Defining Teachers' Technostress Levels: A Scale Development

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Abstract
With the integration of technology in recent years, use of technology has rapidly increased in educational system, and has become almost a must rather than an option. The use of technology in educational processes accompanies some adaptation issues due to the nature of technology (rapid development, cost, need for electricity, change of roles, etc.). An important professional group that has been affected from this process is teaching. The pressure on teachers results in a stress commonly referred as techno-stress. The purpose of the present study is developing a Likert-type scale called as "Teachers' Techno-stress Levels Defining Scale (TTLDS)" intended for defining teachers' techno-stress levels. In accordance with this purpose, data were collected from 395 teachers. The steps followed in the present scale development study respectively are; forming the theoretical framework and pool of items, getting expert opinion, and testing validity and reliability. To define factor structure for validity, exploratory and confirmatory factor analyses, and item discrimination; and for reliability internal consistency coefficient (Cronbach Alpha) and split-halves reliability coefficient (Spearman-Brown) were calculated. Validity and reliability studies resulted in a 28-item, five-factor ("Learning-Teaching Process Oriented", "Profession Oriented", "Technical Issue Oriented", "Personal Oriented", and "Social Oriented") scale. For reliability coefficients, Cronbach Alpha was calculated as 0.917, and Spearman-Brown was calculated as 0.845.
Keywords: Technostress, Psychology, ICT use, Teachers.

1. Introduction

Teachers play an important role in the integration of technology to learning-teaching process (Ilie, Courtney & Slyke, 2007; Miller & Sim, 2004). Taking a research conducted in 22 countries and on 35000 teachers into consideration, Law et al. (2008) referred to teachers as the most important determiner of the integration of technology. From this perspective, the importance of teachers in the integration process is obvious. On the other hand, considering teachers' use of technology in their classrooms, even their opportunities to access technology at their schools have increased significantly, teachers are having problems in integrating technology to their teaching, and therefore they resist doing so (Howard, 2013). The findings of a research conducted by International Society for Technology in Education (ISTE) indicate that even teachers have access to technology at their schools, they don't use it in their teaching processes adequately (Moursund & Bielfeldt, 1999). From this perspective, preparing teachers is one of the most important issues in the integration of technology to education (Schrum et al., 2005; Roblyer & Knezek, 2003). With this aspect, there are some factors significantly affecting technology integration in education, such as teachers' beliefs, knowledge and skills, their time, work-load, and attitudes towards technology and pedagogy in learning and teaching processes (Marwan & Sweeney, 2010; Chen, 2008; Lim & Chai, 2008; Shaunessy, 2007; Mainka, 2007; Mouza, 2003). One of these factors is techno-stress. The concept of techno-stress was coined to refer to problems encountered in keeping pace with new technologies (Sami & Pagannaiah, 2006).

Brod (1984) defined the concept of techno-stress as a modern adaptation disorder resulting from failure in coping with new technologies in a healthy way. The panic and stress occurring in case of frequent or constant failure in using technological devices is called as techno-stress (Brillhart, 2004). It is a kind of stress caused by Information and Communication Technologies (ICT), and a case of exhibiting negative perception when users cannot adapt to ICT (Tu et al., 2008). When they work with computers, users may suffer from increase in adrenalin levels, headache, heart attack, digestive problems, aggression, insomnia, asthma, tonus, increase in heart rate and blood pressure, and in some rare cases they may present signs of diabetes and cancer (Kakabadse, Porter & Vance, 2009; Gendreau, 2007; Brillhart, 2004; Johnson & Indvik, 2004; Arnetz & Wiholm, 1997; Hudiburg, 1995; Crampton et al., 1995; Muter et al., 1993).

More workload assigned to users due to the perception that work can be done easier and faster with the developed technology may result in stress as well (Hung, Chang & Lin, 2011; Ayyagari, Grover & Purvis, 2011; Tarafdar, Tu & Ragu-Nathan, 2010; Tu, Wang & Shu, 2005; Frankenhaeuser, 1978). Lack of professional development, and practice, limited training and sources, over workload, inadequate technology set-up and lighting, devices of poor quality, low human interaction, noisy devices, and hesitation are cases that may cause techno-stress (Karr-Wisniewski & Lu, 2010; Ayyagari, 2008; Ragu-Nathan et al., 2008; Wang et al., 2008; Shepherd, 2003). Additionally, difficulty in remembering user names and passwords, hardware break downs, computer break downs, increase in expectations in computer skills, too many e-mails, the complexity of computer terminology, slow Internet connection, slow computers, lack of human interaction, and the high cost of technological devices are other cases that may result in techno-stress (Ayyagari, 2012; Hung, Chang & Lin, 2011; Kim, Mannino & Nieschwietz, 2009; Ragu-Nathan et al., 2008; Shepherd, 2004).

As is the case with every area, techno-stress is an important issue for teaching profession. Teachers especially experience techno-stress during the process of integration of new technologies, which is a case frequently encountered with digital technologies (Lei, 2010; Lei & Zhao, 2007; Zhao & Frank, 2003). Besides, the on-going technology integration pressure both from the institutions, and the society also cause techno-stress among teachers due to lack of knowledge and support (Longman, 2013).

