invitation to participate in this work. The invitation included information on the study instrument, an introduction to the study and its purpose, reasons for inviting the recipient to participate, and a notice informing the recipient that participation was optional and that they were free to withdraw from the study at any time. Seventy teachers responded by using the research instrument. Table 1 presents the participants' demographic information.

### 7.3 Data Collection

We used open-ended questions to collect data from the target audience, this technique allowed us to collect qualitative data about the participants' lived experiences. The participants were asked to write their responses to the listed questions on the form (Creswell, 2014). We developed the open-ended questions based on the findings of previous studies, including the work of Joo et al. (2016), Çoklar et al. (2017), Özgür (2020), and Christian et al. (2020). Thorndike and Thorndike-Christ (2010) defined open-ended questions as a method that asks the participants to write their responses in their own words. This approach is generally used to gather unlimited information about a specific phenomenon without limiting the participants' responses and to explore the participants' attitudes about the phenomenon (Creswell, 2014; Harlacher, 2016). We developed an open-ended questionnaire in Arabic that explored the teachers' responses about the factors that influenced the technostress they experienced while using new emerging technology in the learning process in middle school settings.

The form (see Appendix 1) includes three sections. The first section includes information about the study, the second is designed to collect the participants' demographic information, and the third includes six open-ended questions (see Appendix 1). The six

questions examine the technological, instructional, and social reasons for the negative impact of technostress and using technology on teaching performance. We used Microsoft Office 365 to design the form and sent the teachers a link to the form through email. We used Office 365 because the participants would be familiar with it as all teachers in Palestine have an account and can easily use and are familiar with the technology.

#### **7.4 Data Analysis**

We used thematic analysis to analyze the data and allowed the themes to come from the teachers who have lived experience with technostress while using technology in teaching in middle school settings. Thematic analysis is a type of qualitative data analysis that offers an extensive view of variation, along with details that include basic, interruptive, and qualitative content analysis (Drisko & Maschi, 2016). Using thematic analysis enables researchers to analyze data by creating themes and subthemes (Creswell, 2014). We used NVivo 12 software to analyze the collected data to understand the reasons behind teachers' technostress.

#### **7.5 Data Analysis Procedures**

To analyze the data, we followed the thematic analysis procedures set out by Hsieh and Shannon (2005). The analysis was carried out in three stages: preparing the data for thematic analysis by numbering participants' responses, compiling the responses into one file, and cleaning the data. The second phase was carried out in two stages, the first of which was identifying a unit of analysis, which in the current study was a phrase or sentence related to teachers' technostress reported by participants. We based this stage (identifying the unit of analysis) on the findings of previous studies on the same topic, including Joo et al. (2016). The second stage of the second phase (compiling the responses) was to develop a coding book, create themes based on the literature review, and organize these themes into reasons for technostress experienced by teachers while using technology in teaching. After developing the coding book, we pre-tested the code by asking an external researcher to take a portion of data (10%) and apply the coding to it to ensure its consistency and accuracy. The last phase of data analysis was coding all the data, then assessing the coding to check the trustworthiness of the data analysis by establishing a comparison between the agreement and disagreement of the coding process; for this phase, we followed the procedures suggested by Creswell and Miller (2000). Moreover, two of the current study's researchers coded the data individually to enhance the reliability of the research by comparing their coding once the process was finished. The agreement and disagreement between the two coders was 86%. The two researchers resolved the disagreement through negotiations to achieve agreement on the final themes and subthemes. Table 2 shows an example from the coding book used in the data analysis.

#### **7.6 Trustworthiness**

Arabic teachers checked the open-ended questions for the survey to increase understandability and verify the content for accuracy. Three professors (of educational technology and psychology) then received the form to check the appropriateness of the questions. The form

**Table 2** Shows an example from the coding book we have used in our data analysis

Text segment	Main idea	Theme	Subtheme
<p>Teacher 5: as teachers we are required to use new technology each time with lack support from schools. According to my experience with using new technology, I have to check if the technology easy to use and I can use in my classes without extra cost. Previously I used a technology but after designing the activities the whole website asked me to pay while put me under stress and anxiety</p>	<p>Using technology mandatory; technology characteristics</p>	<p>School support; technology characteristics</p>	<p>Policy; easy to use; accessibility usefulness</p>
<p>Teacher 33: I experienced a lot of anxiety while trying to use a given new technology because honestly I am convinced to use technology in teaching kids, it is consuming and wasting my time ... my knowledge and experience in integrating technology in my classes is limited</p>	<p>Attitudes, knowledge, skills, previous experience</p>	<p>Individual characteristics</p>	<p>Professional identity</p>
<p>Teacher 62: I am familiar in using technology for different purposes, but when I come to using it for teaching in-class... it is difficult for me to change the traditional strategies in teaching, I am struggling to design technological activities and suitable content which made me upset</p>	<p>Instructional issues in using technology</p>	<p>TPACK</p>	<p>Change of teaching strategies; design suitable activities</p>

was also piloted by five different teachers to test the understandability of the open-ended questions.

The MoE and the Scientific Research Directorate granted permission based on our research proposal before we proceeded to contact the participants and invite them to participate.

## 7.7 Findings

### 7.7.1 Research Question #1: What Are the Causes of Palestinian Middle School Teachers' Technostress While Using ICTs in Teaching?

