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MEDIA, TECHNOLOGY & LIFELONG LEARNING
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ISSN: 1504-4831 Vol 19, No 1 (2023), e5257 https://doi.org/10.7577/seminar.5257

Experiences of technostressors during the Covid-19 pandemic among Finnish comprehensive school teachers

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Abstract

The Covid-19 pandemic caused significant changes to teachers' work, including a rapid switch to remote teaching. This increased the role of ICT in teachers' work and made teachers susceptible to technostress. In this study, we aimed to identify ICT-related stressors (i.e., technostressors) in comprehensive school teachers' work in Finland during the Covid-19 pandemic. The data, consisting of answers to two open-ended questions, were gathered as part of a questionnaire (n=361), and qualitative content analysis was applied. Based on the analysis, technostressors were divided into five categories: rapid ICT adoption, technological inadequacies, ICT-related pedagogical challenges, limitations in social interaction, and multichannel communication and availability pressure. The findings indicate that schools were not prepared for the pandemic-induced online teaching, which showed in inadequate resources and support for teachers. Moving forward, schools could reduce technostressors by, for example, organizing technical and pedagogical support, developing shared practices to decrease the digital communication load and availability pressure, and fostering interaction and collaboration in online environments.

Keywords: technostress, ICT, education, Covid-19

Introduction

The Covid-19 pandemic caused rapid changes in teachers' work in spring 2020. Classroom teaching was mostly shifted to remote teaching, which significantly increased teachers' information and communication technology (ICT) use. In Finland, the Covid-19 situation and restrictions were relatively mild. However, due to the government-imposed restrictions on schools, most comprehensive school teachers were obliged to work remotely in spring 2020 and adopt online teaching and digital communication channels rapidly. Requirements to adopt new work methods due to technology implementation may produce higher work pressure as well as increase experiences of stress (Ragu-Nathan et al., 2008). Prior research indicates that the pandemic-induced changes increased comprehensive school teachers' overall workload and worries about weakened interaction with pupils (Alasoini et al., 2022). In addition, blurring boundaries between work and family domains characterized primary and secondary school teachers' work (Kaden, 2020; Lizana & Vega-Fernadez, 2021), possibly following – at least partly – from increased availability demands through ICT (Andrade & Petiz Lousã, 2021). Therefore, it is not surprising that burnout among compulsory education teachers seems to have increased during the pandemic (Salmela-Aro et al., 2021; Lavonen & Salmela-Aro, 2022).

Technostress

Technostress refers to stress experienced by individuals due to ICT use at work (Tarafdar et al., 2007). Salanova and colleagues (2013) use the term "technostrain" to underline the role of psychological responses that refer to feelings of anxiety, fatigue, skepticism, and inefficacy caused by technology use. Scholars have found technostress to have various negative implications, such as weakened job satisfaction and ICT user satisfaction as well as increased exhaustion (Tarafdar et al., 2007; 2011; Ayyagari et al., 2011) and decreased job performance (Tarafdar et al., 2014). Furthermore, among teachers at various educational levels, experiences of technostress seem to negatively affect the motivation to use ICT at work (Joo et al., 2016; Chou & Chou, 2021).

Prior research has addressed larger organizational aspects by examining, for example, the role of technostressors, psychological strain, and factors that can mitigate the effects of technostressors (see e.g., Ragu-Nathan et al., 2008; Pirkkalainen & Salo, 2016) as well as the role of information systems design (Tarafdar et al. 2019). To combat teachers' technostress, research emphasizes the role of individual factors (e.g., positive attitudes toward ICT) on the one hand, and organizational factors (e.g., school support for ICT use) and the possibilities of aligning content and pedagogy meaningfully with technology (Syvänen et al., 2016; Joo et al., 2016) on the other hand. Thus, discovering ways to prevent technostress appear to be crucial to both employee wellbeing and job performance.

However, it should be noted that ICT at work is not just a stress-inducing job demand. Rather, its role is more complex. The use of ICT can have both positive and negative effects simultaneously; for example, digital communication can help employees stay connected and reduce isolation, but it can also cause feelings of intrusion (Day et al. 2019). Moreover, the consequences of technostress are not always negative; technostress has also been found to have positive outcomes, such as increased innovation (Tarafdar et al. 2019). Furthermore, recent research on techno-work engagement outlines the possibilities of ICT as a motivating and inspiring job resource (Mäkiniemi et al., 2019; 2020; Mäkiniemi, 2022).

