Technostress in Medical Students During Pandemic-Prompted Distance Education: Adaptation of Technostress Scale Based on Person-Environment Misfit Theory

Alirıza Erdoğan, MD., Assist. Prof. [1]
Mustafa Öztürk, Ph. D., Assoc. Prof. [2]
Pınar Erdoğan, MD., Assist. Prof. [3]
Ramazan Kürşad Zor, MD., Assist. Prof. [4]
Selim Çınaroğlu, Ph. D., Assist. Prof. [5]
Kenan Öztorun, MD., Assist. Prof.[6]
Üner Kayabaş, MD., Prof.[7]

[1] General Surgery. Niğde Ömer Halisdemir University, Medical Faculty, General Surgery Department. Niğde Ömer Halisdemir University Research and Training Hospital, Aşağı Kayabaşı mah. Hastaneler cad. 51100 Merkez, Niğde- Turkey.
ORCID ID: (https://orcid.org/0000-0002-8931-0907)

[2] Curriculum & Instruction, EFL Instructor, Hacettepe University School of Foreign Languages Beytepe Campus 06800 Çankaya, Ankara – Turkey
ORCID ID: (https://orcid.org/0000-0001-7845-6882)

[3] Obstetrics and Gynecology. Niğde Ömer Halisdemir University Zübeyde Hanım School of Health, Midwifery Department, Atatürk Bulvarı, Derbent Campus Merkez/ Niğde- Turkey
ORCID ID: (https://orcid.org/0000-0002-8435-795X)

[4] Ophthalmology. Niğde Ömer Halisdemir University, Medical Faculty, Ophthalmology Department. Niğde Ömer Halisdemir University Research and Training Hospital, Aşağı Kayabaşı mah. Hastaneler cad. 51100 Merkez, Niğde- Turkey
ORCID ID: (https://orcid.org/0000-0002-3233-7906)

[5] Anatomy. Niğde Ömer Halisdemir University, Medical Faculty, Anatomy Department. Niğde Ömer Halisdemir University Central Campus, Bor yolu üzeri, 51240 Merkez, Niğde- Turkey
ORCID ID: (https://orcid.org/0000-0002-4495-6106)

[6] Urology. Niğde Ömer Halisdemir University, Medical Faculty, Urology Department. Niğde Ömer Halisdemir University Research and Training Hospital, Aşağı Kayabaşı mah. Hastaneler cad. 51100 Merkez, Niğde- Turkey
ORCID ID: (https://orcid.org/0000-0001-9994-3479)

[7] Clinic Microbiology and Infectious Diseases. Niğde Ömer Halisdemir University, Medical Faculty, Clinic Microbiology and Infectious Diseases Department. Niğde Ömer Halisdemir University Research and Training Hospital, Aşağı Kayabaşı mah. Hastaneler cad. 51100 Merkez, Niğde- Turkey
ORCID ID: (https://orcid.org/0000-0002-5323-0796)

Declaration of Interest: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions:
Alirıza Erdoğan: Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing- Original draft preparation, Writing- Reviewing and Editing.
Mustafa Öztürk: Conceptualization, Methodology, Validation, Resources, Data curation, Writing- Original draft preparation, Writing- Reviewing and Editing.
Pınar Erdoğan: Conceptualization, Methodology, Validation, Data curation, Writing- Original draft preparation, Writing- Reviewing and Editing, Supervision.
Ramazan Kürşad Zor: Conceptualization, Methodology, Investigation, Resources, Data curation, Writing- Reviewing and Editing.
Selim Çınaroğlu: Conceptualization, Validation, Investigation, Resources, Data curation, Writing- Reviewing and Editing.

Kenan Öztorun: Conceptualization, Validation, Investigation, Resources, Data curation, Writing- Reviewing and Editing.
Üner Kayabaş: Conceptualization, Methodology, Validation, Resources, Data curation, Writing- Original draft preparation, Supervision.
All the authors contributed to the critical review of the manuscript and agreed on the final layout for submission.

Ethics:
Approval for the study was granted by Niğde Ömer Halisdemir University Ethics Committee (11.02.2021; 2021/26). The permission to adopt the survey was granted form Prof. Dr. Wang via 02.01.2021 dated e-mail.

Data Availability Statement:
The data that support the findings of this study are openly available in figshare.com at https://doi.org/10.6084/m9.figshare.16635118.v1.

ABSTRACT
This paper investigates the phenomenon of technostress in medical students and its predictors during pandemic-prompted distance education. From a sample of 259 students in a school of medicine at a public university in Turkey, the data were collected using convenience sampling through an online questionnaire based on person-environment misfit theory and were analyzed by means of descriptive and inferential statistics. Descriptively, the participant students reported experiencing relatively mild level of technostress. As a result of the multiple regression analysis, regular attendance and participation, adequate learning environment, perceived negativity of distance education, perceived need for psychological support, and year at medical school were all found to be significant predictors of technostress in medical students. This is the first study evaluating technostress on medical students. Students who do not attend classes regularly, do not have an adequate learning environment, have higher degree of perceived negativity of distance education, have need for psychological support and are at higher grade levels experience more technostress. Finally, according to the person-environment misfit theory the major component of technostress in medical students originated from the tool-related component. Although the level of technostress was relatively low, technological tools generate pressure even on the digital native generation.
Keywords: technostress, medical education, distance education, technology-enhanced learning, Person-environment misfit theory