The aim of the first research question was to explore teachers' opinions about the causes of technostress they faced while using new technology in their classrooms for academic purposes. The 70 participants in the study reported a variety of causes. The participants' opinions reflected their experiences with new technology in an environment in which they face daily difficulties, political crisis, and economic crisis and requires the mandatory use of new technology in their teaching practice. We coded 140 different opinions from 70 teachers in middle school settings, which we grouped into themes and subthemes based on their characteristics, the themes that emerged were individual factors, school support, technology characteristics, and TPACK. Table 3 summarizes the themes and subthemes of the sources of technostress reported by the teachers.

## 7.8 Individual Factors

We based our definition of this theme on different previous studies. Analyzing the teachers' responses to the open-ended questions revealed subthemes related to individual characteristics, including professional identity, language problems, lack of experience, lack of time, and social commitments.

Professional identity refers to professional knowledge, perception of teaching with technology, attitudes, skills, and willingness to share knowledge with the community (Rodrigues & Mogarro, 2019). Forty-three of the participants reported that a teacher's professional identity, which includes their attitudes, knowledge, skills, self-efficacy, and sharing knowledge with the community, is an important factor that could increase or mitigate technostress levels confronted by teachers while using new technology. For example, Teacher 3 stated that "My negative attitudes towards the new technology I have to use put me under stress and pressure.... My attitudes came due to a previous experience I had with similar technology."

Five of the teachers connected the technostress they confront to the multitasking they must perform through various platforms and their ability to finish teaching tasks. Teacher 11 stated, for example, that "I do not have the ability to do many tasks on different platforms at the same time.... I do not have enough skills and knowledge to use the platforms."

Fifteen of the teachers reported that language barriers were another source of stress, as the applications and platforms are in English and some platforms do not support writing from right to left (as is standard in Arabic). Teacher 70 reported that "The tools on the platforms are in the English language.... I do not know English; I use Google Translate to translate.... In addition, the platforms do not support writing in Arabic language, it converts it to symbols."

**Table 3** Themes and subthemes reported by the participants in the current study

Theme	Subtheme	Example	
Individual factors	Professional identity	Lack of skills and knowledge of using new technology in a successful use makes me upset and demotivate me to use it (Teacher 11)	
	Language problems	The guideline of using a technology and the concepts are in a foreign and I don't understand anything. I need to know what it is. This makes me anxious... (Teacher 19)	
	Lack of previous experience with using technology	...This is the first time for using this technology [Microsoft Teams] in my teaching... I have to put more efforts to use it effectively which put me under stress (Teacher 28)	
	Lack of time	Using new technology needs a lot of time to learn about it and to prepare activities to use it (Teacher 69)	
	Social commitments	Not visiting and participating my family and friends social events makes me stress (Teacher 30)	
	Training programs	Training how to use a given technology and how it works are insufficient which force me to look for additional resources...It is time consuming (Teacher 27)	
	School support	Policy	The policy of using technology is not clear, is using it supplemental or mandatory? (Teacher 18)
		Trust	Our school administration did not allow us to choose the time and specific technology to use based on our needs (Teacher 5)
		Management support	Lack of financial and managerial support from the school management make me anxious (Teacher 13)
		Peer support	When I asked to assistant or a consultant about using technology in my classes from my colleagues in the school they did not give me sufficient information that I need to use technology (Teacher 21)
Technical support		People who help teachers in case of technical issues such as crash or not responding are limited which increase risks and stress on teachers (Teacher 45)	
Infrastructure		Unfortunately schools are not well equipped with suitable infrastructure to use technology such as strong Wi-Fi, suitable resources,... (Teacher 51)	
Technology characteristics		Continue updating	When I was using it [MS Teams], It started updating without any notification message which forced me to stop the class (Teacher 58)
		Simplicity to use	The complexity of a given technology needs much time and efforts and made me afraid to fail in using it (Teacher 65)
		Usefulness	Knowing the value and benefits of using a given technology motivate me to use it and reduces the anxiety ... (Teacher 67)
		Reachability	I am stressed when I have difficulties to access to the new technology (teacher 31)
	Privacy concerns	I am not savvy in technology, my fears and concerns always on using a new technology is my identity, safety, and privacy (teacher 37)	

**Table 3** (continued)

Theme	Subtheme	Example
TPACK	Change of teaching strategies	I do not enough knowledge about the technology pedagogy to use technology in my teaching practice (Teacher 17)
	Meet student's needs	The new given technology cannot meet my needs and student's needs (Teacher 25)
	Design activities (content)	My concern is about designing suitable content and activities for using the new technology in my classes, I do not have enough skills to do that (Teacher 41)

The majority of the teachers connected the levels of technostress they experience with their ability to use new technology in their teaching practice and to meet the expectations of their school principals. Teacher 23 reported that "I do not believe that I will succeed in using the new technology in teaching my math class.... It needs a lot of effort, which caused me to be stressed." One female teacher said, "I think the source of my stress and pressure is to meet the expectations of my headmaster to use technology.... I do not have the ability to succeed in it" (Teacher 3).

A few of the teachers reported that they consider it their social responsibility to share knowledge and skills with the local community to educate them and help them to assist their children with their school work. We sent a follow-up question to those teachers enquiring how sharing knowledge with the community would increase their level of technostress. An example of the responses is represented by the teacher who said that "parents start to send for help and clarification about the new technology, which forces me to spend more effort and time to teach them how to use the technology" (Teacher 55).

Most of the teachers connected their levels of technostress with a lack of time to learn about the technology and how to use it in their practice, which requires more effort. As one teacher reported, "learning how the new technology works and how to use it needs more time and effort.... I do not have enough time... lack of time makes me stressed" (Teacher 11).

