Journal of Information Technology Education: Research

An Official Publication of the Informing Science Institute InformingScience.org

JITEResearch.org

Volume 22, 2023

TPACK, ORGANIZATIONAL SUPPORT, AND TECHNOSTRESS IN EXPLAINING TEACHER PERFORMANCE DURING FULLY ONLINE LEARNING

Indra Maipita	Faculty of Economics, Universitas Negeri Medan, Medan, Indonesia	imaipita@unimed.ac.id
Faisal Rahman Dongoran*	Department of Accounting Education, Faculty of Teacher Training and Educational Science, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia.	faisalrahman@umsu.ac.id
Dedy Husrizal Syah	Department of Digital Business, Faculty of Economics, Universitas Negeri Medan, Medan, Indonesia.	desra@unimed.ac.id
Gaffar Hafiz Sagala	Department of Digital Business, Faculty of Economics, Universitas Negeri Medan, Medan, Indonesia, and Doctoral School of Economics, Business, and Informatics, Corvinus University of Budapest, Budapest, Hungary	hafizsagala@unimed.ac.id

* Corresponding author

ABSTRACT

Aim/Purpose	This study aims to analyze (1) the effect of organizational support on Technological Pedagogical Content Knowledge (TPACK), (2) the effect of organizational support and TPACK on teacher performance, (3) the effect of organizational support and TPACK on technostress, and (4) the effect of technostress on teacher performance.
Background	The disruption of Information Technology (IT) innovation in educational practice happened two decades ago. However, the more massive and intense IT integration in teaching and learning practice was demanded during the COVID-19 pandemic. These circumstances made teachers and students face a new teaching and learning environment with complete IT mediation. Therefore, they will

Accepting Editor Kay Fielden │Received: June 28, 2022│ Revised: December 13, December 18, December 23, December 28, 2022 │ Accepted: January 2, 2023.

Cite as: Maipita, I., Dongoran, F. R., Syah, D. H., & Sagala, G. H. (2023). TPACK, organizational support, and technostress in explaining teacher performance during fully online learning. *Journal of Information Technology Education: Research, 22,* 41-70. https://doi.org/10.28945/5069

	show a unique response valuable for managing effective education and further research regarding teaching and learning in the online environment.
Methodology	Using a purposive sampling technique, data was collected from 419 pre-service teachers in the economics and business field. The data was then tabulated and analyzed using PLS-SEM.
Contribution	This study connects the concept of TPACK as knowledge to organizational support and technostress as the organizational and personal response to deal with massive IT integration in fully online learning during the COVID-19 pandemic. This study bridges the educational concept of teacher competence to the behavioral framework of IS users to deal with the online environment. Teaching and learning are tasks that engage human-to-human interaction, which is different from other productive activities like the business sector. Therefore, this study may give fruitful findings, both theoretically and practically, to improve educational practice in this digital age.
Findings	Researchers found that organizational support and TPACK were valuable antecedents of teacher performance in an online environment. At the same time, technostress is not a critical threat to teacher performance. However, technostress exists among teachers and is uncontrollable by TPACK and organizational support. Researchers argue it is an unavoidable circumstance. The educational system demands a rapid shift to fully online learning due to the COVID-19 pandemic. Therefore, the teacher should accept the challenge to maintain the continuity of teaching and learning activities.
Recommendations for Practitioners	(1) Teachers' knowledge and organizational support should become an essential concern for policy makers and school leaders to maintain teacher performance in this dynamic online environment. (2) The educational leader should develop a strategy to manage technostress among teachers from another aspect beyond TPACK and organizational support. (3) Policymakers should develop a strategy to compensate for teacher effort and sacrifices resulting from IT disruption in their working experience.
Recommendations for Researchers	Researchers should confirm and refine the framework developed in the private sector to the educational sector to generate more theoretical and empirical understanding regarding the functional integration of IT devices on certain entities' productive tasks.
Impact on Society	This study gives more understanding of how teachers respond to IT-integrated tasks in their academic activity. This discussion will give more wisdom to understand the threshold of IT usefulness in the educational field besides giving preference to managing it to maintain teachers' work quality.
Future Research	Further research is required to identify the critical factors to manage teachers' technostress effectively. A qualitative research method may be helpful in exploring teachers' complex responses regarding IT-integrated tasks.

Keywords	online learning, COVID-19, physical distancing, teacher education

INTRODUCTION

Information Technology (IT) has accelerated innovation in learning practices significantly. Various studies have revealed the acceleration of learning quality through technology integration (Moreira-Fontán et al., 2019). In addition, researchers found that learning is more dynamic and richer with the help of IT combined with pedagogic practices (Badia et al., 2013; Ersanli, 2016; Koh et al., 2017). The knowledge that teachers need for this practice is called TPACK (Technological, Pedagogical, Content Knowledge) (Graham, 2011; P. Mishra & Koehler, 2006; Niess, 2011). Unfortunately, education in developing countries, including Indonesia, shows a different response. Researchers and education practitioners find that the challenges of this digital era are not enough to spur conceptual and practical knowledge related to IT-integrated pedagogy (Accilar, 2011; Effiyanti & Sagala, 2018; Georgsen & Zander, 2013; Kalolo, 2019; Miah & Omar, 2012). This condition has become more realized by various obstacles in fully online learning during the COVID-19 pandemic (Adarkwah, 2021; Alawamleh et al., 2020; Bao, 2020; L. Mishra et al., 2020; Zhou et al., 2020). Researchers suggest that teachers have various obstacles in online learning, both technical and pedagogical constraints, such as difficulty in using learning management systems, developing e-learning materials, adjusting the instructional design to the online environment, and maintaining student engagement (Adarkwah, 2021; Ali, 2020; Bao, 2020; Dumford & Miller, 2018; L. Mishra et al., 2020; Sun et al., 2017). Other researchers suggest that both teachers and students experience pressure or stress due to online learning (Effiyanti & Sagala, 2018; Li & Wang, 2021; Sim et al., 2021). This happened due to several factors including (1) limited literacy and technological efficacy of educators (Christensen & Knezek, 2017a; Effiyanti & Sagala, 2018), (2) limited specific and continuous IT-integrated pedagogic research (Cochrane, 2010), (3) limited knowledge transfer culture in educational organizations (Lu & Ramamurthy, 2011; Zeng et al., 2019), and (4) unequal access to IT infrastructure among educators (Sun et al., 2017).

The technostress phenomenon has existed and has been studied for a long time. Initially, the technostress phenomenon occurred because of the limitations of teachers in using information technology (IT) (Brod, 1984; Effiyanti & Sagala, 2018). However, nowadays, the phenomenon probably transforms into more complex circumstances such as high workloads, disruption of work-life balance, and job insecurity and uncertainty resulting from technological innovation (Ayyagari et al., 2011; Li & Wang, 2021; Tarafdar et al., 2010). The pressure in work is unavoidable because, in turn, IT will disrupt the work patterns naturally that have occurred so far for teachers. IT integration in learning requires teachers to make various changes in learning activities, including instructional design, learning media, teaching materials, and evaluation designs (Cochrane, 2010; Daniel, 2020; Sun et al., 2017). That issue has become more demanding when government regulations required full online learning due to the COVID-19 pandemic to prevent virus transmission (Daniel, 2020; Naciri et al., 2020; Zhou et al., 2020). In this situation, almost all teachers and educational institutions experience culture shock, and irritation occurs during the migration from face-to-face and blended learning to fully online learning (Sagala et al., 2021). The main problem is not solely on the teacher's computer skills but on the intensity of the increasingly massive use of IT and the specific tasks of using IT, such as learning activities (Cochrane, 2010; Sagala et al., 2021; Sun et al., 2017).

From an infrastructure point of view, accessibility to IT has no significant issue. Almost all academic staff in various regions have their own IT tools and are supported by the availability of open-source LMS that can be utilized by teachers and students anywhere (Sagala et al., 2021). Likewise, as explained earlier, irritation still occurs because of the unstoppable IT innovation and the increasingly massive intensity of its use in learning. Therefore, educational institutions, including schools and universities, must have an organizational support system that can reduce irritation during the migration process to online learning (Li & Wang, 2021). Furthermore, a support system should be used as an instrument to control teacher technostress in the implementation of online learning and mastering the teacher's computer skills in academic activities (Cochrane, 2010; Sun et al., 2017). For empirical justification, this study aims to analyze (1) the effect of organizational support on TPACK, (2) the effect of organizational support and TPACK on teacher performance, (3) the effect of organizational support and TPACK on technostress, and (4) the effect of technostress on teacher performance.

Previous studies have developed and investigated the importance of TPACK in educational practice in this digital era (Graham, 2011; P. Mishra & Koehler, 2006; Niess, 2011). At the same time, several research projects have analyzed the negative impact of technostress on end-user computing and the importance of organizational support to control the risk among organizations' human resources (Ayyagari et al., 2011; Effiyanti & Sagala, 2018; Li & Wang, 2021; Ragu-Nathan et al., 2008; Sim et al., 2021; Tarafdar et al., 2011). Besides, knowledge was seen as the crucial factor that makes ICT become a valuable tool (Cochrane, 2010; Grant, 1996; Sredojević et al., 2016; Sun et al., 2017). Factually, schools still face irritation during full online learning implementation, especially in developing countries. Scholars reported that schools are still not yet controlling the ICT migration carefully (Adarkwah, 2021; Christensen & Knezek, 2017b; Effiyanti & Sagala; Kalolo, 2019). Additionally, previous research regarding technostress, organizational support, and knowledge management regarding ICT integration and migration is still dominated by private sector organizations. Therefore, this study wants to bridge those gaps by using TPACK as the knowledge aspect that is specifically used to proxies teacher-specific responsibilities. This study also wants to enrich the findings regarding the technostress phenomenon and its controllable construct to maintain individual performance in the educational sector. The current study is important as a theoretical and empirical foundation to deliver teaching and learning qualities in the digital environment.

A second-order construct measures the TPACK, Organizational Support, and Technostress variables in this study because of the broad dimensions of these variables. A second-order analysis is also done to obtain a holistic capture of the phenomenon to gain implications for making the right decision. In addition, this study can contribute to the management of technostress for teachers so that educational institutions can consistently provide meaningful learning amidst the uncertainty of learning practices due to technological disruption.