Nevertheless, it is important to pay attention to teachers' technostress during the Covid-19 pandemic. As a situational factor, the pandemic represents a specific condition that created an urgent need to develop new ways of ensuring students' learning at a distance (Whalen et al., 2020). Prior research indicates that during the pandemic, conditions for learning weakened, and there were issues with securing pupils' equality in teaching (Lavonen & Salmela-Aro, 2022). This observation, together with other threats to teachers' wellbeing (see e.g., Kaden, 2020; Andrade & Petiz Lousã, 2021; Salmela-Aro et al., 2021; Lavonen & Salmela-Aro, 2022), indicate the importance of recognizing burdening factors in ICT-mediated teaching during the

pandemic. In this study, our aim is to recognize technostressors in comprehensive school teachers work during the Covid-19 pandemic in Finland. Identifying technostressors is important because it makes it possible to improve teachers' ICT-related working conditions.

Technostressors

Technostressors refer to technology-related conditions and factors that exceed available resources, making it difficult and/or burdening to manage with technology-induced changes and challenges. Technostressors (also called technostress creators) are often categorized into five elements: techno-complexity, techno-uncertainty, techno-insecurity, techno-overload, and techno-invasion (Tarafdar et al., 2007). Techno-complexity refers to the perceived complexity of technology and/or insufficient skills to effectively manage work tasks using technology (Tarafdar et al., 2007). Prior research on teachers' ICT use at various educational levels indicates that low self-efficacy beliefs regarding ICT appear to increase stress (Siddiqui et al., 2023) and decrease teachers' intentions to utilize ICT (Hatlevik & Hatlevik, 2018). Furthermore, a study conducted among primary school teachers revealed that techno-complexity was associated with reduced job satisfaction and efficacy (Lee & Lim 2020).

Techno-overload arises from situations where users must work longer or faster due to technology (Tarafdar et al., 2011; Ragu-Nathan et al., 2008). Techno-insecurity refers to the fear of losing one's job due to technological changes, and techno-uncertainty to the perceived unpredictability and rapid pace of technological changes (Tarafdar et al., 2007). Techno-invasion, which is also referred to as ICT availability demands, indicates constant connectivity – that is, the need to be available beyond regular working hours, therefore blurring boundaries between the work and non-work domains (Day et al., 2012; Ragu-Nathan et al., 2008). Research by Califf and Brooks (2020) has revealed that techno-insecurity, techno-invasion, and techno-overload were the most prominent sources of higher burnout among K-12 teachers in the US (Califf & Brooks, 2020). Overall, research underlines the significance of technostressors as a source of increased strain across various fields (Borle et al., 2021).

Conditions creating and preventing technostress in the school context

Research on teachers' technostress has identified factors related to working conditions and work methods that can induce or reduce technostress. Factors such as technical problems (e.g., Çoklar et al. 2016; Al-Fudail & Mellar 2008) and ICT-induced changes in teaching style and approach (e.g., Çoklar et al. 2016; Mäkiniemi et al. 2017) have been identified as potential stressors. Moreover, prior studies emphasize the role of school and technical support in the creation and reduction of teachers' technostress (see e.g., Al-Fudail & Mellar, 2008; Joo et al., 2016; Syvänen et al., 2016; Özgür, 2020). In addition, it has been found that a working environment that encourages knowledge and skill-sharing between teachers can reduce feelings of technostress (Califf & Brooks, 2020). Overall, it appears that a lack of organizational and collegial support can be a technostressor, making teachers susceptible to experiences of technostress.

Recent studies on teachers' technostress also underline the importance of Technological Pedagogical Content Knowledge (TPACK; Koehler & Misra, 2005), meaning that aligning a specific content area with pedagogical and technological knowledge may prevent technostress (Joo et al., 2016; Özgür, 2020). Teachers' ability to develop and apply TPACK has, in fact, also been associated with collegial support (Dong et al., 2020). In supportive work environments, teachers may feel free to ask others when encountering problems and thus feel more competent and innovative in the long run to align technology meaningfully with pedagogy.