INTRODUCTION

As the whole world has undergone a kind of 'reset' driven by the imperatives of the current global pandemic, there has been almost no single area where technology has not reached or been used. While digital technologies have become a part of our lives more than ever before, they have also brought or forced structural changes in education systems, as well. Having dominated the last two years, the Covid-19 crisis has been very effective in accelerating this transformation. Closing schools has been one of the primary measures taken by almost all countries around the world, which has influenced the learning process of millions of students from pre-school to higher education. With the closure of educational institutions and the interruption of face-to-face education, 1.6 billion students, which means approximately half of the student population from all levels of education, have been influenced negatively (UN, 2020). Educational conditions created by the pandemic have revealed the necessity of digital transformation to be applied to the entire system of education, in particular higher education. With the need to reduce human interaction to prevent the spread of the pandemic, digital connections have increased, and a lot of educational processes have largely moved to online environments. As in all educational contexts, medical education has also been transformed by the pandemic. Considering the transformational effects of the pandemic-prompted conditions on medical schools as well as challenges, limitations and emerging concerns placed upon by distance education, this paper investigates the phenomenon of technostress and its predictors in a sample of medical students.

Technology-enhanced learning (TEL) is comprised of any form of learning that is catalyzed via the integration of information and computer technology (ICT) in educational practices (Wang et al., 2020). Investments concerning TEL are increasingly demanded by many universities worldwide as transformation of conventional learning, especially in higher education, becomes inevitable (Dunn & Kennedy, 2019). Postmodernism and the digital era accelerated the course of time tremendously, thus Industry Revolution 4.0 along with Internet of Things enabled various robotic devices and artificial intelligence integrated technologies as parts of everyday life (Romli et al., 2020). Consequently, a digital native generation has grown up in close contact with technology, not only in their social life but also in all educational settings including higher education. Therefore, these circumstances ineluctably lead to the evolution of conventional learning characterized by traditional face-to-face lessons, rote learning, compulsory attendance and manual practice methods into technology-enhanced, dynamic, and interactive

learning forms that ease the activity of learning (Bond et al., 2019). By all odds, TEL provides flexibility, convenience and the opportunity to high quality resources for students (Wang et al., 2020). Meanwhile, these modalities might give rise to some degree of technostress in students. This is mainly because individual needs and personal expectations require more effort and consume more time. Additionally varying skills in dealing with time management and personal abilities in accession, validation and internalization of information put pressure on vulnerable individuals, which might be expressed as technostress (Qi, 2019).

The American Psychological Association defines technostress as a form of occupational stress that is associated with information and communication technologies such as the Internet, mobile devices, and social media (https://dictionary.apa.org/technostress). In previous studies, technostress was studied in employees in different job sectors and both creators and inhibitors of technostress were defined accordingly (Ahmad et al., 2012; Ragu-Nathan et al., 2008). Ahmed et al., examined technostress in a sample of academic librarians and Tarafdar et al., investigated employees in different public-sector organizations (Ahmad et al., 2012; Ragu-Nathan et al., 2008). Repeated research on various populations identified and validated 5 technostress generators which can be sorted as techno-overload, techno-invasion, techno-complexity, techno-insecurity and techno-uncertainty (Ahmad et al., 2012; Hassan et al., 2019; Ragu-Nathan et al., 2008). Techno-overload is referred to the extra workload and necessity for working faster, harder and longer (Tarafdar et al., 2011). Techno-invasion is referred to the invasion of personal life by demands of technology and technology itself (Qi, 2019). The perception of 'being continuously on-line' results in feeling of imprisonment with fiber chains of technology as well as a sensation of interference in personal grounds. Techno-complexity is referred to the feeling of inadequacy while dealing with various forms of technological equipment. More time and effort is required to deal with complex and sophisticated digital systems, and in this way individuals get stressed or even exhausted while trying to understand, learn and execute high technology programs or devices (Peiris-John et al., 2020). Techno-insecurity refers to the fear of losing one's job to ICT-related devices, programs or someone better in technology manipulation (Ahmad et al., 2012). Techno-uncertainty is described as the lack of confidence toward the perpetual evolution of technology (Ragu-Nathan et al., 2008). Individuals with technostress related to techno-uncertainty hardly catch up with continuous changes, upgrades, and extremely short half-life time of ICT systems.

The determination of technostress creators in various populations and in different context has assisted researchers in understanding the dimensions and different aspects of ICT effects on employees.(Fuglseth & Sørebø, 2014; Hwang & Cha, 2018; Jena, 2015; Lee et al., 2016; Ragu-Nathan et al., 2008; Tarafdar et al., 2011).

Although technostress and adverse effects of technostress are both recognized, studies on this issue, especially in higher education is insufficient (Al-Fudail & Mellar, 2008; Jena, 2015; Joo et al., 2016). The identification of the students with phrases such as 'net generation' or 'digital native', resulted in an assumption that the preferences of the students in development and adaptation of TEL modalities consisted solely of 'more technology demand' (Echenique, 2014; Yu & Suny, 2020). Accordingly, the presumption that these students are techy and free of technostress evoked the neglect of the psychological reaction and adaptation of the students who play a key role in the success of TEL (Qi, 2019).

Technostress is a component of overall stress which inextricably hinder the academic performance of students (Penado Abilleira et al., 2020). Although there are dimensions overlapping with technostress creators described in employees, different causal factors should be researched in students. The identification of technostress creators is essential because it will assist students suffering from technostress and therefore enhance their academic performance. Furthermore, it will provide educators guidance with how to effectively deal with technostress(Upadhyaya & Vrinda, 2021). It is also important to consider individual differences in levels of technostress and types of technostress creators experienced in students(Krishnan, 2017). For instance, age, gender, year and level of experience were studied to some extent (Barrick & Mount, 1991; Bono & Judge, 2004; Krishnan, 2017; Wilkins & Ouchi, 1983). Demographic factors are superficial in nature, rather personality and adopted cultural beliefs would exert deeper effects on overall performance, behavior and academic achievement (Krishnan, 2017). It was postulated that individuals might have positive or negative consequences of the same independent factor depending on the individual character properties and cultural adaptation (Krishnan, 2017). The situation is similar in stress. Low level of stress provokes and enhances learning as well as achievement of both practical and theoretical grounds whereas high level of stress downregulates learning abilities and demonstration of previously acquired skills (Krishnan, 2017; Qi, 2019).