LITERATURE REVIEW

UTILIZATION OF IT INVESTMENT

The euphoria of the presence of technology promises innovation in professional practice in various fields, including education. From the utility point of view, the usefulness of IT is measured by reviewing the increase in productivity and time utilization of an IT innovation and investment (OECD, 2000). IT researchers believed that productivity and time utilization would impact economic growth (OECD, 2000; Pohjola, 1998, 2000). However, IT investment must be followed by education investment (OECD, 2000; Rebelo, 1998). This view shifts Solow's neoclassical perspective, which believes that IT investment is the critical factor determining productivity (Rebelo, 1998; Sredojević et al., 2016). Endogenous researchers offer theory X, which suggests endogenous variations in determining the usefulness of IT investments that lead to knowledge acquisition (Grant, 1996; Rebelo, 1998; Sredojević et al., 2016). Knowledge acquisition is seen as a driver of optimizing the benefits of IT investments (Grant, 1996; Sredojević et al., 2016). Therefore, IT investment must continuously innovate certain professional practices to create optimal value-added according to a particular field of work (Rebelo, 1998). At this critical point, every organization, including educational organizations, must possess the creation and mastery of new knowledge. Educational investment can be directed at mastering competencies related to the use of IT in optimizing academic activities. In turn, the availability of IT will help innovate pedagogical practices following teachers' and schools' specific needs.

TPACK AND ORGANIZATIONAL SUPPORT

In 2006, P. Mishra and Koehler formulated a new knowledge framework called Technological Pedagogical Content Knowledge (TPACK). TPACK is built on the framework of Shulman (1986, 1987), who developed the concept of Pedagogical Content Knowledge (PCK) that suggests that pedagogic knowledge has to be adapted to specific needs in teaching certain learning content (Koehler et al., 2013). P. Mishra and Koehler (2006) added technological knowledge to accommodate IT integration needs in learning in the digital era based on this framework. P. Mishra and Koehler view that teachers need to master technological, pedagogical, and content knowledge that is equivalent and blend in with each other to integrate technology in optimizing learning. From this mix of expertise, there will be slices of knowledge that interact with each other so that teachers can design their teaching and learning activities to fit the content material and utilize the right technology (Koehler et al., 2013; Schmidt et al., 2009).

This knowledge need is theoretically relevant to the endogenous theory, which suggests that technology investment success is determined by various endogenous factors, including organizational readiness, policy support, and mastery of knowledge (OECD, 2000; Sredojević et al., 2016). Likewise, although this knowledge framework was initiated more than a decade ago, various studies still show teachers' difficulties in integrating IT into learning (Effiyanti & Sagala, 2018). This difficulty has become increasingly apparent when fully online learning was implemented during the COVID-19 pandemic, especially in developing countries (Adarkwah, 2021; Naciri et al., 2020). This phenomenon indicates teachers' and schools' slow absorption of knowledge in certain areas.

The publication of the TPACK concept was followed by various professional training classes to maintain the continuity of the development and practice of TPACK in the classroom (Jang, 2010; Koh et al., 2015; Niess, 2011). However, the accessibility of teachers to training is not evenly distributed in certain areas. In addition, the conditions faced by teachers in schools are undoubtedly different. Ragu-Nathan et al. (2008) observed this phenomenon with situational factors. Situational factors are organizational mechanisms that produce variations in responses from organizations and their members regarding the use of IT in their productive activities (Ragu-Nathan et al., 2008). Many factors may play a role in situational factors, including job and position redesigning, information sharing, stress management training, social support and assistance, technical support, job control and procedures, literacy facilitation, and engagement facilitation (Burke, 1993; Davis & Gibson, 1994; Jimmieson & Terry, 1998; Karasek, 1979; Li & Wang, 2021; Ragu-Nathan et al., 2008). Ragu-Nathan et al. (2008) and Li and Wang (2021) use these situational factors as inhibitors to control stress or pressure when working in an IT integration environment. So that when a person is faced with changing working conditions due to IT integration, these inhibitors can control the stress that may occur due to the work pressure that arises.

Other studies review a similar phenomenon with the concept of organizational support in the same context. Eisenberger et al. (1986) formulated this construct to capture individual perceptions of organizational treatment that can affect one's commitment to maintaining personal productivity, better attachment and performance, and acceptance of work challenges. In this case, the teacher assesses the school regarding the extent to which the school supports teachers in migrating learning to online learning. Perceived organizational support indicates to what extent a person believes that the organization where they work appreciates and considers them valuable so that they need to be given support to carry out their work well (Baran et al., 2012; Eisenberger et al., 1986; Rhoades & Eisenberger, 2002; Wang & Shu, 2008). According to the need to shift in learning design to be fully online and the demands for mastery of TPACK as new knowledge, teachers need support to maintain their performance. This organizational support is necessary because this shift increases the complexity of the work that requires teachers to sacrifice more significant effort than usual (Eisenberger et al., 1986), such as updating pedagogic knowledge (TPACK), adjusting learning formats, preparing new media, and teaching materials, and implement it in actual learning activities (Li & Wang, 2021). Therefore, this study formulates the following hypotheses:

H1: Organizational support has a positive effect on TPACK.

H2: Organizational support has a positive effect on teacher performance.

H3: TPACK has a positive effect on teacher performance.

The organizational support construct in this study refers to the technostress inhibitor constructs used by the research of Li and Wang (2021). These stressor inhibitors are forms of assistance provided by institutions to assist teachers in utilizing IT in academic activities (Skaalvik & Skaalvik, 2017). These assists were found to reduce stress and improve teacher performance (Li & Wang, 2021; Skaalvik & Skaalvik, 2017). However, in this study, these supports are expected to help teachers master TPACK, which is specific knowledge in utilizing IT with new learning designs. This organizational support can help teachers sharpen their sensitivity to IT for learning activities. This is necessary because teachers currently have mastered the use of IT in general but are constrained by its use with specific goals such as teaching and learning activities (Sagala et al., 2021). Organizational support is analyzed with a second-order construct with three dimensions: literacy facilitation, technical support provision, and involvement facilitation (Li & Wang, 2021). Literacy facilitation refers to programs organized by institutions to share, train, and improve teacher knowledge regarding IT usage for teaching and learning activities (Li & Wang, 2021). Technical support provision refers to technical assistance institutions provide to assist teachers in using IT and overcoming various obstacles in using IT in teaching and learning activities (Li & Wang, 2021). Lastly, involvement facilitation refers to teacher involvement in IT integration phases, such as appreciation when using new technology, accepting teacher recommendations for system improvement, and engaging teachers to improve applications or design new strategies (Li & Wang, 2021).

Technostress

The phenomenon of technostress has emerged and has been long studied by information systems researchers (Ayyagari et al., 2011; Brod, 1984; Tarafdar et al., 2011). Due to the massive implementation of IT in all fields of work, the education sector cannot be separated from the phenomenon of technostress (Effiyanti & Sagala, 2018; Li & Wang, 2021; Penado Abilleira et al., 2021; Rolón, 2014). Technostress itself is a psychological response from IT users who show pressure and tension due to the use of IT in their productive activities (Brod, 1984). These responses arise due to various factors called stressors. Usually, these stressors occur due to changes in work patterns, such as academic work, which used to have minimal technological integration but now demands high-intensity use of information technology. Adopting new IT tools can increase workload, job uncertainty, and insecurity due to weak IT mastery, work-home conflicts, and continuous technological innovation (Ayyagari et al., 2011; Effiyanti & Sagala, 2018; Li & Wang, 2021; Ragu-Nathan et al., 2008; Tarafdar et al., 2011). These criteria are called technostress-forming stressors.

Furthermore, this technostress phenomenon has been researched extensively so that it can be controlled to reduce human costs for companies and maintain the mental health of employees due to this technological disruption (Marchiori et al., 2019; Ragu-Nathan et al., 2008; Salanova et al., 2013; Tarafdar et al., 2011). Ragu-Nathan et al. (2008) and Tarafdar et al. (2011) used the inhibitor construct as a technostress controller for employees. Li and Wang (2021) also used this construct to control technostress in teachers in universities. As explained earlier, this inhibitor construct has the same basis as the organizational support construct. Therefore, in this study, the inhibitor construct was used as a proxy for organizational support to measure the extent to which teachers believe that the institution considers their existence as an asset so that teachers are supported during the migration process for fully online learning during the COVID-19 pandemic. Organizational support as an inhibitor of technostress will be helpful for controlling stress that may arise among teachers due to mandatory demands to carry out learning in a fully online mode (Sagala et al., 2021). At the same time, organizational support will help teachers master new knowledge, where new knowledge will help teachers master IT in learning, which in turn will help teachers control stress that arises in their academic work (Effiyanti & Sagala, 2018; Li & Wang, 2021; Sagala et al., 2021; Sredojević et al., 2016). Therefore, this study hypothesizes that:

H4: Organizational support has a negative effect on technostress.

H5: TPACK has a negative effect on technostress.

H6: Technostress has a negative effect on teacher performance.

The shifting circumstances toward fully online learning demand teachers to learn new IT utilization techniques and increase the intensity of work using computers; this is called techno-overload (Effiyanti & Sagala, 2018; Li & Wang, 2021; Ragu-Nathan et al., 2008). Furthermore, because teachers need to learn and practice new teaching modes, teachers may perceive IT for learning as a complex application and make their work complex; this response is known as techno-complexity (Li & Wang, 2021; Ragu-Nathan et al. al., 2008). Furthermore, continuous changes in the use of technology and the increasing intensity of facing computers may make teachers feel attacked by technology and increase uncertainty in their work patterns; this condition is called techno-invasion and techno-uncertainty (Li & Wang, 2021; Ragu-Nathan et al., 2008). Finally, these complex demands may make the teacher reflect on their capacity. This process of reflection often results in insecurity about their work due to their inability to master IT and compete with other teachers who are more proficient in IT; this insecurity is called techno-insecurity (Effiyanti & Sagala, 2018; Li & Wang, 2021; Ragu-Nathan et al., 2008). The five dimensions are stressors that form technostress. This study measured those dimensions using second-order constructs as previously done by Ragu-Nathan et al. (2008). Furthermore, the technostress construct was then tested for its influence on teacher performance to test the hypothesis of this research (Figure 1).