The majority of the teachers expressed that not being able to attend to or achieve their social commitments raised their levels of technostress. As one participant stated, "It is important for me and my family to meet the social commitments such as visiting relatives, participating in the family, community activities.... This cannot happen because I am learning about a new technology or sometimes because of the intertwine between my life and teaching from home" (Teacher 17).

## 7.9 School Support

We found different subthemes related to the theme of school support, including training programs, policy, trust, management support, peer support, technical support, and infrastructure.

Thirty-nine of the teachers reported that absent or insufficient training programs for new technology are a source of increased levels of technostress. For example, Teacher 19 said, "I did not attend any training about using the new technology; also, they did not provide us instruction about how to use it, which put me under stress."

Using new technology was a mandatory policy implemented by the MoE without any flexibility; thus, teachers must use it or be punished, which, as 29 of the teachers reported, put them at managerial risk and under stress. As Teacher 13 reported, "We have to use the new technology without any exclusion or training, if I do not use it, my supervisor will report me to the principal and the directorate, which could influence my promotion."

Moreover, some of the teachers reported that the technostress they experienced was due to lack of trust from their school administration, parents, or their supervisors. One teacher reported that "My school administration asked me to provide them with the link to use MS Teams to make sure that I am teaching which makes me stressed.... They can know about my online teaching through asking in a different one" (Teacher 31).

Thirty-five of the participants reported that lack of school administration support, including from principals and managerial staff, increased their levels of technostress related to using new technology. Teacher 26 said, for example, "When I required assistance

from the principal to use MS Teams, she did not give me the required information, which made me anxious.”

Seven of the teachers mentioned that lack of colleague support in using new technology sometimes increased stress among them. Teacher 57 stated, “I asked my colleagues from other schools to get assistance to use the new technology, they refused because they do not have time.”

Lack of technical support was also a source of technostress reported by 10 of the teachers who experienced various levels of technostress, and especially techno-overload. As Teacher 33 said, “I faced many technical issues without managing to resolve them, which forced me to stop using technology, which put me under stress.”

The infrastructure of teaching and learning for teachers and students was reported to be a creator of technostress, especially when the internet was weak or students lacked devices. One teacher reported that, “I get angry when I am talking and suddenly there is no internet or students got out because of the weakness of internet on their side or because of electricity cut-off” (Teacher 5).

### 7.10 Technology Characteristics

Fifty-four teachers reported that technology characteristics have a role in the level of technostress. Technology characteristics include continuous updating, simplicity of use, usefulness, reachability, and privacy concerns.

Seventeen of the teachers reported that the system started updating (i.e., to update the application and the platform) while they were using the new technology, which interrupted their use of the technology during the class and put them under stress and pressure. Teacher 51 said, “While I was using MS Teams in the class, it started updating, which stopped the class; that made me anxious.”

The complexity of using new technology was another source of technostress reported by 48 of the teachers. The teachers confirmed that it requires effort and time to learn about complex technology and how to use it in teaching. For example, Teacher 5 said, “I felt stress and under pressure when I tried to use the technology because it is difficult to use its interface and the tools on it.”

Sixty of the teachers reported that they felt comfortable when they understood the value and benefits of using new technology in teaching. As Teacher 30 reported, “I feel comfortable and happy when I know the value and the usefulness of the new technology in teaching my classes.”

Nine of the teachers reported that difficulties in accessing the new technology increased their level of technostress. For example, Teacher 8 stated that, “While I tried to access the website of the platform, I faced difficulties, which made me stressed to continue using it.”

Concerns related to digital privacy are another source of technostress; 59 of the teachers reported thinking deeply about their privacy with regard to using new technology. Teacher 21 said, “My digital privacy was damaged while using the platform because students were able to get my social accounts without permission and asked me to add them...that is the kind of stress came from this platform.”

### 7.11 Technological Pedagogical Content Knowledge

Thirty participants confirmed that their lack of TPACK skills was a major source of their technostress. Eight teachers reported that they have the technical skills to use technology

but lack knowledge of the suitable instructional strategies for use in new-technology integration. As one teacher stated, "The big issue for me is using the suitable teaching method while using a new technology" (Teacher 14).

Designing activities with suitable open educational resources was another source of technostress reported by 25 of the teachers. Teacher 67 stated, "I do not have the skills required to design activities to be used in the integration process of a new technology in my classes."

The last source of technostress that was reported by 41 of the teachers relates to meeting the students' needs through the use of the new technology. Teacher 10 reported that, "MS Team did not meet the students' needs in teaching science, which caused me to be angry and upset."

In summary, the teachers who participated in this research reported sources of technostress that we divided into themes and subthemes. The main sources of technostress were found to be technology characteristics and individual factors.

### **7.11.1 Research Question #2: How Do Palestinian Teachers in Middle School Settings Describe Their Experience of Technostress While Using ICTs in Teaching?**

We asked the teachers to describe their experiences with technostress caused by using new technology. The teachers' responses varied, ranging from experiencing a small amount of anxiety and stress to feeling unable to use the new technology in their teaching practices even though they know it is mandatory.

Some teachers expressed that they experienced technostress related to their students not interacting with them while using technology. One teacher said, "I feel anxious because I don't see and feel the responses from the students; because of that I feel distance, not just the physical distance, but also emotional distance between myself and the students. That puts me under stress" (Teacher 29).