Person-environment (P-E) misfit theory was proposed as the basis of research on technostress that is assumed as a psychological answer to the inconsistency between the environment and the individual (Al-Fudail & Mellar, 2008). P-E misfit theory argues that all types of stress, including technostress, demonstrates complex features and hence is not originated from the individual or the environment only, rather from the interactions of both (Chuang et al.,

2016). Furthermore, environmental factor is multidimensional and affected by the organization of the individual, the culture of the organization, terms of task description and others surrounding the individual (Edwards & Billsberry, 2010). P-E misfit theory-based technostress scale was developed by Wang et al., and aimed to evaluate the dimensions involving person-organization (P-O), person-TEL (P-TEL), person-other people's (P-P) interactions. Furthermore, exhaustion of the students, continuity on TEL, and individual performance perceptions were other items evaluated in the scale (Wang et al., 2020).

The integration of TEL into medical and nursing education is grounded on the same rationale and is realized in a similar manner (Hampton et al., 2020). Particularly in medical education, as integration, transformation and evaluation process of TEL was prosecuted globally, Covid-19 pandemic compelled a premature and absolute transition which, for sure, has had a wide variety of psychological, sociological, individual, and communal effects other than urging learning and teaching to be maintained through distance education. The concept of 'distance' at this juncture emphasizes not only the physical one, but also the interactional and the psychological distance (Bozkurt, 2020). In this context, such a type of distance eliminates all the dialectical elements and networks of human communication and interaction, and the learning naturally resulting from interactive or communicative flow of information in face-to-face education turns into a centralized and digitalized exertion of information in a technology-enhanced distance education. This transformation largely influences the emotional and psychological state of the learners by placing new or emerging challenges, limitations and concerns driven by technology. Therefore, this study aimed to identify specify the predictors of medical students' technostress during distance education prompted by Covid-19 lockdowns and to understand how their technostress level changed as a result of particular variables.

THE STUDY

This study was designed and performed as a prospective cross-sectional web-based survey study and was reported according to Consensus-Based Checklist for Reporting of Survey Studies (CROSS) guidelines for both web- and non-web-based surveys (Sharma et al., 2021). All the procedures in this study were in compliance with the institutional and national research committee ethical standards and the 1964 Helsinki Declaration and its later amendments. Approval for the study was granted by XXXXXXX University Ethics Committee (11.02.2021; 2021/26). The permission to adopt the survey was granted form XXXX via 02.01.2021 dated e-mail.

Designed as a survey, the study is principally a correlational study exploring the relationship between certain variables and technostress. To this end, the following research question was formed to answer:

- How well do the variables including (1) regular attendance and participation, (2) adequate learning environment, (3) perceived negativity of distance education, (4) perceived need for psychological support, and (5) grade level predict medical students' technostress?

Based on the research question, there main hypotheses were constructed to test:

- H0: None of the variables included in the model predicts medical students' technostress.
- H1: At least one of the variables included in the model predicts medical students' technostress.
- H2: All the variables included in the model predict medical students' technostress.

Using convenience sampling, 259 medical students from the Faculty of Medicine at XXXXXX University, Turkey were included in the study as the participants. Ranging from 18 to 29, the average age of the participants was twenty (M=20.3). Table 1 presents the background information about the participants. Accordingly, 57% of the participants were female while the rest (43%) were male. Since the current program started to accept students four years ago, only the students from 1st to 4th grades were represented in the study (34% 1st graders, 32% 2nd graders, 19% 3rd graders, and 14% 4th graders). Almost half (48%) of the participants were the graduates of Anatolian High Schools, which was followed by Science High Schools (39%) and other types of high schools (13%). A great majority of the participants were living in the city (60%), while the rest were living either in a district (31%) or a small town/village (9%).

Table 1. Participant Students' Background Information

Background factors	Groups	*N*	*%*
Gender	Female	148	57
	Male	111	43
Grade Level	1st	88	34
	2nd	85	32
	3rd	49	19
	4th	36	14
Type of High School	Anatolian High School	124	48

	Science High School	101	39
	Other Types of High Schools	34	13
Place of Living	City	156	60
	District	80	31
	Small Town/Village	23	9

The data were collected through an online questionnaire which was adapted from Wang et al., (2020) (Wang et al., 2020). After taking the necessary permissions from the scale developers, the instrument was translated into Turkish and the translated version was peer-examined by two language experts who are proficient in both Turkish and English. As a further step, a back-translation procedure was carried out to make sure that there were minimal differences between the English and the Turkish versions of the scale. The data collection instrument used in the current study included three main sections. In the first section, demographic information about the participants was inquired through items on gender, age, grade level, type of high school graduated from, and place of living. Not all of them were used as variables in the analyses, though. The second section comprised of 10 items to cover possible internal or external independent variables that were assumed to be significant predictors of the participants' technostress level. These items were grouped into four dimensions as the predictor variables: regular attendance and participation (RAP), adequate learning environment (ALE), perceived negativity of distance education (NDE), and perceived need for psychological support (NPS). The dimensions of RAP, ALE, and NDE were measured in a scale from 1 to 5 through three items in each, and all three sets formed a reliable scale, .70, .69, and .77 respectively (Table 2).