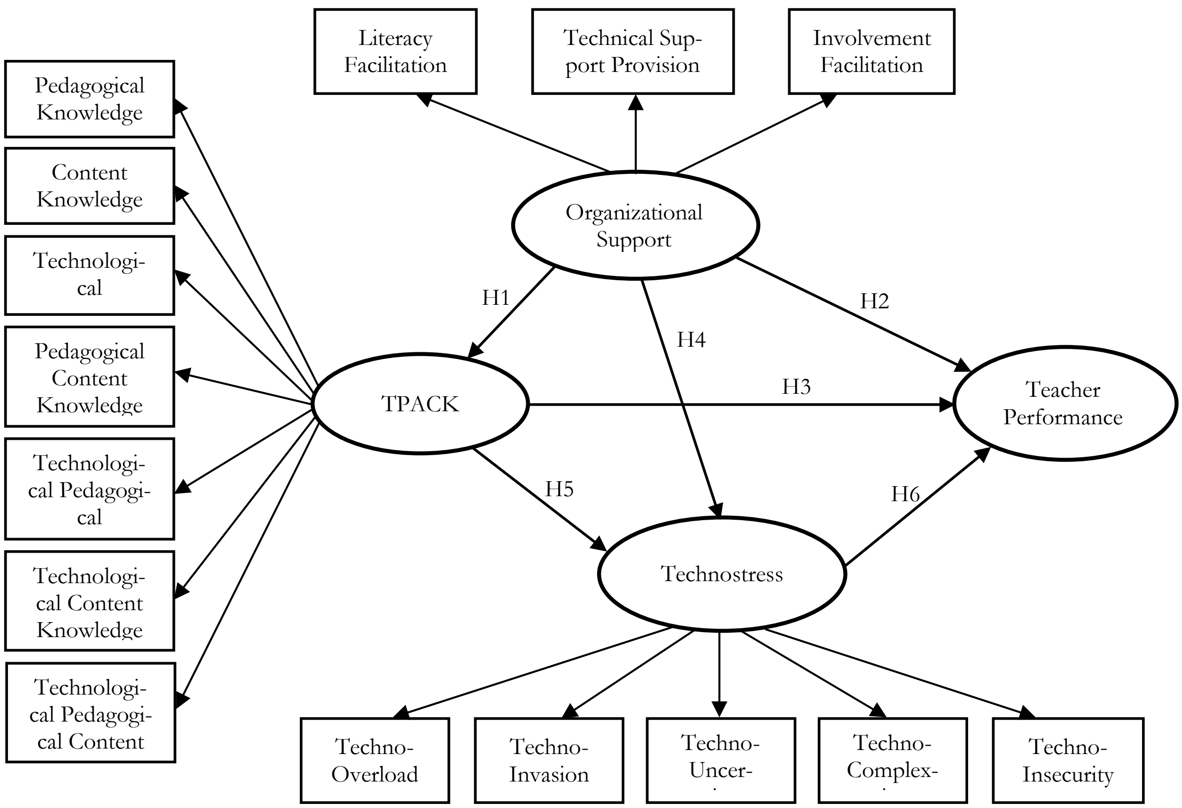

Figure 1. Research model

METHOD

RESEARCH INSTRUMENT

This research instrument was adapted from previous research. This study adopts the TPACK research construct from Schmidt et al. (2009) and Schmid et al. (2020), the organizational support construct was adapted from Marchiori et al. (2019), Fuglseth and Sørebø (2014), Ragu-Nathan et al. (2008), and Tarafdar et al. (2010), the Technostress construct from Li and Wang (2021), Fuglseth and Sørebø (2014), Ragu-Nathan et al. (2008), and Tarafdar et al. (2010), and the Work Performance construct from Tarafdar et al. (2010). These constructs were translated into Bahasa Indonesia and applied content validity by two experts. After that, the researcher also conducted face validity. Face validity is done by inviting four pre-service teachers to represent prospective respondents to review the questionnaire content. The purpose is to identify whether the prospective respondents have similar perceptions intended by the researcher regarding the questions or statements in the questionnaire. After obtaining input from experts and prospective respondents, the researchers made improvements, and the instrument was uploaded using a Google form so that respondents could access it easily. The questionnaire uses a 5-point Likert scale to obtain the data for the sample. The questionnaire contained 29 items to measure the TPACK construct, 13 items to measure the organizational support construct, 22 items to measure the technostress construct, and four items to measure the teacher work performance construct. TPACK itself contains seven dimensions, including pedagogical knowledge (PK), content knowledge (CK), technological knowledge (TK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPCK). Organizational support contains three dimensions, including literacy facilitation (LF), technical support provision (TSP), and involvement facilitation (IF). Technostress contains five dimensions, including techno-overload (TO), techno-invasion (TI), techno-complexity (TCx), techno-insecurity (TInsc), and techno-uncertainty (TU). The questionnaire items are in Appendix A. The outline of the variables' operational definitions is presented in Table 1.

Table 1. Variables and instruments sources

No	Variable	Operational definition	Sources
TPACK			
1	Pedagogical Knowledge	Pre-service teachers' knowledge of pedagogic aspects includes knowledge-related teaching plans, teaching methods, models, learning styles and student characteristics, basic teaching skills, and assessment and evaluation methods.	Schmidt et al. (2009)
2	Content Knowledge	Pre-service teachers' knowledge of the content of teaching materials following their fields of expertise, including the conceptual framework and the improvement of its practice.	
3	Technological Knowledge	Pre-service teachers' knowledge of recent technologies includes using various technologies such as computers, digital cameras, mobile devices, and word and data processing software.	
4	Pedagogical Content Knowledge	Learning management knowledge refers to content or teaching materials. In this aspect, pre-service teachers can manage appropriate learning strategies according to the content they teach or have reasons based on teaching materials in developing learning strategies.	
5	Technological Pedagogical Knowledge	Technological knowledge to implement the chosen learning strategy. In this case, pre-service teachers can find out, select and use the technology they need for teaching.	
6	Technological Content Knowledge	Pre-service teachers' knowledge about how technology changes the context and content of teaching materials also updated teaching materials on an ongoing basis.	
7	Technological Pedagogical Content Knowledge	A complex interplay of pedagogic, content, and technological knowledge so that teachers can integrate all three in learning. By mastering this knowledge, pre-service teachers know to teach students by utilizing appropriate technology and pedagogical strategy, presenting up-to-date teaching materials, and optimizing learning activities with this knowledge mix.	

Organizational Support			
8	Literacy Facilitation	Knowledge-sharing services to facilitate teachers' use of IT in teaching activities. This service can occur informally in discussion forums, learning communities, classroom learning, or special service centers provided by campuses or schools.	Fuglseth and Sørebø (2014); Li and Wang (2021); Tarafdar et al. (2011)
9	Technical Support Provision	A service center specifically established to assist prospective teachers regarding technical issues in using e-learning, learning management systems, network technicalities, etc.	
10	Involvement Facilitation	Support, appreciation, and praise for using technology in learning activities. The form of gratitude can be given verbally or with specific incentives. For example, in on-campus learning in teaching practice-oriented technology-oriented teacher candidates can be appreciated with good grades.	
Technostress			
11	Techno-Overload	Perception of excessive workload due to the use of IT in fully online learning carried out during the COVID-19 pandemic. The increase in workload occurs due to the obligation of pre-service teachers to prepare hybrid teaching materials, online learning media, learning videos, etc.	Li and Wang (2021), Ragu-Nathan et al. (2008)
12	Techno-Invasion	Changes in work culture due to the use of technology make prospective teachers feel intimidated by technology. As a result, technology is perceived as a threat and a demand in work.	
13	Techno-Complexity	Complicated feelings due to the use of complex technology such as e-learning, learning management systems, making learning videos, and online platform exams.	
14	Techno-Insecurity	Insecurity, in this case, is the concern of pre-service teachers losing their jobs or job opportunities because they are probably replaced with IT or other teachers who are more familiar with information technology in learning.	
15	Techno-Uncertainty	The constantly changing, evolving, and innovating IT features require pre-service teachers to continue learning and adapting.	
Performance			
16	Work Performance	Pre-service teachers' perception of the fully online teaching and learning activities they have implemented during the internship program.	Li and Wang (2021)

DATA COLLECTION

The researcher used a survey method with a purposive sampling technique to collect the data (Cooper et al., 2006; Creswell, 2012; Sekaran & Bougie, 2021). The research subjects were pre-service teacher-students in the economics and business field. Pre-service teacher-students are teacher-students who have passed their internship program. The teacher-students are trained to be teachers in vocational high schools in economics and business. When the data was collected, they already had experience in teaching, mainly in an online environment. The targeted respondent is considered representative in this research because the pre-service teacher-student has had actual teaching experience and organizational experience in their internship schools. The pre-service teacher-student is also expected to provide an objective response to their teaching experience because they are free from social desirability bias (Ashton & Kramer, 1980; Fisher, 1993). Social desirability bias is the tendency of the response given to meet the expectations of certain parties, for example, stakeholders or school as employer. That purpose is reasonable because students do not yet have an attachment to the school, so their opinions tend to be more objective than the teachers of the school itself (Ashton & Kramer, 1980). In addition, this study used an anonymous questionnaire to maintain the objectivity of the respondent's data.

Students with the criteria described above are in the seventh semester at the State University of Medan, Indonesia. Data collection was carried out using electronic questionnaires distributed through the head of the class (Cooper et al., 2006). Preservice-teacher student is not mandatory to participate in the survey. They were given the freedom to participate or not in the survey. Besides, the questionnaire is designed as anonymous to control their independencies when filling out the questionnaire. From 12 classes of teacher education study programs at the Faculty of Economics, State University of Medan, researchers collected 419 data for analysis. The demographics of the sample can be seen in Table 2.

Table 2. Demography of sample

No.	Variable		n	%
1	Gender	Male	64	15,24%
		Female	355	84,76%
		Sum	419	100%
2	Age	18	26	6,21%
		19	115	27,44%
		20	130	31,02%
		21	148	35,32%
		Sum	419	100%
4	Department	Administration Education	52	12,42%
		Accounting Education	92	21,95%
		Business Education	104	24,82%
		Economics Education	171	40,81%
		Sum	419	100%

The demographics of the sample show that women dominate the respondents. That composition is natural because women dominate the population of teacher-students at Medan State University. Furthermore, although the respondent's criteria are students who have completed the internship program, there is a wide age range among respondents, namely from 18 to 21 years of age. However, most of the participants are between 19 and 21 years old. This age range is very reasonable for 7th-semester students. Furthermore, the sample demographics also show that the researchers managed to get a representative sample from all teaching departments in the Faculty of Economics. The distribution of sample representation does seem uneven, but the weight of each representative is significant enough to represent the population in each department.