Furthermore, the Covid-19 pandemic as an unexpected disruption may entail specific stressors related to ICT use in teachers' work. During the pandemic, clearly defined goals, teacher competences, and

arrangements for learning to apply ICT in teaching seemed to be essential at various educational levels (König et al., 2020; Schildkamp et al., 2020). In addition, the pandemic-induced switch to remote teaching may have increased straining ICT availability demands. A study of elementary school teachers revealed that ICT availability demands were associated with both school principals' and parents' expectations (Park et al., 2020). In Finland, families' difficulties in managing remote learning (Lavonen & Salmela-Aro, 2022) may also have increased teachers' availability demands.

In this study, our aim is to recognize technostressors in comprehensive school teachers' work during the Covid-19 pandemic. The research question we aim to answer is: What kinds of technostressors did comprehensive school teachers experience in their work during the Covid-19 pandemic in Finland?

Methods

Data collection and participants

The data were gathered between December 2020 and February 2021 as part of a larger research and development project focusing on employee wellbeing and health. The project was funded by EU regional and structural policy programmes. Part of the project focused on the wellbeing of comprehensive school teachers during the Covid-19 pandemic. During the data collection period, teachers were back in the classroom teaching after the government-ordered school closure in spring 2020. However, teachers were still providing remote and hybrid teaching as needed due to pandemic quarantines issued by local health and safety officials.

The data consist of answers to two open-ended questions included in an online questionnaire addressing teachers' work during the Covid-19 pandemic. The questionnaire was carried out using Microsoft Forms. A link to the questionnaire, information about the study, and a privacy notice were sent to comprehensive school (grades 1–9) teachers employed by the City of Tampere, Finland (N=1300). The link was sent by the City's contact person using the schools' communication channel. Answering the questionnaire was voluntary and informed consent was obtained. Ethical review and approval were waived for this study since the research design elements of this study do not contain any of the elements that would require ethical approval stated in the Finnish National Board on Research Integrity guidelines. In our study, we have followed the ethical principle of self-determination.

A total of 361 participants filled in the questionnaire. The response rate was 28%. Of the participants, 84% identified as women and 13% as men. The average age of the participants was 48 years, and the ages ranged from 25 to 69 years. The duration of the participants' teaching tenure averaged 19 years. The two open-ended questions utilized in this study and the respective respondent numbers were: "Describe your experiences of working during the Covid-19 pandemic" (n=275) and "In your work, what matters have you perceived as burdening during the Covid-19 pandemic?" (n=352).

The length and depth of the individual answers varied from one-word answers to lengthy descriptions. The total quantity of data obtained through the two questions was 15,930 words. The participants' answers were written in Finnish. The quotations included in the results have been translated into English.

Data analysis

The data were analyzed by applying the method of qualitative content analysis (see e.g., Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). The analysis method was inductive, as we wanted to gain an understanding of the participating teachers' experiences of ICT-related straining factors during the pandemic without being tied to the prior categorizations of technostressors (e.g., Tarafdar et al., 2007).

First, all answers to the open-ended questions were read through. After the initial read, it became obvious that ICT-related issues were largely emphasized in the data and thus became the focus of the study.

Answers to the first, more general question ("Describe your experiences of working during the Covid-19 pandemic") were mostly descriptions of burden and burdening factors, which underlined the need and affirmed the decision to study stressors. Burden and burdening factors were distinguished from other descriptions of work especially by the expression of negative affect (e.g., demanding, heavy, burdensome, distracting, lonely).

The data were transferred to the qualitative analysis program Atlas.ti. All the answers covering ICT-related demands were identified and preliminary descriptions were written. Responses were identified as descriptions of technostressors if they described ICT or ICT-related matters (e.g., mentions of applications or platforms, ICT-mediated communication, ICT-mediated teaching) as factors that cause burden and strain (e.g., mentions of burden, stress, difficulties). Answers with similar themes were grouped together and given preliminary titles. The data were read through several times, organized, re-organized, and re-named as needed. In the end, five themes covering technostressors in comprehensive school teachers' work during the Covid-19 pandemic were formed.