Twenty of the teachers experienced high levels of technostress because their students did not interact with them while using the new technology, and they felt that this separated them from their students. As Teacher 55 reported, "While I was teaching using Microsoft Teams, half of the students in the class did not interact with me, which made me anxious." Another teacher stated that "The biggest stress in using MS Teams is you cannot know what the student is doing behind the screen" (Teacher 40).

Forty of the teachers who had experience with using technology in teaching reported low levels of stress. In their responses, they mentioned their experience with integrating various tools of ICT into their teaching process. For example, Teacher 41 said, "I have extensive experience with using computer applications for designing technological activities for the interactive projector in my school." More than 15 teachers reported that they increased their knowledge and skills in using technology in teaching through practice, and that this reduced the technostress they confront.

Forty-two of the teachers expressed discomfort related to using new technology that differs from previous technology they had experience with. They reported pressure resulting from not having enough time to learn how the new technology works and how to use it in their teaching.

Sixty of the teachers, meanwhile, expressed their level of technostress as techno-overload resulting from using different platforms and technology in their teaching practice. Teacher 51 said, "During summer I attended two workshops about using various technological platforms to design activities, which made me upset and asking the trainers

which one should I use? Why did you not train us on only one?" Other teachers reported, "I'm spending a lot of time on the Facebook and WhatsApp groups and having to write responses for the students and even having online sessions on Zoom. Some students send files or questions. It is a complicated process and I think this might be the main cause of stress" (Teacher 39).

Four of the teachers expressed techno-complexity as a contributor to technostress, mentioning the difficulties of using the notebook in the Microsoft Teams application. For example, Teacher 29 said, "I felt stressed with how to create the notebook for my students and add the activities on it."

Moreover, five of the teachers preferred to use technology they were familiar with since it did not require extra work and would have been easy for them to continue using it. Teacher 17 reported that "I felt stressed when the school administration asked me to use a new one.... I do not know why, I prefer to use the technology I had used in my classes, I am familiar with it."

Techno-invasion was another level of stress that 15 of the teachers mentioned as a cause of discomfort and stress. Preparing activities to use with a new technology intertwines with their social life as they must prepare the activities from home. As Teacher 57 stated, "I have to work from home to prepare for the activities, I felt stress because there are no limited working hours, which causes me to cancel my social activities with my family." Another teacher shared that "The stress is managing my social activities with my family so I cannot go out for a short trip" (Teacher 8).

Seventeen of the teachers wrote about their experiences with isolation when they were teaching online using Zoom. "I felt isolated from my environment while teaching online.... There is no social communication, it was a hard time for me, which made me stressed" (Teacher 13).

### **7.11.2 Research Question #3: What Approaches Do Palestinian Teachers Currently Use to Mitigate the Levels of Technostress They Face While Using ICTs in Teaching?**

We asked the teachers about the steps they took to reduce the level of technostress they faced while using a given technology in their teaching practices. In their responses, the teachers reported many different approaches they have taken to reduce the level of technostress and its consequences. For example, 18 of the teachers reported that they changed their teaching approach. The changes they described included using new strategies (such as a flipped classroom), giving students more roles in the online sessions, and using open-education resources suitable for their students and classroom activities. For example, one teacher expressed that "When I experienced stress while using Zoom, I started thinking about the activities and how can I engage the students in online learning" (Teacher 5). Another teacher said, "Honestly, I used a lot of extra curriculum from free websites and open resources, they were helpful to reduce the time I need with less stress" (Teacher 21).

Thirty of the teachers expressed the importance of the awareness of using technology versus teaching without using technology, which encouraged teachers to shift their expectations to using technology and preparing for it. For example, Teacher 33 said, "Changing your expectations toward using technology may make teachers to prepare well and reduce stress."

Another approach that 25 of the teachers reported using to reduce technostress while teaching was time management. "It is important to put a schedule to divide your working time and social events even when you are teaching online.... My experience taught me to

put boundaries [working hours and social events] and organize my time to reduce stress as I can as possible," shared Teacher 41.

Twenty of the teachers reported having received social support from their colleagues in and out of their schools, which had a positive impact on reducing their levels of technostress while using new technology. For example, Teacher 69 stated that "I got support from my friends who are teaching the same topics by using technology, they taught me how to use it [technology] in my topics and share with me educational resources that are suitable for the new technology."

Five of the teachers reported that they reduced their technostress levels by working collaboratively with their peers in planning for technological activities and developing materials. Teacher 49 said, "I collaborated with my friends from different schools to share with each other the activities we teach online and develop materials for all of us.... It was helpful in reducing the time I needed, getting support, and reducing stress."

Receiving technical and instructional support from school administration and colleagues may also reduce the stress of using new technology, as 23 teachers reported. Teacher 5 said, "My principal was helpful for me through providing technical and instructional assistance to use technology.... He was an IT teacher before being a principal." Another participant reported that "My colleagues are good in using technology in teaching, they have experience.... I asked them for assistance, which helps me to reduce the time I need to learn about the new technology" (Teacher 29).

Fifty-five of the teachers reported that the best way to mitigate technostress is to ensure that they receive training on how a new technology works and how they should use it in teaching. Teacher 67 said, "Through getting skills and knowledge about the new technology and how to use it can mitigate the stress levels.... It can be achieved through weekly workshops and training days during the academic year."

Seven of the teachers expressed their need for the MoE to provide suitable material and teaching activities through the curriculum unit to use in integrating a new technology. Teacher 7 expressed that "Providing us with designed activities and materials to be used with the new technology from the MoE, it can reduce our efforts and time to design such activities."