Table 2. Reliability Analyses of the Dimensions as Predictor Variables

Predictor Variables	Cronbach's Alpha	Number of Items
Regular Attendance and Participation (RAP)	.703	3
Adequate Learning Environment (ALE)	.691	3
Perceived Negativity of Distance Education (NDE)	.767	3
Perceived Need for Psychological Support (NPS)	-	1

The NPS dimension was measured with only one item asking about how often the participant students feel the need for psychological support during distance education. The third section, as the main body of the instrument, consisted of 30 items aiming to measure the participant students' technostress level. The *Cronbach* alpha for the 30 items was calculated as .97, which was considered to have a high level of internal consistency (Table 3).

Table 3. Reliability Analyses of the Dimensions as Outcome Variables

Outcome Variables	Current Study		Wang et al. (2020)	
	Cronbach's Alpha	Number of Items	Cronbach's Alpha	Number of Items
1. Institution-related Technostress	.913	9	.95	9
2. Tool-related Technostress	.941	9	.94	9
3. Human-related Technostress	.936	12	.85	4
3.1. Peer-related	.873	4	.85	4
3.2. Family-related	.899	4	-	-
3.3. Instructor-related	.882	4	-	-
Overall Scale	.970	30	.93	22

The first 22 of the items were taken from the original scale and used as suggested by Wang et al., (2020). Two additional sets of items (8 items in total) were added to the scale with two new sub-dimensions under the human aspect of the original scale. In the original scale, the human aspect was measured through 4 items focusing only on 'peers.' In the Turkish version of the scale, the human aspect was measured through 12 items focusing on 'parent's/family members' and 'instructors' in addition to 'peers.' While forming the wording of the additional items on 'parent's/family members' and 'instructors,' the same patterns of statements were used as in the items on 'peers.' In this line, the dependent (outcome) variable, the medical students' technostress, was measured in a rating scale from 1 (*never*) to 5 (*always*) through 30 items representing three dimensions: (a) institution-related, (b) tool-related, and (c) human-related technostress. The *Cronbach* alpha for each dimension was calculated as .91, .94, and .93, respectively (Table 3).

Within the third dimension (human aspect), three sub-dimensions were included in the study as peers, parent's/family members, and instructors. The rationale behind this step was based on the observations of the researchers during distance education. The students were in need of support, not only from their peers but also

from other people around. Especially during the pandemic, the role of family and instructors in motivating, encouraging, and supporting the students was undeniable. Therefore, adding two new sub-dimensions into the human-related technostress was considered to be critical. The Cronbach alpha values of the three sub-dimensions were .87, .89, and .88, respectively (Table 3).

In order to answer the research question, a multiple regression analysis was run to predict the participant students' technostress level by means the software *IBM SPSS 23*. Based on the design, five independent (predictor) variables were included in the model: regular attendance and participation, adequate learning environment, perceived negativity of distance education, perceived need for psychological support, and grade level. On the other hand, technostress was the dependent (outcome) variable to be predicted from a combination of those five variables. The simultaneous regression (the *SPSS Enter*) method was employed to consider all the variables at the same time. Before interpreting the regression model, the necessary assumptions were checked to ensure that the analysis was independent of possible violations. Considering the *Correlation Matrix* depicted in Table 4, there were no higher intercorrelations than .43 among the predictor variables and all the values were below .60, which ensured that the multicollinearity assumption was not violated.

Table 4. Correlations Matrix of Predictor Variables

Predictor Variables	2. ALE	3. NDE	4. NPS	5. GL
1. regular attendance and participation (RAP)	-.292	.252	-.182	-.031
2. adequate learning environment (ALE)		-.263	.316	.204
3. perceived negativity of distance education (NDE)			-.430	-.108
4. perceived need for psychological support (NPS)				.101
5. grade level (GL)				

Furthermore, other collinearity statistics such as Tolerance and VIF were checked and none of the values regarding any variable indicated a problematic case for multicollinearity. The relationship between each of the predictor variables and the dependent variable was linear and the errors, the residual, were normally distributed and uncorrelated with the predictors. As observed, all the independent variables were significantly correlated with the dependent variable (Table 5).

Table 5. Pearson Correlations between the Predictor Variables and the Outcome Variable

Predictor Variables	technostress
1. regular attendance and participation (RAP)	-.342*
2. adequate learning environment (ALE)	-.440*
3. perceived negativity of distance education (NDE)	.567*
4. perceived need for psychological support (NPS)	.489*
5. grade level (GL)	.245*

*Correlation is significant at the .001 level (2-tailed).

To control the extreme values, the residual statistics were checked for the maximum values in *Mahalanobis Distance*, *Cook's Distance* and *Centered Leverage* and the extreme cases were deleted. A *Scatterplot Matrix* was created to check the assumption of linear relationship of each predictor with the dependent variable and a scatterplot between the predictive equation and the residual was checked for the assumption that these are uncorrelated. Normal distribution of the errors was assumed by checking the *histogram* and *P-P plot*. Homoscedasticity was also checked through *Scatterplot* and no violation was observed.

FINDINGS

The data that support the findings of this study are openly available in figshare.com at https://doi.org/XXXXXXX

The overall mean value of the scale (M=2.19) indicated a relatively low level of technostress among the participants, which could be interpreted that the participant medical students were able to cope with the stress placed on them by distance education. Table 6 presents the results of descriptive statistics regarding all dimensions within the scale. Considering the mean value of each dimension, the participants had a slightly higher level of technostress resulting from the technological tool used in their distance education (M=2.28) compared to human-related (M=2.13) and institution-related (M=2.20) technostress. Looking into the human aspect comparatively, the

instructor-related technostress (*M*=2.24) seemed to be a little higher than the family-related (*M*=2.01) or peer-related (*M*=2.14) technostress despite all being fairly low.