Results

Based on the analysis, comprehensive school teachers' technostressors during the Covid-19 pandemic were divided into five main categories: rapid ICT adoption, technological inadequacies, ICT-related pedagogical challenges, limitations in social interaction, and multichannel communication and availability pressure. Each of the five themes and their sub-themes are presented in Table 1 and discussed in more detail below.

Main themes	Sub-themes
Rapid ICT adoption	Learning to use ICT Lack of ICT training and training time Guiding others in ICT use
Technological inadequacies	Lack of equipment and other resources Technical problems Lack of technical support
ICT-related pedagogical challenges	Preparing online lessons Assessing assignments Supervising and motivating pupils
Limitations in social interaction	Difficulties in ICT-mediated communication Reduced interaction and collaboration Difficulties in reaching pupils
Multichannel communication and availability pressure	Need to use multiple communication channels Volume of digital communication Pressure to be available

Note: The main themes and sub-themes of comprehensive school teachers' technostressors during the Covid-19 pandemic as shown in table 1

Rapid ICT adoption

Rapid ICT adoption depicts the hurried situation of moving to ICT-mediated learning, including the need to learn ICT quickly and without adequate support, and to help and support others in using ICT. The rapidity of ICT adoption is also partly intertwined with the other four themes, as it seemed to define the work of the participating teachers' during the pandemic.

Participants described how in the early stages of the Covid-19 pandemic they were obliged to rapidly transition to online teaching. The swift and surprising shift was often described as challenging and straining, as teachers needed to quickly adopt and learn the technology themselves as well as familiarize and guide their pupils in ICT use. The amount of learning and changes associated with increased ICT use and online teaching was perceived as overwhelming.

ICT adoption also came up as quite a lonely endeavor; participating teachers seemed to have learned ICT use mostly on their own. They noted that there was no formal training available, and even the school-provided instructions seemed to be inadequate or scattered and varied. There also seemed to be no time allocated for learning – rather, participants tried to come to terms with ICT in their leisure time, which could blur the boundaries between work and non-work, as one participant described:

> The beginning of remote work was really challenging because we didn't receive any instructions on how to keep in touch with pupils. We had to learn the use of Teams after workdays and on the weekends. The first weeks were nothing but work from mornings to nights and into the weekends.

In the participating teachers' work, part of the ICT adoption process seemed to involve helping and familiarizing pupils with ICT to enable online learning. The participants could still be struggling with learning the technology themselves, and on top of that they also tried to help pupils with it. Participants also described their frustration with the time and resources required to teach ICT. The constant need to help and instruct pupils with ICT was perceived to take too much time away from the actual subject being taught, as highlighted in the following quote: "Teaching technology took too much time. Pupils didn't know how to use it, so I had to hold their hands through it. The subject we were supposed to learn became secondary."

Due to the novel pandemic situation and the consequent switch to online work, participants were contacted and asked to instruct and help colleagues as well as pupils' parents with ICT issues, which seemed to further increase their workload. Like the participating teachers themselves, the pupils' parents could struggle with rapid ICT adoption, and this manifested in both the quantity and quality of parents' contacts, as described in the following quote:

> The adoption of new technology was easy for me, so I ended up teaching and helping others. [--] Parents were hopeless with technology. Some called and asked for help in a civil manner, some called on the weekend or evening and yelled and blamed me for nonfunctioning equipment or their own lack of skills.

Consequently, it seems that the participating teachers were not only responsible for their own ICT adoption but also that of their pupils. They additionally had to tend to colleagues' and parents' demands and requests for help. This seemed to have stretched the teachers' usual job descriptions as well as their working hours.

Technological inadequacies

Technological inadequacies include the lack of available equipment and appropriate teaching materials, as well as the experience of technical problems and inadequate technical support. Technological inadequacies are partly intertwined with ICT-related pedagogical challenges, as the lack of online materials required more effort from teachers.

Due to the sudden switch to online teaching, many schools seemed to lack enough computers and phones to give to teachers and pupils. Some participants described the need to use their own personal equipment to teach. In addition to the lack of computers, participants also found it burdening that they were often not provided with any teaching material for remote teaching and needed to source suitable material online. One participant summarized the situation as follows: “Lack of computers and still the demand to use them. Searching teaching material on the Internet, lack of teaching equipment.”