RESULTS AND DISCUSSION

DESCRIPTIVE STATISTICS

This study uses the 5-point Likert scale to measure the phenomenon. Therefore, the data is scaled from 1 as most dissatisfactory to 5 as most satisfactory. In descriptive statistics, the data is analyzed using the mean to understand the center of response, and standard deviation to understand the data variation for each dimension. Descriptive statistics in this study indicate that, in general, the dimensions that make up the TPACK indicate that prospective teachers have a moderate perception of mastery of TPACK with a range of 3.62-3.85. The TPACK dimensions also show a reasonably good data variation between 0.743-0.937. This value is slightly above the median value but has not entered the high category. The highest perception of mastery is on the Technological Pedagogical Knowledge variable, while the lowest perception of knowledge is on the Technological Knowledge variable. This condition is not statistically satisfactory. However, suppose we reflect on the limitations of the literature related to IT integration in fully online learning and the limitations of discussion about it in the classroom, then the profile is quite good and has the potential to be improved.

Furthermore, the response to organizational support shows a moderate number as well. Literacy facilitation has a mean score of 3.86 and a standard deviation of 0.893, Technical Support Provision has a mean of 3.71 and a standard deviation of 0.926, and Involvement Facilitation has a mean score of 3.87 and a standard deviation of 0.974. The value is the same with mastery of TPACK. This condition is not high but has the potential to be developed further. Even though schools may not have excellent technical support, they have been perceptions indicating there is support for prospective teachers to study technology for learning. This support can occur in classroom learning, in community or student study groups, mentoring in apprenticeship schools, and technical services provided by campuses or schools. However, further investigations related to this support must be studied further.

The technostress response of the sample is below both the TPACK mastery response and the organizational support response, which is in the range of 3.12-3.49, and the standard deviation is between 0.870-1.194. The standard deviation profile indicates that the teacher has a varied technostress response gap. This technostress profile cannot be underestimated as a threat variable. The trend of technostress experienced by teachers is still above the median value, which indicates that respondents tend to perceive technostress rather than not being disturbed by the demands of using IT. Researchers argue that teachers are still very likely to feel threatened due to IT integration in their teaching assignments. Likewise, the perception of teacher performance shows a reasonably high response, which is 3.91 on average. In addition, this variable also indicates a relatively low deviation rate, namely 0.797. The value indicates that the variation in the data is slightly near between one respondent and another (Table 3).

Table 3. Descriptive statistics

No	Variable	Avg	Std Dev
TPACK			
1	Pedagogical Knowledge	3,79	0,816
2	Content Knowledge	3,77	0,805
3	Technological Knowledge	3,62	0,937
4	Pedagogical Content Knowledge	3,69	0,743
5	Technological Pedagogical Knowledge	3,85	0,757
6	Technological Content Knowledge	3,74	0,816
7	Technological Pedagogical Content Knowledge	3,76	0,774
Organizational Support			
13	Literacy Facilitation	3,86	0,893
14	Technical Support Provision	3,71	0,926
15	Involvement Facilitation	3,87	0,974
	Technostress		
8	Techno-Overload	3,46	1,064
9	Techno-Invasion	3,19	1,172
10	Techno-Complexity	3,26	1,039
11	Techno-Insecurity	3,12	1,194
12	Techno-Uncertainty	3,49	0,870
Performance			
16	Work Performance	3,91	0,797

Validity and Reliability Test

This study analyzes construct validity through three steps, including convergent validity, discriminant validity, and reliability tests (Hair et al., 2009). First, convergent validity was carried out by observing the loading factor value and dropping the item with a loading factor of <0.6 (Hair et al., 2009). With these criteria, this study excluded one item from the Techno-Insecurity dimension in the technostress construct, namely the TIsc3 item. Meanwhile, the other items used have met the requirements of convergent validity. The cross-loading table is presented in Appendix B.

Second, the discriminant validity test used the Fornell-Larcker criteria (Fornell & Larcker, 1981). The Fornell-Larcker measure is carried out by reviewing the root of the AVE value entered into the correlation matrix diagonally, and discriminant validity is approved if the correlation value between variables in the correlation matrix is smaller than the root of AVE above it (Fornell & Larcker, 1981; Hair et al., 2009). This situation indicates that each construct is not identical to the other constructs. The value of the root of AVE is observable in the table in Appendix C on the top of each correlation coefficient of each construct in the correlation matrix. Based on the data in the table (Appendix C), the root of AVE has a greater value than every coefficient of correlation that existed under it in the matrix. Therefore, the constructs in this study have met discriminant validity.

Finally, the reliability test was observed by two criteria, namely Cronbach's alpha, and composite reliability, with a critical value >0.8 for both indicators of the test tool (Hair et al., 2009). Based on the data shown in Appendix A, all constructs in this study have met the reliability criteria. Therefore, with the fulfillment of those three criteria, this research can be continued at the second-order factor analysis stage (Table 4).

Table 4. Second-order factor analysis

No.	Second-Order Factor	Loading Factor
Organizational Support		
1	Literacy Facilitation	0,882
2	Technical Support Provision	0,911
3	Involvement Facilitation	0,903
Technostress		
4	Techno-Overload	0,905
5	Techno-Invasion	0,839
6	Techno-Complexity	0,933
7	Techno-Insecurity	0,825
8	Techno Uncertainty	0,635
TPACK		
9	Pedagogical Knowledge	0,850
10	Content Knowledge	0,849
11	Technological Knowledge	0,810
12	Pedagogical Content Knowledge	0,886
13	Technological Pedagogical Knowledge	0,888
14	Technological Content Knowledge	0,912
15	Technological Pedagogical Content Knowledge	0,909

Second-Order Factor Analysis

Researchers used second-order factor analysis to analyze whether the dimensions of the TPACK construct, organizational support, and technostress were decisive in shaping the construct (Rindskopf & Rose, 1988). This study extracts the three variables into a large construct because of the parsimony principle. Researchers avoid using too many variables to measure the effect of complex variables. Therefore, researchers can only examine the primary constructs' effect by utilizing second-order factor analysis. In this case, the researcher uses Confirmatory Factor Analysis (CFA) because the dimensions and constructs used are constructs that have been developed by previous researchers so researchers only confirm the use of these constructs in the new research model (Hair et al., 2009; Rindskopf & Rose, 1988). Testing the coefficients on the construct-forming dimensions in second-order factor analysis can be treated as loading factors in ordinary factor analysis (Rindskopf & Rose, 1988). This study uses <0.6 as the critical value of the loading factor, and the test results can be observed in Table 4 (Hair et al., 2009). The second-order factor analysis test results show that the techno-uncertainty dimension is the weakest dimension with a loading factor of 0.635. Meanwhile, other dimensions of the overall construct have excellent numbers with a loading factor value of >0.8. Thus, all dimensions represent the primary constructs.

Hypothesis Testing and Discussion

The researcher tested the hypotheses using variance-based Structural Equational Modeling (SEM) or PLS-SEM (Partial Least Square-SEM). The use of PLS-SEM was chosen due to sample issues and model complexity. Researchers consider the sample to be relatively small, referring to the complexity of the model with many items to be analyzed. Therefore the PLS-SEM would be more appropriate for explaining the proposed structural model than the covariance-based SEM (Hair et al., 2019). In addition, PLS-SEM also has good statistical power even though it was carried out in confirmatory studies (Hair et al., 2009, 2019). Thus, the use of PLS-SEM is considered more suitable in this study. The coefficient significance indicator from this data analysis is t-stat >1.96 (Hair et al., 2009). The results of the structural model test are presented in Table 5.

Table 5. Hypothesis testing

H	Path	Coef	t-stat	p-value	Result
H1	Organizational Support → TPACK	0,588	15,106	0,000	Supported
H2	Organizational Support → Work Performance	0,457	7,926	0,000	Supported
H3	TPACK → Technostress	0,353	7,738	0,000	Supported
H4	Organizational Support → Technostress	0,219	3,126	0,002	Not-Supported
H5	TPACK → Technostress	0,234	3,560	0,000	Not-Supported
H6	Technostress → Work Performance	0,021	0,560	0,576	Not-Supported

Based on the results of the PLS-SEM test, the researchers found that organizational support had a positive and significant effect on TPACK (r = 0.588, t-stat = 15.106); thus, H1 is supported. This finding reinforces the technology investment framework proposed by the OECD (2000). In this framework, the OECD argues that technology investment cannot be carried out without being followed by investment in human resources and policies to support the growth of these human resources. This finding also confirms the views of Adarkwah (2021), Bao (2020), Christensen and Knezek (2017b), and Daniel (2020), which indicate that teachers need sufficient knowledge to be ready to implement online learning. In the same context, Effiyanti and Sagala (2018) recommend professional teacher training so that teachers have computer skills and can compromise with the challenges of this digital era. This study found evidence that organizational support is essential for helping teachers master new pedagogical skills. However, as stated by Cochrane (2010), a teacher's expertise in using IT does not necessarily indicate that they can use IT for specific purposes in teaching. Teachers need technical facilitation and a sense of engagement that helps them connect specific pedagogical needs with specific IT needs to deliver certain knowledge content (Figure 2). This finding corrects the research of Li and Wang (2021), which has not considered the aspect of knowledge as a variable that bridges the teacher's performance in teaching students through the use of IT.