Lack of previous experience with using technology was another source of stress and anxiety, and 35 teachers reported that teachers do not always know how to use new technology. For example, Teacher 23 said, "I do not have experience with using technology in teaching... this is the first time for me to use it.... This made me anxious."

Finally, 65 of the teachers cited lack of time to learn about new technology and how to use it with their social commitments and family as a major source of stress while using new technology. One teacher shared that "On the weekend, I prefer to spend it with my family and relatives... but while learning about the new technology, I cancelled the social activities, which made me stressed and angry" (Teacher 67).

## 8 Discussion

The changes and challenges generated by emerging technology require more research to reduce risks and avoid negative effects on teachers and schools. Many of the previous studies on the bright and dark sides of new technologies in various fields such as the business, health, and IT sectors suggest a focus on regulations and identifying working conditions in the context of emerging technology. Therefore, the aim of this study was to develop a

deeper understanding of the factors influencing teachers' experiences of technostress while using new technology in the learning process, specifically in middle school settings in Palestine. We also aimed to classify these factors into themes based on their features, which we determined using open-ended questions for data collection. The current study's findings could inspire decision-makers, teachers, and researchers to design training programs and develop policies for integrating technologies in teaching and learning to mitigate the negative effects of using a given technology. This study was conducted in a country with unique characteristics, and the teachers who participated are under daily stress due to overall instability and using a new technology, which causes levels of technostress.

In this study, individual characteristics were found to play a crucial role in the levels of technostress teachers experienced while using a new technology, which corresponds to the findings of previous studies such as Chou and Chou (2021) and Krishnan (2017). Our analysis found that the major creator of technostress under the individual theme was the professional identity subtheme, which is normally related to one's skills to use a technology and knowledge of how it works (Califf et al., 2020). Moreover, teachers' attitudes toward using new technology is considered to be a component of professional identity, which can be a source of technostress (ÇOKLAR & BOZYİĞİT, 2021). Our findings revealed that a lack of teacher self-efficacy may also contribute to technostress due to techno-overload, which is related to different tools that teachers are required to use, such as designing technological tools while using Microsoft Teams to teach online. These findings are consistent with a recent study by Kim and Lee (2021) that found technology users' self-efficacy can reduce their levels of technostress. Lack of experience in using new technology in teaching may cause additional technostress for teachers because they do not know how to use it for academic purposes; this finding is inconsistent with the work of Camarena and Fusi (2022). Based on our study's findings, technostress generated in the learning environment may not depend only on teachers' experience, skills, knowledge, and attitudes, which opens up theoretical implications. Our analysis shows that social support from school peers, family, and students plays an important role in reducing teachers' levels of technostress, which reveals a practical implication for decision-makers in the MoE to design and implement these kinds of supports. Moreover, school support in various forms, including from administration and colleagues, and good infrastructure with suitable technical support may mitigate technostress levels experienced by teachers who use new technology; this is likely to have a positive effect on teacher performance. This is supported in the literature; for example, Li and Wang (2021) reported that technical support and literacy facilitation can reduce teachers' levels of technostress. Moreover, Palestinian teachers use new technology due to the MoE's policy rather than their own attitudes and internal motivation, which can cause additional stress and anxiety. Moreover, when teachers feel anxious about being required to change their teaching strategies and use newly emerging technology, they resist accepting and adopting the new technology. Therefore, with regard to practical implications, school administration and policy makers should be aware of the negative side of top-down decisions for using new technology; they must recognize that teachers may experience various levels of technostress regarding their acceptance, adoption, and continuance intentions to use new technology (Khlaif et al., 2022).

Moreover, our findings indicate that social support from peers within the school or from other schools, such as having the opportunity to communicate and share knowledge and open educational resources related to the use of the new technology, are necessary for the reduction of technostress among teachers (Joo et al., 2016; Özgür, 2020). Consequently, teachers can gain emotional support from their peers and develop their skills and knowledge by sharing with their colleagues. Moreover, technical support, which is an important

part of school support, plays a crucial role in reducing technostress levels among teachers. This is congruent with Kim and Lee's (2021) findings, which revealed that technical support may reduce technostress.

Teachers' daily use of new technology and rapid changes in this technology through upgrades and updates often negatively affects teachers' usage intentions due to the technostress levels they experienced in this context. This is consistent with the findings of Salo et al. (2017) and Lee (2021), which confirmed that teachers who had experience using technology in teaching can recall prior skills and knowledge to help in integrating new technology.

The complexity and value of a given technology have been shown to be major sources of technostress, as the complexity of a technology affects the amount of time and effort teachers must invest to learn about how the technology works and how to use it, and this can increase technostress for those who lack technical and colleague support (Özgür, 2020). Creating communities of practice for using new technology among teachers may reduce levels of technostress (Salo et al., 2017). Different levels of technostress among teachers may also relate to different teaching experiences with technology and the learning environment or the technology itself. However, our results indicate that teachers often attempt to mitigate their technostress levels through various strategies, which is also supported by previous work. Some mitigation strategies include peer support (Joo et al., 2016), professional development programs (Li & Wang, 2021), open educational resources (Murphy et al., 2021), changing teaching strategies (Joo et al., 2016), and working collaboratively to develop technological activities to use with new technology (Qi, 2019).

This study's findings have also revealed additional factors that could increase teachers' levels of technostress. These factors include a lack of TPACK skills in using new technology for teaching purposes, which is consistent with the works of Özgür (2020) and Dong et al. (2020). A lack of TPACK skills could be related to individual characteristics or due to the new technology itself.