Table 6. Descriptive Results

Dimensions of Technostress	*M*	*SD*	*N*
1. Institution-related Technostress	2.20	.85	259
2. Tool-related Technostress	2.28	.98	259
3. Human-related Technostress	2.13	.90	259
3.1. Peer-related	2.14	.92	259
3.2. Family-related	2.01	.94	259
3.3. Instructor-related	2.24	.93	259
Overall Technostress	2.19	.85	259

The highest level of technostress was measured for the items about meeting the high demands of the university's distance education policies and decisions (*M*=2.88); feeling uncomfortable with the pervasive invasion of distance education in all aspects of a student's life (*M*=2.60); and meeting the expectations of the instructors during distance education (*M*=2.51). On the other hand, the lowest level of technostress was measured for the items about being not encouraged by the parent's/family members (*M*=1.78); not having the relevant tutorials provided by the university (*M*=1.80); and not receiving sufficient incentives for distance education by the university (*M*=1.83).

A multiple regression was calculated to predict the medical students' technostress based on (1) regular attendance and participation, (2) adequate learning environment, (3) perceived negativity of distance education, (4) perceived need for psychological support, and (5) grade level. The model summary indicated that multiple correlation coefficient (*R*), using all the predictors simultaneously, is .70. In this five-IV model, a significant regression equation was found, F (5,253)=48.56, p<.001, with an R^2=.48, which means the model accounted for 48% of the variance in the outcome variable. Accordingly, the medical students' technostress is equal to 2.85 + (-.07*RAP) + (-.31*ALE) + (.25*NDE) + (.19*NPS) + (.11*GL) and could be predicted from those five independent variables combined (Table 7).

Table 7. Multiple Regression Summary

Variables	*B*	*SE*	*β*	*t*	*p*	*R*	R^2	*Adjusted* R^2	*F*
Model					.000	.70	.49	.48	48.56
Constant	2.85	.39		7.16	.000				
RAP	-.067	.02	-.146	-3.05	.003				
ALE	.307	.07	.202	4.03	.000				
NDE	-.254	.03	-.364	-7.14	.000				
NPS	.194	.04	.228	4.45	.000				
GL	.112	.03	.136	2.96	.003				

B=unstandardized coefficients, *SE*=standard error of the estimate, *β*=standardized coefficients

All the independent variables included in the model were found to be significant predictors of technostress. In this framework, RAP was a significant negative predictor of technostress, *β*=-.15, t(253)=-3.05, p<.005, pr^2=.04, which could mean that an increase in the frequency of regular attendance and participation in (synchronous/asynchronous) classes and learning tasks (such as assignments, exams, projects, and so on) would lead to a decrease in the students' technostress level. Similarly, ALE was also a significant negative predictor of technostress, *β*=-.20, t(253)=4.03, p<.001, pr^2=.06, which could be interpreted that the students having a better learning environment for distance education would reflect a lower level of technostress. On the other hand, NDE happened to be a significant positive predictor, *β*=.36, t(253)=7.14, p<.001, pr^2=.17, as having a more negative perception about the influence of distance education on the students' academic, social, and daily life would result in an increase in their technostress level. Likewise, NPS was found to be a significant positive predictor of technostress, *β*=.23, t(253)=4.45, p<.001, pr^2=.07, which could imply that the students who need more psychological support during distance education would also reflect a higher level of technostress. Finally, the students' grade level tended to be another significant positive predictor of technostress, *β*=.11, t(253)=2.96, p<.001, pr^2=.03, which indicates that the higher the grade level was, the more techno-stressed the students were.

The same model of the multiple regression was run for each of the dimensions within the scale and all the independent variables combined were found to be significant predictors of each dimension (Table 8).

Table 8. Multiple Regression Models for Each Dimension

Dimensions	*p*	*R*	R^2	*Adjusted* R^2	*F*
1. Institution-related Technostress	.000	.61	.37	.36	30.26
2. Tool-related Technostress	.000	.71	.50	.49	52.32
3. Human-related Technostress	.000	.67	.44	.43	40.37

Accordingly, the model combining all of the independent variables accounted for:

- 36% of the variance in the institution-related technostress, F (5,253)=30.26, p<.001, R^2=.36;
- 49% of the variance in the tool-related technostress, F (5,253)=52.32, p<.001, R^2=.49; and
- 43% of the variance in the human-related technostress, F (5,253)=40.37, p<.001, R^2=.43.

The values obtained in the model run for each dimension confirm the overall scale and indicate that the students who:

- attend and participate in the classes and learning tasks less regularly,
- have an inadequate learning environment for distance education,
- perceive the influence of distance education on their life from a negative perspective,
- need psychological support during distance education,
- are in an upper grade,

are more likely to have a higher level of overall technostress as well as institution-related, tool-related, or human-related technostress (Figure 1).

DISCUSSION

In this study, the presumption was that the technology-dependent distance education, imperatively driven by the Covid-19 lockdown period, in a field requiring attainments of intensive operative skills like medicine might cause technostress, even on a digitally native generation composed of medical students who are in the first percentile of academic achievement. To test this presumption, the technostress scale developed by Wang et al, (2020) was translated into Turkish language and conducted at a medical school with students from different grade levels (Wang et al., 2020). All the participant students had been mandatorily attending the lessons in a home environment where their family were the closest human source of interaction while their instructors were the most frequently consulted official and academic representatives of the organization. This fact made it necessary to interpolate further dimensions to the P-P interactions of P-E misfit theory, which was tested in the original scale through only the peer dimension as relevant to P-P technostress. In this adaptation, parents/family and instructors were integrated into the scale and this integration performed well with the scale revealing high reliability and internal consistency values throughout the validation of the modified scale. The adapted version of the scale demonstrated that RAP, ALE, NDE, GL and NPS were significant predictor variables of technostress, which was mild in medical students but not negligible though. The most powerful predictor was ALE and the weakest predictor was RAP.