Participating teachers seemed to also be worried about the potential for increased inequality between pupils caused by differences in technical equipment and resources at pupils’ homes. Even if the teacher had adequate devices and materials to teach online, providing equal education to all pupils from different backgrounds and resources was perceived to be a lot more difficult in remote teaching, as the following answer notes: “Pupils’ inequality in ICT skills and equipment. Not everyone has the technological knowledge and devices and connections required for remote learning.”

Participants also brought up frequent experiences of ICT difficulties. Besides the problems encountered with their own computers, the teachers also needed to solve the pupils’ ICT problems. Problems and difficulties with ICT were described as frustrating and time-consuming, for example: “The amount of hassle and wasted time that goes into software/network/sign-in etc. not working.” Participants also described a lack of adequate technical support. Rather, they felt left to their own devices and tried to find support and answers from other sources, such as the Internet, friends and colleagues, or family members, as one participant put it: “My husband has provided me with tech support, not the school.” Some participants expressed their disappointment with their school’s inability to adequately facilitate remote and hybrid teaching during the pandemic.

ICT-related pedagogical challenges

ICT-related pedagogical challenges include demands such as the extra effort needed to prepare online lessons (which is partly intertwined with the technological inadequacies discussed above) and to assess assignments in online format, as well as difficulties in supervising and motivating pupils in online lessons. This is partly intertwined with the issue of limitations in social interaction as interaction is a key element of support and motivation.

In the participants’ descriptions, the need to adjust one’s pedagogical practices to remote teaching was depicted as challenging and burdening. The need to plan and prepare new kinds of lessons in very limited time and to produce suitable materials and assignments for online classes seemed to consume a lot of time and resources and result in increased working hours. Adjusting one’s pedagogical practices and preferences to online teaching could also be perceived as frustrating. In addition, assessing, correcting, and evaluating pupils’ work in the digital environment was perceived to be cumbersome and time-consuming, as described in the following quote: “Preparing lessons took a lot of time since you needed to produce the material yourself. Assessing pupils’ assignments in digital format was slow and laborious.”

Moreover, participating teachers described how operating in the digital work environment made it more difficult to give instructions and help pupils with their assignments. Supervising class activities online was also perceived as demanding. Furthermore, finding ways to motivate and support pupils in online settings seemed to take more effort than usual. Teaching online classes could also leave teachers feeling uncertain about whether or not pupils had fully participated in class activities or even understood the content, as one

participant described: “Online teaching poses challenges. I can’t offer support and help so well. I can’t be absolutely sure what the pupils have understood and what they haven’t. Time-consuming.”

In general, the ICT-related pedagogical changes seemed to increase the workload in the forms of planning, preparing, supervising, and evaluating schoolwork. Consequently, work could easily spill over into leisure time. Moreover, feelings of uncertainty about the quality of often quickly made pedagogical choices also seemed to burden participating teachers.

Limitations in social interaction

Limitations in social interaction depict the stressors associated with the increase in ICT-mediated communication and decrease in face-to-face communication during the pandemic, such as difficulties in ICT-mediated communication, decreased sense of interaction, collaboration, and community, and difficulties in reaching pupils through ICT. As mentioned in the previous chapter, limitations in social interaction are partly intertwined with ICT-related pedagogical challenges, as pedagogy in comprehensive schools is highly interactional in nature.

Participating teachers brought up the various burdening aspects of limited interaction inflicted by ICT-mediated communication. Online teaching and communication were often perceived as difficult and less authentic and comprehensive compared to face-to-face interaction. Participants felt a weakened sense of presence and reciprocity with pupils. As one participant noted, “remote teaching easily turns into a teacher’s monologue.” Interaction with younger children in particular was perceived to be easier and more natural in classroom settings than online.

The participants’ descriptions often depicted the idea that the act of teaching itself requires the teachers’ presence in the same physical space. Some participants described their dislike of digital communication in general and especially in educational settings. Therefore, for some, online communication seemed to make their work less interesting and motivating, and it could even contradict their views of what constitutes quality teaching. Moreover, some participants felt that online interaction prevented them from doing their job properly, as one participant put it: “Technology hasn’t ‘helped me’ [--] but forced me. I’m a person who works with my body, my expressions, tones of voice, and words, and in remote work I’m not able to do my job.”

