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The Arabic version of the technostress scale for primary school teachers: Factorial validity and measurement invariance

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Abstract

Teachers generally understand technostress to represent the psychological distress resulting from problems associated with teaching in a virtual classroom context. This study has been conducted to develop a tool to measure the level of technostress of primary school teachers. The current study evaluated the psychometric properties of the Technostress Scale (10 items) using a sample of 829 (490 female and 339 male) primary school teachers from different geographical regions of Saudi Arabia. The average age of the participants was 38.22, with a standard deviation of 7.08. Exploratory factor analysis produced one factor with eigenvalues of 5.01. This explained 50% of the variance. Confirmatory factor analysis revealed good model fits for one correlated factor, with a comparative fit index of 0.968, a Tucker–Lewis Index of 0.959, a standardised root-mean-square residual of 0.051, and a root mean-square error of approximation of 0.094. Although these multi-group analyses demonstrate that the structure factor of the technostress scale is invariant with respect to gender and experience, no differences were observed for the impact of training. This is due to the efforts of the Saudi Ministry of Education to provide the necessary training for teachers to use distance education tools.

Keywords: CFA, technostress, quantitative approach, teachers;

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Introduction

In recent years, teachers, as agents of change in the education system, have been urged to integrate technology into their classrooms. The success and failure of modern technology depends on how teachers use a given technology (Khlaif, 2018), leading to teachers complaining about the multitasking demanded on each school day, which requires substantial time and effort (Joon et al., 2016). Although teachers use technology to attract student attention and enhance their learning (Dias & Victor, 2017), researchers have also identified a dark side, which concerns the anxiety, stress, and pressure that technology use causes among teachers (Lee & Xiong, 2021), which can negatively impact their intention to use a new technology in their teaching practices (Teo et al., 2019). Following the development of emerging technologies in the teaching and learning domain, researchers have coined this phenomenon technostress (Ayyagari et al., 2011; Tarafdar et al., 2008).

The issue of technostress can also present in online teaching modes. Due to the COVID-19 pandemic, educational institutions all over the world have shifted to online learning. In Saudi Arabia, for example, the Ministry of Education, like its counterparts in other countries, directed schools to use digital learning platforms for teaching and assessment practices. While this switch to online learning has produced some positive outcomes for student learning and student satisfaction (Li & Wang, 2020), the negative outcomes include teacher and student stress, discomfort, and anxiety due to the high speed at which technological change takes place and the constant use of the internet, email and smartphones (Molino, 2020; Salanova et al., 2013, Spagnoli et al., 2020). Meanwhile, according to Li and Wang (2020), the continuous upgrades and advances of technologies can provoke technostress in teachers.

1.1. Related Studies

1.1.1 Defining Teacher Technostress

There have been many published definitions of technostress. For example, Dong et al. (2020) described technostress as individuals' inability to cope with the increase in modern technologies. For Estrada Muñoz et al. (2020), it is an individual or organisation's inability to use technology in a healthy manner, and Panisoara et al. (2020) defined it as "a problem of improper adaptation caused by the failure of people to cope with technology and the changes in requirements related to the use of technology, which generate psychological and physical stress towards the latter".

Technostress can also be understood as an interaction between individuals and the environment that can produce negative or positive attitudes towards modern technologies or a new environment (Wang et al., 2020).

For this study, the researchers have defined technostress as stress, discomfort, or pressure on a teacher due to the use of a modern technology, whether mobile technology, wearable technology, platforms, devices or any form of digital media.

1.1.2 Factors Influencing Technostress

Previous studies have explored the reasons for teachers experiencing technostress in various contexts, including health, higher education, business, and public education (Çoklar et al., 2017; Joo et al., 2016). Additionally, researchers have developed many technostress scales to identify technostress levels, with those produced by Çoklar et al. (2017) and Ozgur (2020) prominent examples. Elsewhere, Cliff and Brooks (2020) classified the causes of technostress into the categories of techno-overload, technology characteristics, techno-uncertainty, techno privacy (Khlaif et al., 2022a), techno-invasion, techno-overload, lack of professional development and techno-complexity. Techno-complexity occurs when the complexity of technology is accompanied by a lack of technological skills, demanding teachers devote time and effort to learning to fulfil their tasks using technology. Techno-insecurity describes the feeling of threat that one might lose their job to a more technologically qualified individual. Techno-overload is the feeling that one must work harder and faster than usual. Finally, techno-invasion describes the feeling that one should always be connected, such that they can be found anywhere and at any time, which blurs the thin line between professional and personal contexts.