ALE where students feel physically and emotionally safe and secure is considered to be one of the most critical components of learning. Debating on how physical environments shape learning as well as psychological and emotional welfare of learners, the current study defines ALE as physical surroundings that are enriched with digital and adaptive devices that promote better and faster learning during distance education. In this framework, ALE is thought to be related to the techno-security, which, in other words, implies that having inadequate physical surroundings during technology-enhanced learning could lead to techno-insecurity among students as a sub-dimension of technostress (Ahmad et al., 2012; Hassan et al., 2019; Ragu-Nathan et al., 2008). In this line, the positive impact of ALE on learning would also demonstrate significant outcomes in students' psychological wellbeing, because students who study in a technologically safe and secure environment would be more motivated and engaged and therefore they tend to reflect a lower level of technostress.

Interpretation of RAP as an independent technostress creator involves the dimensions of both techno-overload and techno-invasion. In a study examining different aspects of academic stress, researchers concluded that maintaining regular class attendance as a minimum requirement of the course and fulfilling the obligatory tasks were among the major factors of academic stress caused by the programmatic aspects (Nandamuri & Ch, 2009). Among 12 causative factors of academic stress, 60% of the students reported RAP as the first or second choice of preference (Nandamuri & Ch, 2009). Nevertheless, in a research held with medical students, RAP was not reported as a source of stress (Abdulghani et al., 2011). In the present study, RAP was only a minor component of overall technostress. It is possible that failure to meet required attendance and participation evoked technostress in a couple of ways. First, as students missed more classes, the amount of incomplete course work increased. Secondly, additional occupations or personal preferences might converge with timing of the lectures which might result in the perception of techno-invasion. This was solidified in a study investigating the reasons for not attending classes in university students (Kottasz, 2005). During face-to-face education, 50% of the students stated that timing of the lessons was

not right, 38% stated that they were able to access the lesson content without attending the lesson. Additionally, %61 had some other occupation convergent with the timing of the lesson. Illness and transportation issues were also stated as reasons of non-attendance (Kottasz, 2005).

Negative perception on distance education stems from personal attitudes. As with all applied sciences, in medical education master-apprentice relationship is a long-established tradition. Although it seems like a challenging requirement that students are supposed to attend practical lectures and learn specifically by both observing the mentor and executing the procedures, collaborative teaching methods and TEL are still in progress in medical education contexts. Moreover, surveys undertaken recently revealed that both students and teachers were in favorable attitudes towards distance education (Çokyaman & Ünal, 2021). Nevertheless, it is a fact that obligatory distance education due to Covid-19 lockdown resulted in numerous mistakes, deficiencies, and inadequate applications worldwide. This inevitably and adversely effected the attitudes of most of the students, teachers and parents, as well (Çokyaman & Ünal, 2021). Moreover, negative reactions depend on affections, private standards of judgement and personality traits (Krishnan, 2017). The major component of negative attitude towards distance education was associated with location of the hometown (Upadhayaya et al., 2021). Negative attitudes demonstrate positive correlation with the distance of the hometown from the city center (Upadhayaya et al., 2021). Naturally, the difficulties in accessing the Internet and infrastructural problems disable individuals and cause exhaustion while dealing with timely and bulky lectures.

Increasing technostress by increasing grade level is probably related to work overload along with techno-complexity. Medical students feel the heavy responsibility of dealing with 'someone's life' after 3rd grade. Bed-side lectures, clinic visits and internship in in-patient clinics constitute the mainstay of medical education. During the obligatory lockdown period most of the universities were caught unprepared or half-prepared although some degree of TEL was a part of curriculum. Video demonstrations and controlled laboratory dummy studies fell short in satisfying students. Perception of self-confidence in technical and applicable skills were deficient in students.

Need for psychological support is an indicator of overall stress and is the result of an inability to deal with existing stressors and non-adaptation. Technostress was investigated in medical freshmen (Madaan et al., 2020). Distinctly authors identified technostress as 'stress related to technology being a part of everyday life' rather than stress originating from TEL (Madaan et al., 2020). Technology utilization in areas other than education is an important part of the lives of university students. Nearly 90% of medical freshmen reported using the Internet for entertainment purposes and nearly half of them reported feeling distressed if they were not able to access the internet for 1 day (Madaan et al., 2020). Therefore, as a double-edged sword, ICT utilization in everyday life eventually leads to vicious circle of cause and effect relations for psychological conditions (Qi, 2019).

The P-E misfit theory stands on three cornerstones as described previously. It is not surprising that the most prominent component estimated in the present study was the tool-related technostress. Everyday new advancements are realized in ICT and technological tools like computer integrated systems, multiple complicated databases are source of great amount of strain on individuals (Jena, 2015). Technostress, as emphasized in the term itself, is primarily associated with technology utilization, which is realized through use of electronic devices, software, and hardware as well as every day evolving intelligent machines. The results of this study revealed that the rapid and ever-changing nature of technological tools generate pressure even on the digital native generation. Human-related technostress was the weakest component of technostress in the present survey. Neither family members nor peers were a source of remarkable technostress on medical students. On the other hand, instructors evoked technostress level nearly as much as the technological tool did. It is a fact that most of the teachers and academicians experience reputable amount of technostress during teaching within the context of TEL (Jena, 2015). Additionally it has been demonstrated that individuals experiencing technostress have negative impacts on job performance, gradually end up with job dissatisfaction and induce negative affectivity depending on personal characteristics (Jena, 2015; Ragu-Nathan et al., 2008; Tarafdar et al., 2007, 2011). Academicians deal with technostress by either struggling to accept or by over-identifying with collaborative teaching methods (Jena, 2015). In the last instance, these collaborative technologies consisting of e-mails, spreadsheets, presentations, interpretation of statistical outcomes and using multimedia soft wares all promote the techno-overload on the students (Groves & Zemel, 2000; Jena, 2015).