## 9 Theoretical Implications

The findings of the present study indicate that the factors that influence teachers' levels of technostress can provide a useful understanding of how new technology use in teaching practices.

affects technostress levels and extends existing factors of teachers' perspectives (Dong et al., 2020; Özgür, 2020; Li & Wang, 2021) through reporting new factors such as trust, privacy, and professional identity. Our findings resulted from a unique case in which teachers used new technology in a mandatory environment during political, economic, and natural crises. Moreover, this study advances our understanding of the use of new technology in teaching and learning and how individual characteristics and social support can affect technostress levels (Murphy et al., 2021; Qi, 2019).

## 10 Practical Implications

This study provides important practical implications for MoE decision-makers. Teachers, school administrations, and non-profit organizations could refer to its findings when developing approaches to improve responses to using new technology in teaching and learning.

First, decision-makers should focus on improving professional identity (especially skills and knowledge and ability to succeed in using technology) through training programs and providing technical support for teachers (Taser et al., 2022). Second, to reduce technostress levels, the MoE and schools should encourage peer support and cultivate a culture of collaborative work among teachers to allow them to share knowledge, skills, and technological activities related to using a new technology (Li & Wang, 2021). Third, to mitigate technostress levels, teachers must be supported in creating a knowledge community through which they can share their experiences with designing activities and TPACK skills (Dong et al., 2020).

## 11 Limitations and Future Research

The current study has some limitations that make its findings difficult to generalize. One such limitation is the number of the participants, while another is our use of an open-ended question form for data collection. Moreover, we collected the data for this study during a crisis, when teachers were just starting to teach online using Microsoft Teams, and therefore, they still had limited experience. Future research that includes more teachers and uses different research instruments and a different methodology would be beneficial for uncovering additional factors; it would also be beneficial to conduct a study that focuses on the use of a different technology. Finally, it is important to further investigate the relationship between the factors to determine how these factors influence each other and their indirect impact on teachers' technostress.

## 12 Conclusion

The aim of this study was to explore the factors that contributed to teachers' experiences of technostress due to teaching in a mandated environment that requires integrating new technology into their teaching practice. We approached this by attempting to learn from the participants' lived experiences. Therefore, this study contributes to the body of literature and current knowledge of technostress among teachers and expands the research on teachers who teach in a mandated environment in a country that has suffered crises over more than 70 years. This work differs from previous studies that mainly focused on other sectors, such as business and health.

This study revealed a variety of factors that contribute to the levels of technostress experienced by teachers. We have grouped these factors into the themes of individual factors, school support, technology characteristics, and TPACK knowledge. The teachers' responses indicate that they experience various levels of technostress while using new technology in their teaching practice. Further to this, teachers report many strategies that they employ to reduce the levels of technostress they are faced with; these include receiving social support, using open educational resources, and attending training on using a new technology. Previous experience with using technology in teaching plays an important role in mitigating the levels of technostress experienced by teachers.

## Appendix 1

### Systematic Review of Prior Research on Factors Influencing Technostress (2016–2022) Published in Peer-Reviewed Journals Only

Authors	Title	Type of the study	Instruments	Context	Factors
Camarena and Fusi (2022)	Always Connected: Technology Use Increases Technostress Among Public Managers	Quantitative	Existed survey	Business	ICT use, age, gender, organization practices
Tuan (2022)	Employee mindfulness and proactive coping for technostress in the COVID-19 outbreak: The roles of regulatory foci, technostress, and job insecurity	Quantitative	Existed survey	Service industry, Veitnam	Job insecurity, mindfulness, gender
Baabdullah et al. (2022)	Usage of augmented reality (AR) and development of e-learning outcomes: An empirical evaluation of students' e-learning experience	Quantitative study	Scale items of UGT constructs were derived from Nam-bisan and Baron	Undergraduate students from Saudi Arabia	
Salo et al. (2022)	Formation and Mitigation of Technostress in the Personal Use of IT	Qualitative study	The researchers developed the tool	IT users, Finland	Invasion, dependency, privacy concerns, time management, and complexity

Authors	Title	Type of the study	Instruments	Context	Factors
Li and Wang (2021)	Technostress inhibitors and creators and their impacts on university teachers' work performance in higher education	Quantitative study	Developed based on Tarafdar et al. (2007)	University teachers, China	Literacy facilitation, technical support, and involvement facilitation
Chou and Chou (2021)	A multi-group analysis of factors underlying teachers' technostress and their continuance intention toward online teaching	Quantitative study	Self-developed questionnaire	Teachers in formal education in Taiwan	Self-efficacy, school support, privacy concerns
Iskandar (2021)	The Factors Influencing Compulsive Social Apps and Its Impact on Technostress among Students	Quantitative study	Not reported wither adapted or developed tool	High school students, Malaysia	technology feature of using social application does not influence technostress
Shirish et al. (2021)	Switching to online learning during COVID-19: Theorizing the role of IT mindfulness and technostress for facilitating productivity and creativity in student learning	Quantitative study	survey adapted from existed survey	Graduate students, France	IT mindfulness
Thiyagu (2021)	Techno-Stress Scale of Teacher Educators: Construction of the Tool	Quantitative	Self-developed	Teacher, India	The researcher did not report the dimensions of the survey