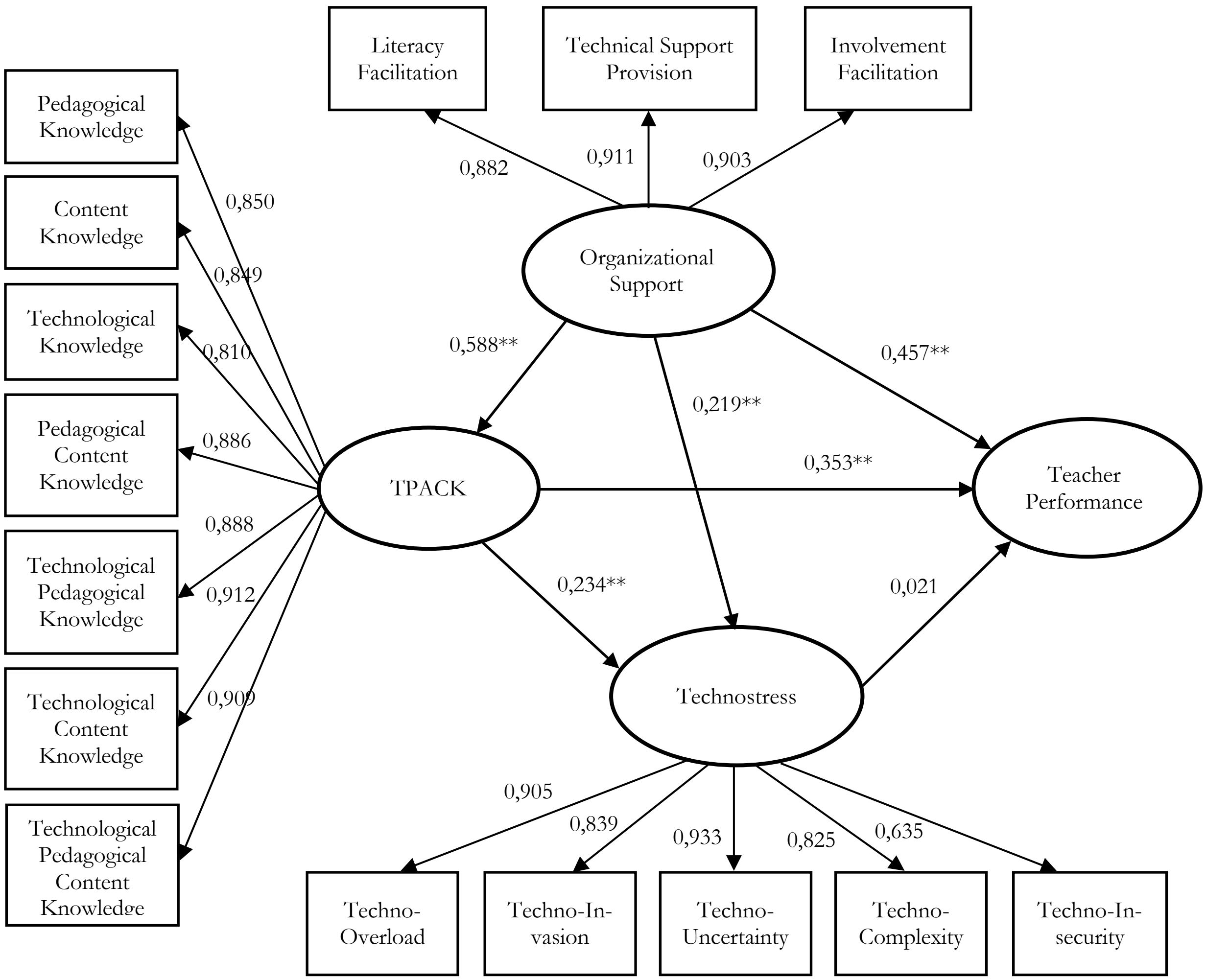

Figure 2. Result of structural model analysis

This study also found that organizational support and TPACK had a positive and significant effect on work performance (r = 0.457, t = 7.926; r = 0.353, t = 7.738). These findings support H2 and H3. According to endogenous theory, IT investment does not necessarily result in better individual or organizational performance (Sredojević et al., 2016). The findings of this study support this view by proposing two key variables, namely organizational support, and knowledge in producing teacher performance in IT-integrated learning or online learning. These two variables are very relevant to the indicators of IT investment success proposed in the endogenous theory framework (Sredojević et al., 2016) and the new economic framework (Grant, 1996; OECD, 2000; Rebelo, 1998). Specifically, in education, experts argue that TPACK is a key instrument for teachers to be ready and successful in implementing learning in this IT era (P. Mishra & Koehler, 2006; Niess, 2011; Schmidt et al., 2009). The results of this study provide empirical justification for this view with the TPACK value that positively and significantly affects teacher performance. With TPACK, teachers can master certain pedagogic needs so that students can engage in IT-mediated learning, which helps them master certain content of teaching materials (Koehler & Mishra, 2009; P. Mishra & Koehler, 2006). Referring to the results of other studies, this study complements the findings of Li and Wang (2021) and Ragu-Nathan et al. (2008) who previously found that these technostress inhibitors or in this study were reviewed as dimensions of organizational support affecting positive performance on IT-mediated jobs. Referring to the coefficient owned by each endogenous variable, it appears that the coefficient owned by organizational support is higher than TPACK itself. This finding indicates that organizational support is a key antecedent in producing optimal teacher performance in online learning, either by adding TPACK knowledge or directly to teacher performance.

Furthermore, this study found that organizational support and TPACK had a significant positive effect on technostress ($r = 0.219$, $t = 3.126$; $r = 0.234$, $t = 3.560$). Thus, H4 and H5 are not supported. This finding is unique because instead of reducing technostress, organizational support and TPACK increase technostress in teachers. This phenomenon may be explained by presenteeism on the use of IT in work (Ayyagari et al., 2011). In this case, Ayyagari et al. (2011) interpret presenteeism as the possibility of a person's accessibility to their work due to the use of IT. As has happened in online learning, especially during the COVID-19 pandemic, the use of IT or the full implementation of online learning is done to provide access to learning for students. Simultaneously, this access certainly opens equal access to teachers regarding their academic work. This access will provide an opportunity to exceed work time limits, discussion rooms, or other academic services that teachers provide through various possible devices, such as email, LMS, social media, mobile phones, and laptops (McGee, 1996). In addition, this data collection was carried out when there was a massive shift in educational and teaching practices due to the COVID-19 pandemic. Even though pre-service teachers had a lot of interaction with IT in their learning activity in the classroom, its use in a massive intensity and fully mediated by IT during the COVID-19 pandemic was something new for them. That new way of teaching and learning can put pressure on student teachers because they must prepare various learning tools and new media and have to learn new applications (Ayyagari et al., 2011; Daniel, 2020; Sagala et al., 2021). In new IT implementations and ongoing IT developments, the stress response is a reasonable response demonstrated by IT users (Arnetz, 1997; Ayyagari et al., 2011; Johansson, 1989; Korunka et al., 1995). Instead of reducing stress, organizational support opens a new understanding of how technology develops in education and the new complexities it will face. The teacher also realizes that the new knowledge demands are increasing and needed. In such circumstances, the teacher does not choose to avoid their work responsibilities. Therefore, the perceived stress is thought to increase because of unavoidable demands.

Finally, technostress was found to not affect teacher performance ($r = 0.021$, $t = 0.560$). This finding also shows the uniqueness of this study because technostress was found to have no impact on teacher performance. Referring to the research findings of Li and Wang (2021), some of the stressor variables tested did show inconsistencies; for example, techno-overload positively affected teacher performance, while techno-uncertainty did not affect teacher performance. Penado Abilleira et al. (2021) also found the influence of technostress dimensions partially on teacher performance. In the context of teachers unfamiliar with the use of IT in learning, technostress on lack of instruction and techno-inefficiency, which reduces teacher performance (Penado Abilleira et al., 2021). Meanwhile, for teachers who are accustomed to using IT in learning, it is found that IT misfits with needs that cause a decrease in performance (Penado Abilleira et al., 2021). Although, in research conducted in the business sector, technostress consistently has a negative impact on a person's performance (Ayyagari et al., 2011; Ragu-Nathan et al., 2008; Tarafdar et al., 2015). This uniqueness occurs presumably because of the teacher's working conditions and the teacher's unique characteristics. Teachers' working conditions during the COVID-19 pandemic have indeed placed IT integration as mandatory. Thus, even though teachers are under pressure when interacting with IT, it does not interfere with their optimal performance. On the other hand, the teacher's habit of using IT to prepare learning tools, teaching materials, and teaching media helped him compromise with full online learning, as Penado Abilleira et al. (2021) found. Thus, the technostress experienced by teachers due to changes in work patterns and the use of new IT is not enough to negatively affect their performance.

IMPLICATIONS

The results of this study have implications for managerial decision-making related to the management of teacher knowledge and expertise in implementing online learning. Educational institutions, schools, and universities should pay attention to providing teachers with access to new pedagogical knowledge, represented by mastery of TPACK. At the same time, schools or other educational institutions should ensure that teachers receive technical support, engagement, and literacy in various IT-mediated changes in learning practices. These two aspects can be implemented through teacher professional development programs, forming a technical assistance team, teacher assistance in the development of learning designs, teacher collaboration with the IT team, involving teachers in the development of applications and learning media, and various other strategic policies.

Furthermore, although technostress does not affect teacher performance, this phenomenon should still be controlled concerning mental health issues in the experience of technostress. Based on this study's results, technostress is challenging to manage as it exists by nature of the teacher's work environment. Additionally, the possibility of technostress experience is rising due to the continuous changing of IT that escalates the demands for learning innovations. Therefore, schools should have a compensation mechanism that targets social and financial aspects to control technostress among teachers. The accuracy of effective policies related to this issue certainly requires further research.

From the university's point of view, the current study's findings are helpful in refining the curricula of teacher training programs or teacher education programs and giving technical assistance to pre-service teachers. The teacher education and training program should update its curricula to construct TPACK as a standard in preservice teacher knowledge. The updated curricula may help the preservice teacher design more proper instruction for the online, blended, and hybrid teaching and learning environment. Furthermore, suppose those issues or materials have been discussed well in many courses and learning materials in the classroom, then pre-service teachers should gain more intense practical experience during internships. Practical experience should make teachers more agile in using their knowledge in dynamic circumstances. In the case of pre-service teachers doing practical experience in the internship program, universities should give technical or functional assistance in discussing their teaching problem, solving the problem with constructive discussion, and improving their performance. There are many activities that universities should do to assist the pre-service teachers' practical experience. First, is practical assistance regarding the content and pedagogical aspect. The pre-service teacher may obtain it from their supervisor lecturer. Second, is technical assistance regarding the technological aspect of teaching and learning activities. Technical assistance should be delivered by the supervisor lecturer, the school's LMS admin, and the university/faculty technical assistant according to the specific issue faced by the pre-service teacher. The point is that universities must take part in anticipating the massive impact of IT in teaching and learning activities by preparing preservice teachers with appropriate knowledge and skills.