The results of this study is limited to 259 medical students at a single institution of a public university in Turkey, and more diverse settings to be included into future studies would definitely add to the validity and to the interpretations of the findings. Health hazards like pandemics are enormously effective environmental agents. Besides, they function as powerful personal stressors. Inevitably, both P and E components of P-E misfit theory were adversely affected from the presence of Covid-19. Therefore, the results should be interpreted from that point of view. False positive rate or higher than real values might have exerted from this study. The number of the

participants in the present study was sufficient for factor and statistical analysis. However, results from a larger population would be a better guidance. Also, using only one item to measure NPS was another limitation of the scale which might either have over-estimated or under-estimated its relationship to technostress. Finally, creators and inhibitors might be more reliably determined in a population with inertly higher technostress rather than a digital native generation.

Health hazards like pandemics are enormously effective environmental agents. Besides, they function as powerful personal stressors. Inevitably, both P and E components of P-E misfit theory were adversely affected from the presence of Covid-19. Therefore, the results should be interpreted from that point of view. False positive rate or higher than real values might have exerted from this study. The number of the participants in the present study was sufficient for factor and statistical analysis. However, results from a larger population would be a better guidance. Also, using only one item to measure NPS was another limitation of the scale which might either have over-estimated or under-estimated its relationship to technostress. Finally, creators and inhibitors might be more reliably determined in a population with inertly higher technostress rather than a digital native generation.

CONCLUSIONS

- Validation of technostress scale of Wang based on P-E misfit theory was elicited for Turkish language.
- This is the first study evaluating technostress on medical students. In medical students, though stress was known and strategies managing stress were studied, the technostress levels were not evaluated before. The level of technostress in medical students were relatively low and nearly half of the generated technostress was explained by 5 creative factors.
- The technostress creator factors determined in this study were NPS, RAP, ALE, NDE and GL. If these factors can be controlled or eliminated, technostress of medical students would be nearly undetectable.
- The major component of technostress originated from the tool-related component. All the factors significantly and independently predicted all the dimensions of technostress. The highest predictive values were detected in tool-related technostress and the lowest predictive values were for the organization-related technostress.

REFERENCES

Abdulghani, H. M., AlKanhal, A. A., Mahmoud, E. S., Ponnamperuma, G. G., & Alfaris, E. A. (2011). Stress and its effects on medical students: A cross-sectional study at a college of medicine in Saudi Arabia. *Journal of Health, Population and Nutrition*, *29*(5), 516–522. https://doi.org/10.3329/jhpn.v29i5.8906

Ahmad, U. N. U., Amin, S. M., & Ismail, W. K. W. (2012). The Relationship Between Technostress Creators and Organisational Commitment Among Academic Librarians. *Procedia - Social and Behavioral Sciences*, *40*(6), 182–186. https://doi.org/10.1016/j.sbspro.2012.03.179

Al-Fudail, M., & Mellar, H. (2008). Investigating teacher stress when using technology. *Computers and Education*, *51*(3), 1103–1110. https://doi.org/10.1016/j.compedu.2007.11.004

Barrick, M. R., & Mount, M. K. (1991). the Big Five Personality Dimensions and Job Performance: a Meta-Analysis. *Personnel Psychology*, *44*(1), 1–26. https://doi.org/10.1111/j.1744-6570.1991.tb00688.x

Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. *British Journal of Educational Technology*, *50*(1), 12–63. https://doi.org/10.1111/bjet.12730

Bono, J. E., & Judge, T. A. (2004). Personality and Transformational and Transactional Leadership: A Meta-Analysis. *Journal of Applied Psychology*, *89*(5), 901–910. https://doi.org/10.1037/0021-9010.89.5.901

Bozkurt, A. (2020). Koronavirüs (Covid-19) pandemi süreci ve pandemi sonrası dünyada eğitime yönelik değerlendirmeler: Yeni normal ve yeni eğitim paradigması. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi*, *6*(3), 112–142.

Chuang, A., Shen, C. T., & Judge, T. A. (2016). Development of a Multidimensional Instrument of Person-Environment Fit: The Perceived Person-Environment Fit Scale (PPEFS). *Applied Psychology*, *65*(1), 66–98. https://doi.org/10.1111/apps.12036

Çokyaman, M., & Ünal, M. (2021). Ö ğ renci ve Ö ğ retmenlerin Covid-19 Salgını Dönemindeki Uzaktan E ğ itim Algısı : Bir Metafor Analizi Distance Education Perceptions of Students and Teachers during Covid-19 Epidemic : A Metaphor Analysis. *OPUS Uluslararası Toplum Araştırmaları Dergisi*. https://doi.org/10.26466/opus.913396

Dunn, T. J., & Kennedy, M. (2019). Technology Enhanced Learning in higher education; motivations, engagement and academic achievement. *Computers and Education*, *137*, 104–113. https://doi.org/10.1016/j.compedu.2019.04.004

Echenique, E. G. (2014). An Integrative Review of Literature on Learners in the Digital Era. *Studia Paedagogica*, *19*(4), 161–184. https://doi.org/10.5817/sp2014-4-8

Edwards, J. A., & Billsberry, J. (2010). Testing a multidimensional theory of person-environment fit. *Journal of Managerial Issues*, *22*(4), 476–493.