Authors	Title	Type of the study	Instruments	Context	Factors
Pflügener et al. (2021)	The direct and indirect influence of mindfulness on technostressors and job burnout: A quantitative study of white-collar workers	Quantitative study	Adapted from Ragu-Nathan et al., 2008)	Workers in different fields, Germany	Mindfulness
Stadin et al. (2021)	Technostress operationalized as information and communication technology (ICT) demands among managers and other occupational groups – Results from the Swedish Longitudinal Occupational Survey of Health (SLOSH)	Quantitative	Adapted existed survey	Health sector, Sweden	ICTs demands, lack of work control, insufficient administrative support, the risk of managerial turnover
Abd Aziz and Yazid (2021)	Exploratory Factor Analysis of Technostress among University Students	Quantitative study	developed by the researchers	Undergraduate student, Malaysia	Techno-overload, techno-uncertainty, techno-insecurity, and techno-complexity
Gökbulut (2021)	The Relationship Between Teachers' Technostress and Their Technopedagogical Competence	Quantitative study	Adapted previous tools (TPACK and technostress scale	Teachers, Turkey	TPACK and its sub-factors

Authors	Title	Type of the study	Instruments	Context	Factors
Panisoara et al. (2020)	Motivation and Continuance Intention towards Online Instruction among Teachers during the COVID-19 Pandemic: The Mediating Effect of Burnout and Technostress	Quantitative study	Developed by the researchers	Teachers, Romania	extrinsic, intrinsic motivation, TPK Self-efficacy
Wang and Li (2019)	Technostress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit	Quantitative study	Adapted from established research	University students, China	Personal factors, environment factors, organization factors, and job factors
Upadhyaya and Virinda (2020)	Impact of technostress on academic productivity of university students	Quantitative study	Adapted from Tarafdar et al. (2007)	Undergraduate students, India	Gender, level of education, ICT experience,
Wang et al. (2020)	Measuring university students' technostress in technology enhanced learning: Scale development and validation	Quantitative study	Self-developed	University students, China	Person-Environment factors which relate to Ability-demands, Needs-supplies

Authors	Title	Type of the study	Instruments	Context	Factors
Dong et al. (2020)	Exploring the Structural Relationship Among Teachers' Technostress, Technological Pedagogical Content Knowledge (TPACK), Computer Self-efficacy and School Support	Quantitative study	Use different existed instrument and adapted based on the constructs of the study	K-12 in-service teachers in China	Administrative support, collegial support, computer self-efficacy
Maier et al. (2015)	Personality Profiles that Put Users at Risk of Perceiving Technostress	Quantitative study	Online survey	Workers in different organization in Bavaria	Personal traits
Özgür (2020)	Relationships between teachers' technostress, technological pedagogical content knowledge (TPACK), school support and demographic variables: A structural equation modeling	Quantitative study	Developed from other studies and use some scales existed	Teachers in Turkey	Gender, Age, overall school support, technical support, TPACK
Christian et al. (2020)	Technostress Creators on Teaching Performance of Private Universities in Jakarta During Covid-19 Pandemic	Quantitative study	Not reported	Higher education in Indonesia	Techno-overload, techno-uncertainty, techno-insecurity, and techno-complexity
Estrada-Muñoz et al. (2020)	Teacher Technostress in the Chilean School System	Quantitative study	RED-TIC questionnaire integrated into the Technical Note of Prevention	Teachers in middle and high schools in Spain	techno-fatigued, Techno-anxiety, teaching age, and gender

Authors	Title	Type of the study	Instruments	Context	Factors
Oladosu et al. (2020)	Learning with Smart Devices: Influence of Technostress on Undergraduate Students' Learning at University of Ilorin, Nigeria	Quantitative study	self-developed survey	undergraduate students, Nigeria	Using mobile devices caused technostress for the students because of the tasks and using it for academic performance
Marchiori et al. (2020)	A RELATIONSHIP BETWEEN TECHNOSTRESS, SATISFACTION AT WORK, ORGANIZATIONAL COMMITMENT AND DEMOGRAPHY: EVIDENCE FROM THE BRAZILIAN PUBLIC SECTOR	Quantitative study	Developed based on literature review	IT users, Brazil	Individual features (age, gender, education, professional experience, occupy). Techno-overload, techno-complexity, techno-insecurity, techno uncertainty
Christopher B. Califf, Stoney Brooks	An empirical study of techno-stressors, literacy facilitation, burnout, and turnover intention as experienced by K-12 teachers	Quantitative study	Adapted from previous studies	K-12 teachers, USA	techno-complexity, techno-insecurity, techno-invasion, techno-overload, techno-uncertainty, and literacy facilitation
Califf and Sarker (2020)	The bright and dark sides of technostress: A mixed methods study involving health IT change	mixed methods approach	Developed by the researchers from the qualitative phase based on theories and models	Nurses, USA	Involvement facilitation, technical support, usefulness, unreliability, insecurity, overload, uncertainty, and complexity

Authors	Title	Type of the study	Instruments	Context	Factors
Liu et al. (2019)	Exploring the factors that influence physician technostress from using mobile electronic medical records	Quantitative study	Developed based on theories and previous questionnaires	physicians in hospitals, Taiwan	Personal characteristics, mobile self-efficacy, and technology characteristics composed of perceived usefulness, perceived complexity, and perceived reality
Mäkineniemi et al. (2022)	How are technology-related workplace resources associated with technostress among a group of Finnish teachers?	Quantitative study	Developed by the researchers as a part of a large project in Finland	Teachers, Finland	Self-efficacy, technology related competency and autonomy
Krishnan (2017)	Personality and espoused cultural differences in technostress creators	Quantitative study	The constructs used in the study were measured using scales adapted from prior studies (see Appendix) to enhance validity	Graduate students in India	Personality traits and espoused culture
Qi (2019)	A double-edged sword? Exploring the impact of students' academic usage of mobile devices on technostress and academic performance	Quantitative study	Not reported	University students, China	Individual differences, self-efficacy