CONCLUSION

This study found that (1) organizational support affects TPACK positively, (2) organizational support and TPACK affect teacher performance positively, (3) organizational support and TPACK affect technostress positively, and (4) Technostress does not affect teacher performance. Those findings are unique and bring insight into theoretical and practical aspects of IT disruption in the educational sector.

First, researchers found that organizational support and TPACK were valuable antecedents of teacher performance in an online environment, but simultaneously, technostress is not critical to threaten teacher performance. These findings show that teachers can maintain their job orientation and productivity even in the shock of shifting circumstances toward fully online learning. Teachers may believe they are responsible for running the instructional program to allow student learning even in uncertain conditions. Referring to Bandura's (1988) self-regulation, someone can accept the challenge and then set their strategy, goal, and action when they have self-regulation capability. However, technostress among teachers exists, and scholars still need to pay attention to that. Universities and schools should consider assuming that technostress impacts another side instead of teacher performance. Researchers argue that technostress will imply teachers' mental health if it is experienced constantly in the long term.

Second, technostress is uncontrollable by TPACK and organizational support. Practically, researchers argue it is an unavoidable circumstance. The educational system demands a rapid shift to fully online learning due to the COVID-19 pandemic. Therefore, it is mandatory for teachers to accept the challenge of maintaining the continuity of teaching and learning activities during pandemics. Therefore, researchers and policymakers should further analyze the precise impact of technostress among teachers. Understanding the negative impact of digital interaction during the productive task is crucial to determine appropriate strategies for maintaining a teacher's convenient work environment.

Third, theoretically, this study connects the concept of TPACK as knowledge to organizational support and technostress as the organizational and personal response to deal with massive IT integration in fully online learning during COVID-19 pandemics. This study bridges the educational conception of teacher competence to the behavioral framework of IS users to deal with the online environment. That approach is essential because teaching and learning is the task that engages human-to-human interaction, which is different from other productive activities like the business sector. This study explains how teachers respond to IT-integrated jobs in their academic activities. Current findings will give more wisdom to understand the threshold of IT usefulness in the educational field and the preference for managing it to maintain teachers' work quality. That uniqueness enriches the theoretical aspects of human-computer interaction and management information systems field.

Finally, this study recommends school leaders, policymakers, and stakeholders: (1) give attention to teachers' knowledge and provide organizational support to help them do their responsibility through excellent performance in an online environment – the dynamic of online learning results in the complex needs of instructional design, making teachers refine their design continuously; (2) develop a strategy to manage technostress among teachers from another aspect beyond TPACK and organizational support; and (3) develop a plan to compensate for teacher effort and sacrifices resulting from IT disruption in their working experience.

This study has a sample related to the teacher's field of study, which is limited to economics and business teachers. Further research can expand the sample variation to increase the generalizability of the research results. Analyzing the critical factors that effectively manage teachers' technostress is also worth doing. A qualitative research method may be helpful in exploring teachers' complex responses regarding IT-integrated tasks. Confirming and refining the framework usually developed in the private and educational sectors is crucial to generating more theoretical and empirical understanding.

REFERENCES

Accilar, A. (2011). Exploring the aspects of digital divide in a developing country. *Issues in Informing Science and Information Technology*, *8*, 231–244. https://doi.org/10.28945/1415

Adarkwah, M. A. (2021). "I'm not against online teaching, but what about us?" ICT in Ghana post COVID-19. *Education and Information Technologies*, *26*(2), 1665–1685. https://doi.org/10.1007/s10639-020-10331-z

Alawamleh, M., Al-Twait, L. M., & Al-Saht, G. R. (2020). The effect of online learning on communication between instructors and students during COVID-19 pandemic. *Asian Education and Development Studies*, *11*(2), 380–400. https://doi.org/10.1108/AEDS-06-2020-0131

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher Education Studies*, *10*(3), 16–25. https://doi.org/10.5539/hes.v10n3p16

Arnetz, B. B. (1997). Technological stress: Psychophysiological aspects of working with modern information technology. *Scandinavian Journal of Work, Environment & Health*, *23*, 97–103. http://www.jstor.org/stable/40966711

Ashton, R. H., & Kramer, S. S. (1980). Students as surrogates in behavioral accounting research: Some evidence. *Journal of Accounting Research*, *18*(1), 1–15. https://doi.org/10.2307/2490389

Ayyagari, R., Grover, V., & Purvis, R. (2011). Technostress: Technological antecedents and implications. *MIS Quarterly*, *35*(4), 831–858. https://doi.org/10.2307/41409963

Badia, A., Meneses, J., & Sigalés, C. (2013). Teachers' perceptions of factors affecting the educational use of ICT in technology-rich classrooms. *Electronic Journal of Research in Educational Psychology, 11*(3), 787–808. https://doi.org/10.14204/ejrep.31.13053

Bandura, A. (1988). Self-regulation of motivation and action through goal systems. In . Hamilton, G. H. Bower, & N. H. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 37–61). Springer. https://doi.org/10.1007/978-94-009-2792-6_2

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, *2*(2), 113–115. https://doi.org/10.1002/hbe2.191

Baran, B. E., Shanock, L. R., & Miller, L. R. (2012). Advancing organizational support theory into the twenty-first century world of work. *Journal of Business and Psychology*, *27*(2), 123–147. https://doi.org/10.1007/s10869-011-9236-3

Brod, C. (1984). *Technostress: The human cost of the computer revolution*. Addison-Wesley.

Burke, R. J. (1993). Organizational-level interventions to reduce occupational stressors. *Work & Stress*, *7*(1), 77–87. https://doi.org/10.1080/02678379308257051

Christensen, R., & Knezek, G. (2017a). Validating a mobile learning readiness survey: Assessing teachers' dispositions toward adoption. *Journal of Digital Learning in Teacher Education*, *33*(4), 148–159. https://doi.org/10.1080/21532974.2017.1347536

Christensen, R., & Knezek, G. (2017b). Readiness for integrating mobile learning in the classroom: Challenges, preferences and possibilities. *Computers in Human Behavior*, *76*, 112–121. https://doi.org/10.1016/j.chb.2017.07.014

Cochrane, T. D. (2010). Exploring mobile learning success factors. *Research in Learning Technology, 18*(2), 133–148. https://doi.org/10.1080/09687769.2010.494718

Cooper, D. R., Schindler, P. S., & Sun, J. (2006). *Business Research Method.* McGraw-Hill.

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating* (4th ed.). Pearson.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, *49*, 91–96. https://doi.org/10.1007/s11125-020-09464-3

Davis, A., & Gibson, L. (1994). Designing employee welfare provision. *Personnel Review*, *23*(7), 33–45. https://doi.org/10.1108/00483489410072208

Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: Exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, *30*(3), 452–465. https://doi.org/10.1007/s12528-018-9179-z

Effiyanti, T., & Sagala, G. H. (2018). Technostress among teachers: A confirmation of its stressors and antecedent. *International Journal of Education Economics and Development*, *9*(2), 134–148. https://doi.org/10.1504/IJEED.2018.092197

Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, *71*(3), 500–507. https://doi.org/10.1037/0021-9010.71.3.500

Ersanli, C. Y. (2016). Improving Technological Pedagogical Content Knowledge (TPACK) of pre-service English language teachers. *International Education Studies*, *9*(5), 18–27. https://doi.org/10.5539/ies.v9n5p18

Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research*, *20*(2), 303–315. https://doi.org/10.1086/209351

Fornell, C., & Larcker, D. F. (1981). *Structural equation models with unobservable variables and measurement error: Algebra and statistics*. Sage Publications. https://doi.org/10.2307/3150980

Fuglseth, A. M., & Sørebø, Ø. (2014). The effects of technostress within the context of employee use of ICT. *Computers in Human Behavior*, *40*, 161–170. https://doi.org/10.1016/j.chb.2014.07.040

Georgsen, M., & Zander, P.-O. (Eds.). (2013). *Changing education through ICT in developing countries*. Aalborg Universitetsforlag.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953–1960. https://doi.org/10.1016/j.compedu.2011.04.010

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(S2), 109–122. https://doi.org/10.1002/smj.4250171110

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Pearson Prentice Hall Publishing. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Jang, S.-J. (2010). Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers. *Computers & Education*, *55*(4), 1744–1751. https://doi.org/10.1016/j.compedu.2010.07.020

Jimmieson, N., & Terry, D. (1998). The role of informational control in the stress strain relationship. *Proceedings of the 13th Annual Conference of the Society for Industrial and Organizational Psychology, Dallas, Texas.*

Johansson, G. (1989). Stress, autonomy, and the maintenance of skill in supervisory control of automated systems. *Applied Psychology: An International Review*, *38*(1), 45–56. https://doi.org/10.1111/j.1464-0597.1989.tb01373.x

Kalolo, J. F. (2019). Digital revolution and its impact on education systems in developing countries. *Education and Information Technologies*, *24*(1), 345–358. https://doi.org/10.1007/s10639-018-9778-3

Karasek, R. A., Jr. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly*, *24*(2), 285–308. https://doi.org/10.2307/2392498

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)?. *Journal of Education*, *193*(3), 13-19. https://doi.org/10.1177/002205741319300303

Koh, J. H. L., Chai, C. S., Hong, H.-Y., & Tsai, C.-C. (2015). A survey to examine teachers' perceptions of design dispositions, lesson design practices, and their relationships with technological pedagogical content knowledge (TPACK). *Asia-Pacific Journal of Teacher Education*, *43*(5), 378–391. https://doi.org/10.1080/1359866X.2014.941280

Koh, J. H. L., Chai, C. S., & Lim, W. Y. (2017). Teacher professional development for TPACK-21CL: Effects on teacher ICT integration and student outcomes. *Journal of Educational Computing Research*, *55*(2), 172–196. https://doi.org/10.1177/0735633116656848

Korunka, C., Weiss, A., Huemer, K.-H., & Karetta, B. (1995). The effect of new technologies on job satisfaction and psychosomatic complaints. *Applied Psychology*, *44*(2), 123–142. https://doi.org/10.1111/j.1464-0597.1995.tb01070.x

Li, L., & Wang, X. (2021). Technostress inhibitors and creators and their impacts on university teachers' work performance in higher education. *Cognition, Technology & Work*, *23*(2), 315–330. https://doi.org/10.1007/s10111-020-00625-0

Lu, Y., & Ramamurthy, K. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, *35*(4), 931–954. https://doi.org/10.2307/41409967

Marchiori, D. M., Mainardes, E. W., & Rodrigues, R. G. (2019). Do individual characteristics influence the types of technostress reported by workers? *International Journal of Human--Computer Interaction*, *35*(3), 218–230. https://doi.org/10.1080/10447318.2018.1449713

McGee, M. K. (1996). Burnout. *Information Week*, *569*(4), 34–40.