Participants also described how interaction that was limited to digital devices made it more difficult to reach some pupils. Pupils could be passive during classes, neglect their assignments, or even disappear altogether. It could be difficult for teachers to get a hold of pupils, and sometimes they had to use various communication channels or even contact pupils’ family members to solve the situation. Being unable to contact pupils could also make participants concerned not only for the pupils’ learning but also for their wellbeing. In addition, trying to get a hold of pupils was perceived as burdening and time-consuming, as the following quote describes: “Some of the pupils were difficult to reach during remote period. Trying to reach them took a lot of time and energy.”

In addition to communication problems with pupils, participants also felt that their interaction and collaboration with colleagues was hampered by online communication. For example, participants described interaction in online meetings as inauthentic and felt that ICT-mediated communication made it difficult to have real conversations with colleagues. Planning and making decisions together were also perceived as more difficult. Some even discussed the potential detrimental effects of digital communication on their workplace’s sense of community. Face-to-face interaction with colleagues was missed for its more holistic nature, as one respondent described: “I truly miss collective face-to-face meetings where you’re able to see and feel other people’s physical demeanor and know what everyone is actually thinking.” In general, computer-mediated communication alone was not perceived to foster authentic, comprehensive interaction in teachers’ work.

Multichannel communication and availability pressure

Multichannel communication and availability pressure include stressors caused by digital communication, such as the pressure to use multiple communication channels, the high volume of digital communication, and the pressure to be constantly available through multiple channels. Multichannel communication and availability pressure are partly intertwined with rapid ICT adoption since the rapid switch to online mode did not seem to support conscious planning of digital communication.

The increased digital communication caused by remote teaching was often depicted as a stressor. Participants described the demand to use various communication channels in their work, for example: "During the remote period, what burdened me was multiple communication channels: Whatsapp, Helmi [the school's communication channel], phone, text messages, e-mail, Teams, and a blog." While some of the work-related communication channels were determined by schools, there still seemed to be a lack of shared understanding on which communication tools to use for which purposes. This often meant that inquiries, assignments, and other communication was spread across various channels and left to the individual teacher to handle to their best abilities. As one participant reflected: "I should have set stricter boundaries on how and through which channels the assignments were submitted, they were flooding from 'all over the place'."

The sheer number of messages was perceived as burdening. Participants felt they needed to be constantly alert and on top of the incoming messages and calls. Some participants even described the beep of incoming messages as a stressor. Participants also felt pressure to be constantly available and to answer messages as quickly as possible. This could lead to diminished breaks and recovery during workdays, as participants felt they needed to be available even during lunchtime or forgo their coffee breaks to keep on top of the continuous flow of messages. Furthermore, the availability pressure was not limited to just working hours – participants described the demand to be available through various channels also in the evenings and on weekends, as described in the following quote: "Workdays seemed to extend to 12 hours. I had difficulties distinguishing between work and free time because both pupils and their parents contacted me around the clock."

The Covid-19 pandemic and the consequent switch to remote and hybrid teaching seemed to have increased digital communication significantly. While teachers were already used to communicating with pupils' families through digital communication channels, the volume of digital communication produced by the pandemic was described as overwhelming. With practically all interaction becoming digital, it seemed to be difficult to manage and limit the multichannel communication flow.

Discussion and conclusions

The aim of the present study was to identify technostressors in comprehensive school teachers' work during the Covid-19 pandemic. The results indicate that during the pandemic, teachers have experienced various technostressors that are also partly intertwined. Based on the analysis, five main categories were identified: rapid ICT adoption, technological inadequacies, ICT-related pedagogical challenges, limitations in social interaction, and multichannel communication and availability pressure.

While Finnish teachers were quite active ICT users even before the pandemic (Kaarakainen & Saikkonen 2021), the role of ICT expanded significantly especially during the early stages of the pandemic, making ICT-mediated learning the primary form of teaching. Based on our findings, comprehensive school teachers' work in the early stages of the pandemic can be characterized by a sudden and rapid need to adopt ICT to carry out teaching and other work tasks while also tending to pupils' ICT needs and helping colleagues and parents with ICT-related issues. Respondents' descriptions of the stressors related to rapid ICT adoption had some similarities with Tarafdar et al.'s (2007) technostress creators, namely techno-overload (increased

workload), techno-invasion (sacrificing leisure time because of technology), and even techno-complexity (difficulties in understanding and using technology).