Authors	Title	Type of the study	Instruments	Context	Factors
Hauk et al. (2019)	The mediating role of coping behavior on the age-technostress relationship: A longitudinal multilevel mediation model	Quantitative study	The survey adapted from Tarafdar M, Tu Q, Ragu-Nathan BS, Tarafdar et al. (2007)	Employees from Germany, Austria and Switzerland	Age
Hassan et al. (2019)	THE EFFECTS OF TECHNO-STRESS CREATORS AND ORGANIZATIONAL COMMITMENT AMONG SCHOOL TEACHERS	Quantitative study	The survey adapted from Tarafdar M, Tu Q, Ragu-Nathan BS, Tarafdar et al. (2007)	Teachers, Malaysia	Techno-overload, techno-uncertainty, techno-insecurity, and techno-complexity
Hauk et al. (2019)	Technostress and the hierarchical levels of personality: a two-wave study with multiple data samples	Quantitative study	Self-developed questionnaire	Germany, Organization (Employees)	All the three personal traits including: neuroticism, personal innovativeness in IT (PIIT), and IT mindfulness influence the perception of technostress
Fischer et al. (2019)	Is the Technostress Creators Inventory Still an Up-To-Date Measurement Instrument? Results of a Large-Scale Interview Study	Qualitative study	Developed by the researchers	Employees in companies, Austria	Techno-unreliability, IT-based monitoring, cyberbullying, techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty
Ioannou et al. (2022)	Using IT Mindfulness to Mitigate the Negative Consequences of Technostress	Quantitative study	Adapted from Ragu-Nathan et al. (2008) and Thatcher et al. (2018)	Workers from UK	IT mindfulness

Authors	Title	Type of the study	Instruments	Context	Factors
Kim and Park (2018)	THE EFFECTS OF TECHNOSTRESS ON INFORMATION TECHNOLOGY ACCEPTANCE	Quantitative	Developed by the researchers	Individual residing in Korea	IT environment characteristics (relative advantage, complexity, reliability, pace of change, and connectivity)
Sarabadani et al. (2018)	10 Years of Research on Technostress Creators and Inhibitors: Synthesis and Critique	Review study		USA	Individual differences (age, gender, education, computer confidence) involvement facilitation, technical support, innovation support, techno-overload, techno-complexity, techno-insecurity, techno-uncertainty, techno-invasion
Okolo et al. (2018)	An Exploration of the Relationship between Technostress, Employee Engagement and Job Design from the Nigerian Banking Employee's Perspective	Quantitative study	Adapted from previous research	Bussines, Nigeria	Job design
Hauk et al. (2019)	Do Individual Characteristics Influence the Types of Technostress Reported by Workers?	Quantitative study	instrument presented by Tarafdar et al. (2007)	Workers in Brazil	Age, gender, experience, and education level
Çoklar et al. (2017)	Defining Teachers' Technostress Levels: A Scale Development	Quantitative study	Self-development	Teachers, Turkey	Technical issue oriented, personal oriented, social oriented, professional oriented, and learning-teaching process oriented

Authors	Title	Type of the study	Instruments	Context	Factors
Yang et al. (2017)	Techno-Stress of Teachers: An Empirical Investigation from China	Quantitative study	developed	Teachers, China	Techno-change frequency, techno-ambiguity
Hsiao et al. (2017)	Exploring the effect of compulsive social app usage on technostress and academic performance: Perspectives from personality traits	Quantitative study	Adapted from prior similar research with slight modification	Computer science students in Taiwan	Personality trait, compulsive mobile application use
Joo et al. (2016)	The effects of secondary teachers' technostress on the intention to use technology in South Korea	Quantitative study	Developed from previous studies	Teachers in public schools in Soujth Korea	TPACK and School support, technical and environmental support,
Çoklar et al. (2017)	Investigation Of Techno-Stress Levels Of Teachers Who Were Included In Technology Integration Processes	Quantitative study	Self-developed	Teachers from public schools, Turkey	Gender, professional experience, time spent on Internet, Learning-Teaching Process Oriented Techno-Stress, Profession Oriented Techno-Stress, Technical Issue Oriented Techno-Stress, Personal Oriented Techno-Stress, and Social Oriented Techno-Stress
Syvänen et al. (2016)	When does the educational use of ICT become a source of technostress for Finnish teachers?	Quantitative study	Based on existed scales such as TPACK	Teachers (subject and classroom teachers) Finland	ICT competence, attitudes towards using ICT, the frequency of using ICT, school support, the concordance of the educational use of ICT with the teaching style

Authors	Title	Type of the study	Instruments	Context	Factors
Estrada-Muñoz et al. (2020)	Reducing techno-anxiety in high school teachers by improving their ICT problem-solving skills	quantitative and qualitative	Designed by the researchers	Teachers, Spain	ICT problem solving skills
Çoklar et al. (2017)	Determining the Reasons of Technostress Experienced by Teachers: A Qualitative Study	Qualitative study	Developed by the researchers	Teachers, Turkey	Individual problems, technical problems, education oriented problems, health problems, and time problems

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## Declarations

**Conflict of Interest** There is no conflict of interest among the authors of the paper. The participants of the research were teachers who are teaching in K-12 school settings in Palestine.

**Informed consent** All of the participants were informed about the purpose of the study and signed a consent form.

**Consent for Publications** No previous publications in the field of Psychology education.

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