Khlaif et al. (2022b) found that the main cause of technostress is information overload, with the vast number of sources available causing the inability to think clearly. Meanwhile, the availability of information intake via smartphones and devices such as tablets, computers and other hubs has produced a situation of complete connectivity. This leads to repeated requests from superiors for teachers to work anytime and anywhere using emails and messages obliviating the line between professional and personal life.

Elsewhere, Oladosu et al. (2020) classified technostress factors into the characteristics of technology, social, technical causes, and lack of training on technology use. For example, employees face problems related to coping with rapidly advancing technology due to their lack of skills. Other researchers have reported additional factors including self-efficacy (Zambianchi et al., 2019), experience with technology (Estrada-Muñoz et al., 2020), organisation culture and commitment (Ishola et al., 2019). Furthermore, the relationship between technostress levels and student self-concepts is significant (Qi, 2019).

Consequently, researchers have developed various models to study the relationship between the factors that influence the teacher experience of technostress. For example, the research model produced by Estrada-Muñoz et al. (2020) concerning integration of technology in educational environments depends on two manifestations: techno-fatigue and techno-anxiety. This model was developed to investigate the impact of teacher age and gender on techno-fatigue and techno-anxiety. Elsewhere, studies conducted in South Korean and Chinese education contexts have introduced a model based on teaching measurement-based technology, pedagogy, and content knowledge (TPACK) as a study variable (Joo et al., 2016; Dong et al., 2020; Schmidt et al., 2009), and a recent study by Fitzgerald (2020) revealed a strong relationship between technology features, techno-stressors and students perceived academic performance.

Meanwhile, Tarafdar et al. (2007) proposed a model investigating the levels of technostress across five dimensions: techno-uncertainty, techno-invasion, techno-complexity, techno-insecurity, and techno-overloading. More recent research has focused more on investigating these constructs (Brivio et al., 2018: Chen, 2015; Khlaif et al., 2022a; Qi, 2019; Shu & Huang, 2016; Zainun et al., 2019), building on the work of Ayyagari et al. (2011), which recognised additional technostress factors including work-overload, invasion of privacy, job insecurity, the policy of organisation, and IT awareness. Previous studies in the educational context have considered these factors, including in cases where the factors were not developed for the education context, as reported by Qi (2019), among several other studies (Hossain et al., 2019; Verkijika, 2019).

Several studies have reported that educators and learners play a crucial role in the success or failure of technological integration because educators are the agent of change and learners represent the centre of education system (Harris & Hoffer, 2011; Paraskeva et al., 2008; Roblyer & Doering, 2013). Furthermore, individual characteristics (e.g., skills, knowledge, attitude, background, experience with

ICT, and anxiety) contribute substantially to the technology integration process (Roblyer & Doering, 2013; Imhof et al., 2007).

According to other models, technostress levels vary significantly among end-users depending on digital literacy, gender, age, and experience using ICT for teaching and learning. Other studies have observed higher technostress levels among men compared to women and among older people compared to younger people (Maier, 2014; Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Tarafdar et al., 2011). Previous studies allow us to conclude that the factors influencing technostress levels should be considered as interconnected rather than mutually independent.

1.1.3 Consequences of Technostress

The consequences of technostress can be classified as physiological, psychological, organisational, and societal. Regarding physiological consequences, Li and Wang (2020) clarified that people may suffer from sleep problems, headaches, musculoskeletal pain, carpel tunnel syndrome, depression, increased levels of adrenalin and noradrenaline, higher blood pressure and heart rate, sleep deprivation, fatigue, immune system problems and health deterioration in general.

Concerning the psychological consequences, Pflügner et al. (2021) found that technostress may cause anxiety, lack of satisfaction in one's job, absent-mindedness and other psychological problems, including scepticism. Regarding the organisational effects of technostress, Torres (2020) confirmed that technostress undermines employee performance by inducing low levels of commitment to the organisation, because employees are prone to describing any error in the work of the institution as caused by a technical error.