Learning to use ICT for remote teaching in a very limited timeframe seemed to increase the amount of work and result in work spilling over into the evenings and weekends. The situation may have been more difficult and burdening for teachers with less ICT competence, as has been noted in prior studies (e.g., Lee & Lim, 2020; König et al., 2020; Schildkamp et al., 2020). However, based on our findings, the pandemic-induced ICT adoption could burden tech-savvy teachers as well, as they were often the ones helping others with ICT-related matters. Because the present study focused solely on identifying stressors, the plausible positive experiences of providing and receiving collegial support with ICT issues that have been raised in previous studies (e.g., Califf & Brooks, 2020; Dong et al., 2020) cannot be discussed. Overall, individual teachers seemed to have significant responsibility for ICT adoption, not only in learning ICT themselves but also in the broader educational context.

Overall, the participating teachers' descriptions of technostressors revealed experiences and feelings of being on one's own – not only in terms of rapid ICT adoption, but also in terms of technological inadequacies, such as making do with inadequate equipment and a lack of technical support. Technological problems have also been identified as a stressor in prior research (e.g., Çoklar et al. 2016; Al Fudail & Mellar, 2008). Based on our data, the novel pandemic situation seemed to have caught schools off-guard, which may be one of the reasons for the inadequate resources and support for ICT-related issues. The importance of school support to buffer teachers' technostress has been identified in prior studies (e.g., Al-Fudail & Mellar, 2008; Joo et al., 2016; Syvänen et al., 2016; Özgür, 2020). For this reason, it is not surprising that participants' descriptions of technostressors seemed to be related in many ways to experiences of having to deal with ICT-related issues on one's own.

ICT-related pedagogical challenges also included experiences of searching for and developing new materials and pedagogical solutions independently. In the rapidly changed situation, teachers tried to find practical solutions to enable pupils to submit their assignments, which often meant that they were sent through digital channels. Assessing assignments, as well as supervising and supporting pupils in digital environments, were depicted as stress-inducing. Prior research has also discussed the role of pedagogical issues in technostress (e.g., Çoklar et al., 2016; Mäkiniemi et al., 2017). ICT-related pedagogical challenges also seemed to be highly intertwined with communication-related stressors, as teachers felt that they were not able to make authentic contact with their pupils. Since certain school subjects that previously had hardly included ICT (or not included it at all) were switched to remote mode, it is highly likely that the teachers were unable to apply the idea of TPACK (Koehler & Misra 2005) – that is, to choose and/or develop technological solutions that are aligned with the teaching content and pedagogy. The role of TPACK in preventing teachers' technostress has been identified in prior research (e.g., Joo et al., 2016; Özgür, 2020; Dong et al., 2020).

Matters regarding digital communication seemed to be a significant technostressor in teachers' work during the pandemic. Our findings indicate that ICT was perceived as providing a limited form of social interaction that made teaching work more difficult and reduced the sense of presence, dialogue, collaboration, and community. It seems that none of the forms of digital communication were perceived to compare to classroom teaching and face-to-face interaction. In addition, the difficulty of reaching some pupils through ICT emerged as a new kind of stressor that could reduce teachers' sense of control at work and create new types of concerns.

It seems that the rapid shift to remote teaching significantly increased the volume and forms of digital communication, resulting in multichannel communication and availability pressure. There seemed to be a high volume of digital communication spread across multiple communication channels, which in turn increased the pressure on participating teachers to be available. The straining effect of ICT-induced availability demands have been recognized in prior studies (e.g., Day et al., 2012; Ragu-Nathan et al., 2008;

Califf & Brooks, 2020; Park et al., 2020). It seems that because of the novelty of the pandemic situation, teachers were contacted by pupils and their parents more often and at more atypical times than usual. Not having clearly appointed communication channels for certain purposes may have imposed the need to monitor various channels at the same time.