Miah, M., & Omar, A. (2012). Technology advancement in developing countries during digital age. *International Journal*, *1*(1), 30–38.

Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open*, *1*, 100012. https://doi.org/10.1016/j.ijedro.2020.100012

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Moreira-Fontán, E., Garcia-Señorán, M., Conde-Rodriguez, Á., & González, A. (2019). Teachers' ICT-related self-efficacy, job resources, and positive emotions: Their structural relations with autonomous motivation and work engagement. *Computers & Education*, *134*, 63–77. https://doi.org/10.1016/j.compedu.2019.02.007

Naciri, A., Baba, M. A., Achbani, A., & Kharbach, A. (2020). Mobile learning in higher education: Unavoidable alternative during COVID-19. *Aquademia*, *4*(1), ep20016. https://doi.org/10.29333/aquademia/8227

Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research*, *44*(3), 299–317. https://doi.org/10.2190/EC.44.3.c

OECD. (2000). *A new economy: The changing role of information technology in growth*. https://www.oecd.org/sti/inno/aneweconomythechangingroleofinnovationandinformationtechnology-ingrowth.htm

Penado Abilleira, M., Rodicio-García, M. L., Ríos-de Deus, M. P., & Mosquera-González, M. J. (2021). Technostress in Spanish university teachers during the COVID-19 pandemic. *Frontiers in Psychology*, *12*, 496–506. https://doi.org/10.3389/fpsyg.2021.617650

Pohjola, M. (1998). Information technology and economic development: An introduction to the research issues. *World Institute for Development Economics Research, Working Papers No. 153*.

Pohjola, M. (2000). Information technology and economic growth: A cross-country analysis. *World Institute for Development Economics Research, Working Papers No. 173*. https://doi.org/10.1093/acprof:oso/9780199243983.003.0011

Ragu-Nathan, T. S., Tarafdar, M., Ragu-Nathan, B. S., & Tu, Q. (2008). The consequences of technostress for end users in organizations: Conceptual development and empirical validation. *Information Systems Research*, *19*(4), 417–433. https://doi.org/10.1287/isre.1070.0165

Rebelo, S. (1998). The role of knowledge and capital in economic growth. *World Institute for Development Economics Research, Working Papers No. 149*.

Rhoades, L., & Eisenberger, R. (2002). Perceived organizational support: a review of the literature. *Journal of Applied Psychology*, *87*(4), 698–714. https://doi.org/10.1037/0021-9010.87.4.698

Rindskopf, D., & Rose, T. (1988). Some theory and applications of confirmatory second-order factor analysis. *Multivariate Behavioral Research*, *23*(1), 51–67. https://doi.org/10.1207/s15327906mbr2301_3

Rolón, M. M. B. (2014). *A quantitative study to explore the relationship between technostress symptoms and technostress among Puerto Rican university students* [Doctoral dissertation, Capella University].

Sagala, G. H., Hasibuan, A. F., & Suharianto, J. (2021). Readiness to implement digital learning: An issue from Faculty of Economics, Universitas Negeri Medan. *Proceedings of the Sixth Padang International Conference on Economics Education, Economics, Business and Management, Accounting and Entrepreneurship* (pp. 331–338). Atlantis Press. https://doi.org/10.2991/aebmr.k.210616.050

Salanova, M., Llorens, S., & Cifre, E. (2013). The dark side of technologies: Technostress among users of information and communication technologies. *International Journal of Psychology*, *48*(3), 422–436. https://doi.org/10.1080/00207594.2012.680460

Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. *Computers & Education*, *157*, 103967. https://doi.org/10.1016/j.compedu.2020.103967

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544

Sekaran, U., & Bougie, D. (2021). *Research methods for business: A skill building approach* (7th ed.). John Wiley & Sons.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22. https://doi.org/10.17763/haer.57.1.j463w79r56455411

Sim, S. P.-L., Sim, H. P.-K., & Quah, C.-S. (2021). Online learning: A post COVID-19 alternative pedagogy for university students. *Asian Journal of University Education*, *16*(4), 137–155. https://doi.org/10.24191/ajue.v16i4.11963

Skaalvik, E. M., & Skaalvik, S. (2017). Still motivated to teach? A study of school context variables, stress and job satisfaction among teachers in senior high school. *Social Psychology of Education*, *20*(1), 15–37. https://doi.org/10.1007/s11218-016-9363-9

Sredojević, D., Cvetanović, S., & Bošković, G. (2016). Technological changes in economic growth theory: Neoclassical, endogenous, and evolutionary-institutional approach. *Economic Themes*, *54*(2), 177–194. https://doi.org/10.1515/ethemes-2016-0009

Sun, Y., Strobel, J., & Newby, T. J. (2017). The impact of student teaching experience on pre-service teachers' readiness for technology integration: A mixed methods study with growth curve modeling. *Educational Technology Research and Development*, *65*(3), 597–629. https://doi.org/10.1007/s11423-016-9486-x

Tarafdar, M., Pullins, E. B., & Ragu-Nathan, T. S. (2015). Technostress: Negative effect on performance and possible mitigations. *Information Systems Journal*, *25*(2), 103–132. https://doi.org/10.1111/isj.12042

Tarafdar, M., Tu, Q., & Ragu-Nathan, T. S. (2010). Impact of technostress on end-user satisfaction and performance. *Journal of Management Information Systems*, *27*(3), 303–334. https://doi.org/10.2753/MIS0742-1222270311

Tarafdar, M., Tu, Q., Ragu-Nathan, T. S., & Ragu-Nathan, B. S. (2011). Crossing to the dark side: Examining creators, outcomes, and inhibitors of technostress. *Communications of the ACM*, *54*(9), 113–120. https://doi.org/10.1145/1995376.1995403

Wang, K., & Shu, Q. (2008, September). The moderating impact of perceived organizational support on the relationship between technostress and role stress. *Proceedings of the 19th International Workshop on Database and Expert Systems Applications, Turin, Italy,* 420–424. https://doi.org/10.1109/DEXA.2008.67

Zeng, J., Liu, Y., Wang, R., & Zhan, P. (2019). Absorptive capacity and regional innovation in China: An analysis of patent applications, 2000–2015. *Applied Spatial Analysis and Policy*, *12*(4), 1031–1049. https://doi.org/10.1007/s12061-019-09300-y

Zhou, L., Wu, S., Zhou, M., & Li, F. (2020). "School's out, but class's on", the largest online education in the world today: Taking China's practical exploration during the COVID-19 epidemic prevention and control as an example. *Best Evidence in Chinese Education, 4*(2), 501-519. https://doi.org/10.15354/bece.20.ar023

APPENDIX A: ITEMS OF RESEARCH INSTRUMENT

QUESTIONNAIRE

The current instrument is a questionnaire on the use of information systems in learning. This questionnaire seeks to capture your perceptions regarding the experience of using information systems in your teaching assignments at school during the COVID-19 pandemic. Your willingness to fill out this questionnaire is not mandatory. In addition, this questionnaire is anonymous to maintain your independence in responding. Therefore, if you decide to participate in this survey, please fill out the following questionnaire according to your real perceptions and abilities regarding Information Technology (IT) and Information Systems (IS) integration in the teaching and learning activities you experience. Your honesty in giving responses will benefit the quality of this research data and the quality of decision-making in the future. We appreciate your willingness to be a respondent. Your participation has helped the development of knowledge and practice in education.

1. **Gender** : M/F
2. **Age** : a. 18 b. 19 c. 20 d. 21
3. **Department** : 1) Administration Education
   2) Accounting Education
   3) Business Education
   4) Economics Education

Technological Pedagogical Content Knowledge (TPACK)

Pedagogical Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
1.	PK1	I can adapt my teaching according to what students have and have not understood.
2.	PK2	I can adapt my teaching style to different students.
3.	PK3	I can use various learning models to manage the class.
4	PK4	I can assess student learning outcomes in various ways.
Content Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
5.	CK1	I have extensive knowledge in the field of science that I teach.
6.	CK2	I can give specific examples in the material I teach.
7.	CK3	I understand the basic theory and concepts of the material I teach.
8.	CK4	I understand the actual development of practice and theory in the field of science that I teach.
Technological Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
9.	TK1	I always keep up to date with new technology.
10.	TK2	I work and learn to use technology regularly.
11.	TK3	I know a lot of different technologies.
12.	TK4	I have technical skills in using technology.

Pedagogical Content Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
13.	PCK1	I know how to choose an effective teaching approach to guide students to think and learn in the subjects I teach.
14.	PCK2	I know how to develop assignments to stimulate students' critical thinking skills in the subjects I teach.
15.	PCK3	I know how to develop exercises that help students construct their knowledge of the subjects I teach.
16.	PCK4	I know how to evaluate student learning performance in the subjects I teach.
Technological Pedagogical Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
17.	TPK1	I can choose technologies that enhance my selected teaching approach.
18.	TPK2	I can choose technologies that help students to learn during the lesson.
19.	TPK3	I can adapt the use of technologies that I am learning about in different teaching and learning activities.
20.	TPK4	I think critically and carefully about how to use technology in my classroom.
Technological Content Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
21.	TCK1	I know why technological developments can change the context and content of my teaching materials.
22.	TCK2	I can explain what technologies are useful in research and content development in my area of expertise.
23.	TCK3	I know what new technologies are currently being developed related to my field of knowledge and expertise.
24.	TCK4	I know how to use technology to participate in research or knowledge development in my area of expertise.
Technological Pedagogical Content Knowledge Schmidt et al. (2009); Schmid et al. (2020)		
25.	TPCK1	I can combine the content, technology, and learning approaches that I got in class when I was in college.
26.	TPCK2	I can develop strategies that combine learning content, technology usage, and appropriate learning approaches to help my teaching activities.
27.	TPCK3	I can choose technologies that can improve the content accessibility of the subjects I teach.
28.	TPCK4	I can choose certain technologies to use in my classroom to improve the quality of what I teach, how I teach, and what students learn.
29.	TPCK5	I can teach with the right combination of subject matter, technology, and learning approach.