Recent research emphasises how technostress impacts job satisfaction via perceived usefulness, organisational commitment, job commitment, negative affectivity due to work and technology-mediated performance (Dong et al., 2020; Ozgur, 2020; Schmidt et al., 2009).

According to Lui and Hu (2021), technostress may have serious negative societal effects, including undermining the social fabric by encouraging people to use technology to chat rather than seeing each other face-to-face. This fundamental problem might cause people to dissociate from their surroundings due to their heavy dependence on technology.

Despite the previously passive effects of technology, we continue to live in a technological age, an age that demands that we use and embrace technology because everything depends on it. Consequently, individuals must choose whether they will use technostress to their advantage by embarking on new projects that benefit from the use of technology.

1.2. Purpose of the study

This study's purpose was to develop a scale to measure technostress among primary school teachers in a crisis context.

1.3. Research Questions

RQ1: What is the structure of the technostress scale developed for primary school teachers?

RQ2: Does the structure of the technostress scale for primary school teachers produce related results for different individuals across gender, experience, training?

2. Methods and Materials

The current study used an exploratory study based on field notes produced by teachers bothered by electronic classroom stress to build the current tool. We developed a Technostress Scale for Elementary School Teachers based on the procedures presented in Table 1.

Table 1. Scale design procedure

Procedure	Action
1. Define the concept of technostress	The current study understands technostress to pertain to the field of mental health and indicate psychological and emotional discomfort felt by teachers when using e-learning processes, adversely impacting the e-education performance.
2. Survey study	Open interviews with teachers
3. Open-ended questions	Teacher responses to questions concerning stress in the virtual classroom
4. Content analysis	Conceptual analysis used to identify agreement
5. Item extraction	Presentation of items to experts in psychology and educational technologies in universities
6. Establish items	Items with 85% approval accepted and inappropriate items deleted

2.1. Participants

A total of 829 (490 females and 339 male) primary school teachers in distinct parts of Saudi Arabia participated in the study. The average age of participants was 38.22 (standard deviation: 7.08). We used snowball and convenience sampling methods to distribute the scale via Google Drive.

More concretely, the survey was distributed to primary school teachers, administrators, and supervisors. We asked participants to share the survey link with their colleagues to reach as many primary school teachers as possible. We conducted data screening to clean the data and remove surveys with more than 10% of the data missing. Table 2 presents demographic profile data about the individuals whose data were collected for analysis.

Table 2. Frequency and percentage values of study sample demographic (n= 829)

Variance	**Percentage**
Gender	
Male	339 (40.89%)
Female	490 (59.11%)
Experience	
< 5 years.	158 (19.06%)
>5 years	671 (80.94%)
Training	
Yes	521 (62.85%)
No	308 (37.15%)

Of the study participants, 490 (59.11%) were female and 339 (40.89%) were male; 158 (19.06%) were experienced (<5 years), 671 (80.94%) were experienced (>5 years); 521 (62.85%) had received training, and 308 (37.15%) had not received training.

2.2. Data Collection Tool

The study proposes a Technostress Scale for Primary School Teachers. The scale comprises 10 items. The scale uses a 5-point Likert scale for responses (1 = strongly disagree; 5 = strongly agree). The total score was calculated by adding each individual's score for each item (Min= 10, Max= 50), with higher scores indicating a higher degree of technostress. Results of tests of internal consistency reveal good reliability (Cronbach's alpha of 0.88).

2.3. Data Analysis

The data analysis process included three phases: explanatory factor analysis (EFA), confirmatory factor analysis (CFA), and multi-group CFA and EFA. The Lavaan package in R software was used to perform the analyses. The researchers randomly divided the total sample into two subsamples to investigate the factor structure for the EFA (n=416) and CFA (n=413). For each subgroup, a polychromic correlation matrix was produced to estimate the linear relationship between two manifest ordinal variables (Flora & Curran, 2004), leading to the decision that the 5-point Likert-type scales should be treated as an ordinal measure (i.e., below 10).