Interestingly, both the limitations set by the nature of digital communication as well as the ICT-enabled constant connectivity seemed to burden the participating teachers at the same time. Overall, the participants' experiences depict an increase in communication quantity but a decrease in communication quality. As this study focused only on stressors, it cannot discuss the potential positive effects of digital communication in comprehensive school teachers' work. The varied and even paradoxical role of digital communication in technostress has been discussed, for example, by Day and colleagues (2019), implicating that ICT-mediated communication is likely to play a far more complex role than that of a stressor alone.

In terms of the practical implications stemming from the findings, there is the need for and importance of school-provided technical, pedagogical, and social support. The findings suggest that the schools were unprepared for the pandemic-induced remote and hybrid teaching, and they were often unable to offer teachers adequate resources and support. The availability of sufficient hardware, software, and instructions, as well as the time allotted for ICT adoption, could potentially have mitigated the teachers' technostress in the early stages of the Covid-19 pandemic. Developing school-level technical support and practices to address ICT-related pedagogical challenges can be useful in buffering teachers' technostress, both in and out of the pandemic context. In addition, paying attention to the interplay of technology design, pedagogy, and teachers' wellbeing may help schools to develop more comprehensive approaches to reducing technostress and supporting wellbeing in digitalizing work.

Additionally, schools could benefit from developing shared practices to decrease burdening aspects of digital communication and availability pressure. While availability pressure seemed to increase during the pandemic, the increase in digital communication is likely to affect teachers' work also under regular conditions, at least in Finland or other countries with a high rate of ICT use in education. Establishing shared practices and etiquette for digital communication could help reduce communication-related stressors and promote digital communication that supports teachers' wellbeing. Shared etiquette could also help teachers to switch off from communication applications and set boundaries between work and leisure time. To combat feelings of limited and inadequate social interaction, it may be useful for schools to develop practices to better foster collaboration and communication in online mode.

The novelty of the study lies in the pandemic context; while teachers' experiences of technostress have been studied before, the pandemic has significantly increased and broadened the utilization of ICT in teachers' work. The present study complements prior research by providing knowledge on ICT-related stressors inflicted by the pandemic. In addition, the qualitative inductive approach enabled us to recognize ICT-related straining factors in teachers' descriptions, which can provide a more nuanced picture compared to established measures. This study also contributes to the larger discussion of technostress and technostressors by highlighting the complex implications of digital communication in terms of experiences of increased quantity and decreased quality of communication. The findings also point to the central role of organizational and social support in technostress reduction, as many of the stressors identified in this study imply a lack of resources and support. Thus, this study adds to the discussion on the interfaces of work environment, information systems design and technostress (Tarafdar et al. 2019) by highlighting the various roles of social and organizational aspects in the creation of technostress. Since this study focused only on technostressors, future research could broaden the perspective by examining positive experiences of ICT use along with technostressors to provide a more comprehensive picture of the impact of ICT on comprehensive school teachers' work. In addition, the multiple and complex roles of digital communication and its' implications for social interaction and teachers' wellbeing could also be explored. Furthermore,

future studies should more thoroughly address the interplay of organizational, social, and pedagogical aspects in teachers' ICT use and technostress.

Limitations

There are some limitations to this study that require discussion. The participants' descriptions of their experiences were gathered through open-ended questions as part of a larger questionnaire. The length and detail of the answers varied, making the data somewhat variable. Thus, the data probably lacked some nuances that some other data collection method (e.g., interview) could have provided. In addition, the data analysis was conducted by one researcher instead of multiple coders. The data were also gathered from one city and country, therefore reflecting a limited geographic area with quite mild Covid-19 restrictions. Therefore, the findings as such may not be applicable to different regions and educational systems. However, the increased use of ICT is likely to have similarities across geographical regions, which may make this study relevant beyond the Finnish comprehensive school context. It should also be noted that as the study focused only on technostressors, it covers only a part of the complex role of ICT in teachers' work and wellbeing. However, the results still provide insights into the effects of the pandemic-induced technostressors in comprehensive school teachers' work and add to the qualitative research on technostressors and the broader discussion on the role of organizational and social factors in technostress.

Acknowledgements

This study was partly funded by the European Social Fund (ESF) grant number S21966 as part of the Sustainable Brain Health project. We would like to thank project manager Mirva Kolonen and project coordinator Kirsi Toljamo for their help and support.

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