Organizational Support

Literacy Facilitation Marchiori et al. (2019); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
1.	LF1	Our school encourages knowledge sharing to help us use Information Technology effectively.
2.	LF2	Our school provides professional training to ensure we use Information Technology effectively.
3.	LF3	Our school creates a work team to increase the use of Information Technology.
4.	LF4	Our school provides clear documents to guide teachers in using Information Technology.
Technical Support Provision Marchiori et al. (2019); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
5.	TSP1	The IT admin at our school works well in answering problems using Information Technology.
6.	TSP2	The IT admin in our school is a good worker and has good Information Technology knowledge.
7.	TSP3	The IT admin at our school is easy to meet.
8.	TSP4	The IT admin at our school is always ready and responsive in helping us.
Involvement Facilitation Marchiori et al. (2019); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
9.	IF1	We are given an appreciation if we use information systems and technology in doing assignments, presentations, or teaching practices.
10.	IF2	We always consult before using a new app.
11.	IF3	We are involved in improving applications or information systems on campus.
12.	IF4	We are involved in improving the way of information systems usage.
13.	IF5	We are always encouraged to use new applications or information systems to improve our teaching

Technostress

Techno-overload Li & Wang (2021); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
1.	TO1	Due to information technology, I have to do more tasks until it is not handled correctly.
2.	TO2	Due to information technology, I have to work with strict time limits.
3.	TO3	I have to change my work habits due to the use of information technology to improve the quality of teaching.
4.	TO4	I have more workloads because of the complexity of using information technology in teaching activities.

5.	TO5	I have little free time due to the use of information technology.
6.	TO6	Due to information technology, I even have to interact with my work on vacation.
7.	TO7	I have to work faster due to the use of information technology.
Techno-invasion Li & Wang (2021); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
8.	TIV1	I feel that I have to sacrifice my vacation time and weekends due to constantly interacting with information technology devices.
9.	TIV2	I feel that my personal life has been disturbed because of the use of information technology devices.
Techno-complexity Li & Wang (2021); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
10.	TC1	I often feel that the information technology tools used in teaching are too complex and difficult to understand.
11.	TC2	I often feel that the information technology tools used in teaching are too complex to be used effectively.
12.	TC3	Because of their complexity, I doubt that information technology tools can be of practical use in teaching practice.
13.	TC4	I do not have sufficient knowledge of information technology in terms of improving my performance in teaching.
14.	TC5	I have to sacrifice a lot of time and energy to learn the use of information technology in teaching activities.
Techno-Insecurity Li & Wang (2021); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
15.	TIS1	The use of information technology interrupts my work patterns.
16.	TIS2	I feel that my field of work is increasingly threatened due to the continuous development of information technology.
17.	TIS3	I have to continuously update my capabilities and expertise so that I will not be replaced by information technology one day or colleagues who have more information technology skills.
18.	TIS4	I feel threatened by other colleagues who are more tech-savvy.
19.	TIS5	I don’t want to share my expertise using information technology with my colleagues because I’m worried he will be replaced me one day.
Techno-Uncertainty Li & Wang (2021); Fuglseth and Sørebø (2014); Ragu-Nathan et al. (2008); Tarafdar et al. (2010)		
20.	TU1	There is a continuous improvement in information technology to increase its use in teaching and learning.
21.	TU2	There is a dynamic change to improve the application function of IS in education and teaching.
22.	TU3	Where I work, the school replaces ICT equipment regularly.

Work Performance

Work Performance Tarafdar et al. (2010)		
1.	WP1	The use of information technology in teaching and learning activities increases my productivity.
2.	WP2	The use of information technology in teaching and learning activities allows me to work anywhere.
3.	WP3	The use of information technology in teaching and learning activities allows me to do more things than usual.
4.	WP4	The use of information technology in teaching and learning activities allows me to try new ways of teaching.

APPENDIX B. CROSS-LOADING FACTOR (CONVERGENT VALIDITY)

Items	CK	IF	LF	PCK	PK	TSP	TCx	TU	TIsc	TI	TO	TCK	TK	TPCK	TPK	WP
CK1	0,881															
CK2	0,898															
CK3	0,854															
CK4	0,884															
IF1		0,822														
IF2		0,819														
IF3		0,852														
IF4		0,889														
IF5		0,785														
LF1			0,817													
LF2			0,864													
LF3			0,896													
LF4			0,887													
PCK1				0,838												
PCK2				0,903												
PCK3				0,899												
PCK4				0,875												
PK1					0,806											
PK2					0,787											
PK3					0,847											
PK4					0,852											
TCK1												0,833				
TCK2												0,885				
TCK3												0,894				
TCK4												0,879				
TCx1							0,869									
TCx2							0,855									
TCx3							0,867									
TCx4							0,810									
TCx5							0,841									
TI1										0,929						
TI2										0,931						

Items	CK	IF	LF	PCK	PK	TSP	TCx	TU	TIsc	TI	TO	TCK	TK	TPCK	TPK	WP
TIsc1									0,887							
TIsc2									0,877							
TIsc4									0,721							
TIsc5									0,794							
TK1													0,726			
TK2													0,899			
TK3													0,899			
TK4													0,881			
TO1											0,793					
TO2											0,813					
TO3											0,724					
TO4											0,834					
TO5											0,791					
TO6											0,759					
TO7											0,736					
TPCK1														0,856		
TPCK2														0,883		
TPCK3														0,874		
TPCK4														0,864		
TPCK5														0,848		
TPK1															0,887	
TPK2															0,899	
TPK3															0,877	
TPK4															0,819	
TSP1						0,869										
TSP2						0,870										
TSP3						0,878										
TSP4						0,889										
TU1								0,894								
TU2								0,898								
TU3								0,840								
WP1																0,895
WP2																0,911
WP3																0,881
WP4																0,900

Appendix C. Discriminant Validity and Reliability

No.	Constructs	α	CR	AVE	CK	IF	LF	PCK	PK	TSP	TCx	TU	TIsc	TI	TO	TCK	TK	TPCK	TPK	WP
1	CK	0,902	0,932	0,773	0,879															
2	IF	0,890	0,919	0,696	0,496	0,834														
3	LF	0,889	0,923	0,751	0,428	0,672	0,867													
4	PCK	0,901	0,931	0,772	0,733	0,461	0,429	0,879												
5	PK	0,842	0,894	0,678	0,762	0,475	0,472	0,731	0,824											
6	TSP	0,900	0,930	0,769	0,408	0,730	0,736	0,437	0,453	0,877										
7	TCx	0,903	0,928	0,720	0,213	0,293	0,244	0,223	0,208	0,172	0,849									
8	TU	0,850	0,909	0,770	0,442	0,532	0,375	0,400	0,428	0,449	0,492	0,878								
9	TIsc	0,839	0,892	0,676	0,142	0,249	0,213	0,126	0,122	0,124	0,789	0,405	0,822							
10	TI	0,844	0,928	0,865	0,184	0,171	0,147	0,163	0,147	0,085	0,782	0,384	0,666	0,930						
11	TO	0,892	0,915	0,608	0,317	0,360	0,327	0,336	0,318	0,274	0,767	0,530	0,607	0,725	0,780					
12	TCK	0,896	0,927	0,762	0,672	0,518	0,486	0,780	0,701	0,495	0,241	0,431	0,178	0,213	0,388	0,873				
13	TK	0,873	0,915	0,730	0,640	0,434	0,470	0,612	0,658	0,455	0,183	0,446	0,176	0,161	0,324	0,730	0,854			
14	TPCK	0,916	0,937	0,748	0,720	0,534	0,425	0,770	0,727	0,447	0,254	0,501	0,150	0,217	0,382	0,838	0,658	0,865		
15	TPK	0,894	0,926	0,759	0,676	0,460	0,442	0,771	0,657	0,443	0,191	0,425	0,125	0,165	0,362	0,827	0,705	0,772	0,871	
16	WP	0,919	0,943	0,804	0,537	0,649	0,542	0,562	0,498	0,610	0,179	0,531	0,138	0,141	0,349	0,567	0,522	0,552	0,603	0,897

Note (*both for Appendix A and Appendix B*):
PK : Pedagogical Knowledge
CK : Content Knowledge
TK : Technological Knowledge
PCK : Pedagogical Content Knowledge
TPK : Technological Pedagogical Knowledge
TCK : Technological Content Knowledge
TPCK : Technological Pedagogical Content Knowledge
LF : Literacy Facilitation
TSP : Technical Support Provision
IF : Involvement Facilitation
TO : Techno-Overload
TI : Techno-Invasion
TCx : Techno-Complexity
TIsc : Techno-Insecurity
TU : Techno-Uncertainty

AUTHORS

Indra Maipita Indra Maipita is a professor of economics at the Faculty of Economics, Universitas Negeri Medan, Indonesia. He is an expert in regional economics, poverty, and economics education with extensive interdisciplinary knowledge. He has a load of experience in developing IT infrastructure in higher education. His research area is poverty, economics education, organizational behavior, and digital interaction toward institutional economic growth.

Faisal Rahman Dongoran is an associate professor at the department of accounting education, Faculty of Teacher Training and Educational Science, Universitas Muhammadiyah Sumatera Utara, Indonesia. He is an expert in professional teacher training and was head of the teacher professional training program from 2018 to 2022 at the University. His research area is teacher education, educational management, and teaching and learning in higher education.

Dedy Husrizal Syah is a lecturer at the Department of Digital Business, Faculty of Economics, Universitas Negeri Medan, Indonesia. Currently, He is a Ph.D. candidate at the Doctoral School of Accounting, Universitas Sumatera Utara, Indonesia. His research interest includes accounting information systems and business information systems.

Gaffar Hafiz Sagala is a member of the Department of Digital Business, Faculty of Economics, Universitas Negeri Medan, Indonesia. Currently, he is a Ph.D. student in Business and Informatics at the Corvinus University of Budapest, Hungary. His research interest includes information systems, human-computer interaction, enterprises digital transformation, behavioral accounting, accounting education, and business ethics.