2.3.1 Confirmatory Factor Analysis

The first subsample comprised 416 participants. The researchers used the principal axis factor as the extraction method to identify the latent factor structure via EFA. The second subgroup (n=413) was used for CFA. We treated the data as ordinal and performed CFA using diagonally weighted least squares estimation (Brown, 2015). The unit variance identification method (UVI) was used as a scaling method that standardised each latent factor (i.e., fixed to 1.00) to allow the loading factors to be freely estimated to measure the individual variables estimates for each item loading (Brown, 2015; Byrne, 2013; Kline, 2016).

2.3.2 Multi-Group CFA

We conducted measurement invariance for the matrix of gender experience and training using multi-group CFA to estimate whether there were any differences in technostress levels between males and females, having more or less than five years' experience, and having received or not having received training, in accordance with Brown (2015). First, we estimated the invariance measurement by testing the CFA model separately to determine the model fit for each group in terms of individual traits (i.e., gender, experience and training).

3. Results

We examined the proportion of missing data and the univariate and multivariate distribution, observing no missing responses for technostress items. The univariate distribution analysis indicated the non-normally distributed responses, which indicate skewness and kurtosis, exceeded the cut-off values of |2.00| and |7.00|, respectively (Curran, West & Finch, 1996). The skewness for the responses on the technostress items ranged from -2.54 to -1.57, indicating that the data are negatively skewed, and kurtosis ranged from -1.16 to 9.20, indicating leptokurtic distribution. For the multivariate distribution, responses for technostress items exhibited significant multivariate abnormality, skewness = 88.92, $z = 115.81$, $p < .001$, and kurtosis = 590.26, $z = 50.66$, $p < .001$. Table 3 reports descriptive statistics for technostress items.

Table 3. Descriptive statistics for the technostress items

	Mean	SD	MIN	MAX
Technostress Total Score	**32.30**	**9.09**	**10**	**50**

RQ1: What is the structure of the technostress scale developed for primary school teachers?

The first study verifies the validity of the scale and the first research question via EFA, with the resulting polychromic correlation matrix reported in Table 4.

Table 4. Polychromic correlation for the exploratory factor analysis (n=416)

	Item1	Item2	Item3	Item4	Item5	Item6	Item7	Item8	Item9	Item10
Item1	1.00									
Item2	0.41	1.00								
Item3	0.49	0.51	1.00							
Item4	0.44	0.40	0.53	1.00						
Item5	0.51	0.46	0.57	0.67	1.00					
Item6	0.28	0.32	0.46	0.43	0.46	1.00				
Item7	0.54	0.44	0.57	0.60	0.75	0.43	1.00			
Item8	0.47	0.28	0.52	0.41	0.45	0.39	0.52	1.00		
Item9	0.45	0.28	0.47	0.48	0.54	0.38	0.62	0.50	1.00	
Item10	0.49	0.42	0.65	0.60	0.57	0.48	0.65	0.60	0.57	1.00

Note. * Indicates the correlation is significant at $p < .05$; ** indicates the correlation is significant at $p < .01$ (two-tailed).

The EFA procedure involved using principal axis factor extraction of technostress items to determine the structure of the scale. The results revealed a one-factor latent variable structure. A parallel analysis of the data indicated that one eigenvalue from the research data exceeded the eigenvalues from the randomly generated data, revealing the presence of one factor. Specifically, Factor 1 had an eigenvalue of 5.01, which exceeded the mean and percentile of the randomly generated data eigenvalues (0.21 and 0.15). Table 5 reports the EFA loadings. Specific variance was calculated for each subtest item.

Table 5. Exploratory factor analysis loadings (n=416)

Items	**Loadings**
Item1	0.64
Item2	0.54
Item3	0.74
Item4	0.74
Item5	0.81
Item6	0.56

Item7	0.84
Item8	0.65
Item9	0.69
Item10	0.80
Eigenvalues	5.01
Percent of Variance	50%
Cumulative percent of variance	50%
Alpha Reliability	0.88

Table 6. Polychromic correlation for the confirmatory factor analysis (n=398)