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

Groves, M., & Zemel, P. (2000). Instructional technology adoption in higher education: An action research case study. *International Journal of Instructional Media*, *27*(1), 57–65.

Hampton, D., Welsh, D., & Wiggins, A. T. (2020). Learning Preferences and Engagement Level of Generation Z Nursing Students. *Nurse Educator*, *45*(3), 160–164. https://doi.org/10.1097/NNE.0000000000000710

Hassan, N., Yaakob, S. A., Halif, M. M., Aziz, R. A., Majid, A. A., & Sumardi, N. A. (2019). The effects of technostress creators and organizational commitment among school teachers. *Asian Journal of University Education*, *15*(3), 92–102. https://doi.org/10.24191/ajue.v15i3.7563

Hwang, I., & Cha, O. (2018). Examining technostress creators and role stress as potential threats to employees' information security compliance. *Computers in Human Behavior*, *81*, 282–293. https://doi.org/10.1016/j.chb.2017.12.022

Jena, R. K. (2015). Technostress in ICT enabled collaborative learning environment: An empirical study among Indian academician. *Computers in Human Behavior*, *51*, 1116–1123. https://doi.org/10.1016/j.chb.2015.03.020

Joo, Y. J., Lim, K. Y., & Kim, N. H. (2016). The effects of secondary teachers' technostress on the intention to use technology in South Korea. *Computers and Education*, *95*, 114–122. https://doi.org/10.1016/j.compedu.2015.12.004

Kottasz, R. (2005). Reasons for Student Non-Attendance at Lectures and Tutorials: An Analysis. *Investigations In University Teaching And Learning*, *2*(2), 5–16.

Krishnan, S. (2017). Personality and espoused cultural differences in technostress creators. *Computers in Human Behavior*, *66*, 154–167. https://doi.org/10.1016/j.chb.2016.09.039

Lee, A. R., Son, S. M., & Kim, K. K. (2016). Information and communication technology overload and social networking service fatigue: A stress perspective. *Computers in Human Behavior*, *55*, 51–61. https://doi.org/10.1016/j.chb.2015.08.011

Madaan, Wundavalli, L., & Satapathy, S. (2020). Techno stress among medical freshmen: An exploratory study. *Journal of Education and Health Promotion*, *9*(1), 178. https://doi.org/10.4103/JEHP.JEHP_242_19

Nandamuri, P. P., & Ch, G. (2009). Sources of Academic Stress – a Study on Management Students. *Journal of Management and Science*, *1*(2), 31–42.

Peiris-John, R., Selak, V., Robb, G., Kool, B., Wells, S., Sadler, L., & Wise, M. R. (2020). The State of Quality Improvement Teaching in Medical Schools: A Systematic Review. *Journal of Surgical Education*, *77*(4), 889–904. https://doi.org/10.1016/j.jsurg.2020.01.003

Penado Abilleira, M., Rodicio-García, M. L., Ríos-de-Deus, M. P., & Mosquera-González, M. J. (2020). Technostress in Spanish University Students: Validation of a Measurement Scale. *Frontiers in Psychology*, *11*(October), 1–9. https://doi.org/10.3389/fpsyg.2020.582317

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

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 validation. *Information Systems Research*, *19*(4), 417–433. https://doi.org/10.1287/isre.1070.0165

Romli, M. H., Cheema, M. S., Mehat, M. Z., Md Hashim, N. F., & Abdul Hamid, H. (2020). Exploring the effectiveness of technology-based learning on the educational outcomes of undergraduate healthcare students: an overview of systematic reviews protocol. *BMJ Open*. https://doi.org/10.1136/bmjopen-2020-041153

Sharma, A., Minh Duc, N., Luu Lam Thang, T., N, N., Ng, S., Abbas, K., Huy, N., Marušić, A., Paul, C., Kwok, J., Karbwang, J., de Waure, C., Drummond, F., Kizawa, Y., Taal, E., Vermeulen, J., Lee, G., Gyedu, A., To, K., … Karamouzian, M. (2021). A Consensus-Based Checklist for Reporting of Survey Studies (CROSS). *Journal of General Internal Medicine*. https://doi.org/10.1007/S11606-021-06737-1

Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivity. *Journal of Management Information Systems*, *24*(1), 301–328. https://doi.org/10.2753/MIS0742-1222240109

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

UN. (2020). *Policy Brief: Education During Covid-19 and Beyond*. https://unsdg.un.org/resources/policy-brief-education-during-covid-19-and-beyond

Upadhayaya, P., Sharma, B., Gnawaliy, Y., & Belbase, S. (2021). Factors Influencing Graduate Students' Perception of Online and Distance Learning in Nepal. *Turkish Online Journal of Distance Education*, 236–269.

Upadhyaya, P., & Vrinda. (2021). Impact of technostress on academic productivity of university students. *Education and Information Technologies*, *26*(2), 1647–1664. https://doi.org/10.1007/s10639-020-10319-9

Wang, X., Tan, S. C., & Li, L. (2020). Technostress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit. *Computers in Human Behavior*, *105*(106208). https://doi.org/10.1016/j.chb.2019.106208

Wilkins, A. L., & Ouchi, W. G. (1983). Efficient Cultures: Exploring the Relationship Between Culture and Organizational Performance. *Administrative Science Quarterly*, *28*(3), 468. https://doi.org/10.2307/2392253

Yu, E., & Suny, C. (2020). Student-inspired optimal design of online learning for generation Z. *Journal of Educators Online*, *17*(1).