	Item1	**Item2**	**Item3**	**Item4**	**Item5**	**Item6**	**Item7**	**Item8**	**Item9**	**Item10**
Item1	1.00									
Item2	0.42	1.00								
Item3	0.53	0.49	1.00							
Item4	0.50	0.46	0.56	1.00						
Item5	0.52	0.48	0.63	0.69	1.00					
Item6	0.22	0.29	0.42	0.43	0.45	1.00				
Item7	0.56	0.47	0.58	0.57	0.76	0.41	1.00			
Item8	0.55	0.28	0.52	0.48	0.46	0.39	0.51	1.00		
Item9	0.39	0.28	0.41	0.42	0.54	0.32	0.61	0.49	1.00	
Item10	0.47	0.48	0.62	0.58	0.56	0.47	0.58	0.57	0.58	1.00

Note. * Indicates the correlation is significant at $p < .05$; ** indicates the correlation is significant at $p < .01$ (two-tailed).

Table 7. Confirmatory factor analysis loadings (n=398)

Items	**Loadings (SE)**
Item1	0.66 (0.03)
Item2	0.58 (0.04)
Item3	0.76 (0.03)
Item4	0.75 (0.03)
Item5	0.86 (0.02)
Item6	0.52 (0.04)

Item7	0.83 (0.02)
Item8	0.67 (0.03)
Item9	0.65 (0.03)
Item10	0.77 (0.03)

Table 8. CFA Fit statistics

Chi	p	DF	RMSEA	SRMR	CFI	TLI
157.46	**<0.001**	**35**	**0.094 [0.079,0.109]**	**0.051**	**0.968**	**0.959**

RQ2: Does the structure of the technostress scale for primary school teachers produce equivalent results for different individuals across gender, experience and training?

The study has verified the validity of the scale, responding to the second research question by considering the measurement invariance in the CFA context for gender, experience and training. These findings appear in Table 9–11.

Table 9. Tests of measurement invariance of the CFA model for male (n = 165) and female (n = 249) teachers.

	x 2	**df**	**Δ x 2**	**Δ df**	**p**	**SRMR**	**REMSEA**	**CFI**	**Δ CFI**
				Single group solution					
Male	112	35				0.042	0.115	0.974	
Female	102.11	35				0.053	0.011	0.965	
				Measurement Invariance					
Configural	118.86	70				0.059	0.101 [0.086, 0.116]	0.968	
Metric	137.59	79	10.67	9	0.299	0.062	.084 [0.069, 0.099]	0.973	
Scalar	175.11	108	48.92	29	0.012	0.059	0.085 [0.072,0.098]	0.962	

Note. df: degree of freedom; RMSEA: root mean square error of approximation; CFI: comparative fit index; SRMR: standardised root means square residual; ΔCFI: comparative fit index difference.

Table 10. Tests of measurement invariance of the CFA model for teachers with less than five years' experience (n =73) and more than five years' experience (n = 341)

	x 2	df	Δ x 2	Δ df	p	SRMR	REMSEA	CFI	Δ CFI
				Single group solution					
< 5 years' experience		35							
>5 years' experience		35							
				Measurement Invariance					
Configural	125.59	70				0.061	0.093[0.078,0.109]	0.965	
Metric	193.84	79	23.14	9	.01	0.071	0.097[0.082,0.111]	0.958	
Scalar	183.04	108	14.43	29	.989	0.062	0.074[0.061,0.087]	0.966	

Note. df: degree of freedom; RMSEA: root mean square error of approximation; CFI: comparative fit index; SRMR: standardised root means square residual; ΔCFI: comparative fit index difference.

Table 10. Tests of measurement invariance of the CFA model for teachers with no training (n = 154) and with training (n = 260

	x 2	df	Δ x 2	Δ df	p	SRMR	REMSEA	CFI	Δ CFI
				Single group solution					
No training		35							
Training		35							
				Measurement Invariance					

Configural	130.78	70				0.064	0.101 [0.086,0.116]	0.959	
Metric	151.62	79	11.97	9	0.215				
Scalar	165.74	108	24.49	29	0.705				

Note. df: degree of freedom; RMSEA: root mean square error of approximation; CFI: comparative fit index; SRMR: standardised root means square residual; ΔCFI: comparative fit index difference.

4. Discussion

The current research aimed to examine the psychometric properties of the developed Technostress Scale for Primary School Teachers. The current findings suggest acceptable reliability and validity of the instrument. The Cronbach's alpha indicates that the instrument is reliable, given that the value of the coefficient exceeded 0.70. EFA demonstrated support for the factorial validity of our scale, and CFA revealed robust values for the loadings of items according to their underlying factor. The 10-item measurement model was found to be an acceptable fit model, providing further evidence of the instrument's construct validity.

Having confirmed that our hypothesised model fits the data well, we were interested in examining potential evidence of invariance in the measurement model across the three covariates of interest: gender, experience and training. According to these multi-group analyses, the structure factor of the technostress scale was invariant with respect to gender. These results support the use of our instrument in future studies, enabling comparison of means between female and male teachers by understanding both groups to be similar. Although the same applies for experience, no differences appeared regarding the impact of training, potentially due to the efforts of the Saudi Ministry of Education to provide teachers with the training necessary to conduct distance education.

Thus, the present research indicates the psychometric quality of the developed technostress scale, suggesting that it can aptly capture teachers' perceptions of anxiety, stress, and pressure related to technology use in the context of Saudi primary schools. This study is highly relevant for not only Arabic-speaking contexts but also other contexts where there is interest in teacher experience of technostress. This instrument can also usefully inform teaching practice by enabling the use of data collected by the questionnaire to understand the teacher experience of using technology, including how stressful activities can impact their work performance.

However, despite this research's demonstration of this tool's crucial implications for research and educational practices, there are some limitations that should be acknowledged. First, although the study considered a large sample of primary school teachers, it did not cover all of Saudi Arabia's geographical regions or other academic levels. Hence, more extensive research covering a wider and more diverse teacher population is critical to improve validation of the instrument and prove its strength. It would also be useful to provide comparative and global assessments. This would encourage the sharing of results and the facilitation of the analysis of differences around the world. Second, this study has not evaluated the predictive validity of the developed instrument. Therefore, further studies should assess the predictive power of the technostress scale in terms of particular outcome variables, such as work engagement and work satisfaction.

5. Conclusion

This study has developed a Technostress Scale for Primary School Teachers. Given the digital transformation imposed by the COVID-19 pandemic, this study recommends that the technostress scale be used to provide the families of primary school children with guidance regarding controlling classroom problems on learning platforms and contribute to the psychological preparation of less experienced teachers. It should also be adapted for teachers at the university and secondary school levels to enable comparisons.

Figures

All figures should be numbered with Arabic numerals (1, 2, n). All photographs, schemas, graphs and diagrams are to be referred to as figures. Line drawings should be good quality scans or true electronic output. Low-quality scans are not acceptable. Figures must be embedded into the text and not supplied separately. Lettering and symbols should be clearly defined either in the caption or in a legend provided as part of the figure. Figures should be placed at the top or bottom of a column wherever possible, and as close as possible to the first reference to them in the paper. Leave one line space between the heading and the figure.

Lettering and symbols should be clearly defined either in the caption or in a legend provided as part of the figure. Figures should be placed at the top or bottom of a column wherever possible, and as close as possible to the first reference to them in the paper. Leave one line space between the heading and the figure.

The figure number and caption should be typed as provided for you below the illustration and left justified.

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Appendix

A.1. Technostress Scale for Primary School Teachers

Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am distressed by the students' non-compliance with the rules of participation in the virtual class.	1	2	3	4	**5**
I am distressed that I don't know how to use the platform in the educational process.	1	2	3	4	**5**
I feel distressed by the lack of direct communication with students during e-learning.	1	2	3	4	**5**
I worry about keeping the mic open while I am explaining on the e-learning platform.	1	2	3	4	**5**
The difficulty of controlling students' behaviour during e-learning increases my anxiety greatly.	1	2	3	4	**5**
The short time allotted to the subject during e-learning makes me more nervous.	1	2	3	4	**5**
I get distressed by the inconveniences of students in class during e-learning.	1	2	3	4	**5**
I feel angry that some students did not participate in the virtual class.	1	2	3	4	**5**
I am very annoyed by parents interfering with the answers on the digital platform.	1	2	3	4	**5**
I get annoyed by the many technical problems during e-learning.	1	2	3	4	**5**