1.1 Related Literature

Below is presented measurement instruments used in studies conducted to reveal techno-stress levels of users of technology in education and other fields.

Tarafdar, Pullins & Ragu-Nathan (2014), Alleyne (2012), Tarafdar, Tu & Ragu-Nathan (2010) and Wang, Shu & Tu (2008) utilized the scale developed by Ragu-Nathan (2008) in order to define employees of business world.

Another subject matter of studies on techno-stress is health. Furniss (2014) and Evans (2013) utilized the questionnaire developed by Tarafdar et al. (2007) in their studies in order to define techno-stress levels of health sector employees.

Popoola & Olalude (2013), Ahmad, Amin & Ismail (2014) also measured techno-stress levels of library employees with the scale developed by Tarafdar et al. (2007), while Khan, Rehman & Rehman (2013) adapted the scale developed by Ragu-Nathan et al. (2008) in their study.

In the field of education, Longman (2013) used an measurement instrument defining teachers’ techno-stress levels. However, this instrument was only at questionnaire level. Measurement instruments used in other studies (Rolón, 2014; Burke, 2005; Agbu & Olubiyi, 2011; Jena, 2015; Booker, Rebman Jr & Kitchens, 2014) in the field of education were either intended for students, or at questionnaire level, and didn’t intend to define teachers’ techno-stress levels.

The literature review conducted for the present study shows that, previous studies on techno-stress were carried on business, library, health and education employees. Most of these adapted the scales developed by Ragu-Nathan et al. (2008), Tarafdar et al. (2007), Weil & Rosen (1999), Hudiburg (1995). In addition, most of these adaptations ceased at questionnaire level. The measurement instrument utilized by Longman (2013) in order to define teachers’ techno-stress levels was also a questionnaire and was developed peculiar to that study. On the other hand, other measurement instruments used in the studies in the field of education were intended for students or academicians rather than teachers; and were adapted instruments at questionnaire level.

1.2 The Importance of the Study

Due to the convenience they provide, Information and Communication Technologies took their place as a pedagogical tool as of early 2000s (Peeraer & Van Petegem, 2015), and started to be integrated into educational systems rapidly (Trucano, 2005). Most countries see ICT as a life saver in their educational systems, and they structure their educational systems with important investments for technology integration (Organisation for Economic Co-operation and Development [OECD], 2001). On the other hand, integration process caused changes in teacher roles, and teachers became an important factor of a successful integration process (Longman, 2013). Many factors have been affecting teachers during the integration process (Roblyer, 2006). Techno-stress is one of these factors. Changing educational understanding along with the nature of technology (technical support, failure in using, purchase, vision of the school, social pressure etc.) are the reasons for techno-stress among teachers.

In Turkey, where the present research was conducted, an important technological investment has been made in the past two decades. Especially in the recent years, teachers’ use of technology has become a must rather than an option with a national level investment on the integration of technology (Increasing Opportunities and Improving Technology Movement – FATIH Project). Many researchers conducted after FATIH project showed that teachers experiences techno-stress (Aktas, Gokoglu, Turgut & Karal; 2014; Ciftci, Taskaya & Alemdar; 2013; Cetinkaya & Keser, 2014; Banoglu et al., 2014; Ozkan & Deniz, 2014; Genc & Genc, 2013; Pamuk et al., 2013). There is a need for a measurement instrument to define teachers' techno-stress levels for a better understanding of the level and effect of techno-stress experienced by teachers.

Literature review didn't present any measurement instrument that can provide a multi-perspective on the reasons of techno-stress among teachers. The present research is important, as it shows that techno-stress is an important parameter in the integration process, forms a conceptual framework techno-stress among teachers, and finally develops a valid and reliable measurement instrument to define techno-stress levels among teachers.

1.3 Purpose of the Research

Teachers are experiencing techno-stress in this period of rapid integration of technology into education. The purpose of the present research is developing a valid and reliable measurement instrument to measure teachers' techno-stress levels (TTLDS) and presenting the factor structure of this scale.

2. Method

2.1 Research Model

The present research is scale development study. The development of a new scale to measure partnership trust presupposes that all items in the scale share a common cause, that is the latent variable trust, and that item-total scores relate to this variable (Devellis, 2012).

2.2 Participants

The total of 395 teachers, who work in two different provinces of Turkey (Ankara and Eskisehir) in 2014-2015 school year. Demographic data related to participants are presented in Table 1.

Table 1. Demographic data related to the teachers who participated in scale development process

Variables		f	%
Gender	Female	252	63.8
	Male	143	36.2
Length of Service	Less than 5 years	32	8.1
	5-10 years	84	21.3
	11- 15 years	108	27.4
	16 or more	171	43.3
Level of Education	Primary	167	42.3
	Secondary	131	33.2
	High School	97	24.6
Internet Use Frequency *	1-2 hours a week	64	16.2
	3-4 hours a week	48	12.2
	1-2 hours a day	188	47.6
	3-4 hours a day	48	12.2
	More than 4 hours a day	42	10.6
	Total	395	100

* Some participants did not answer the question.

2.3 Procedure

First of all, making use of the related literature, the researcher outlined the steps to be followed in scale development, and followed these steps. Although the number of these steps is claimed in different sources to vary with respect to the details of the actions to be taken, the development of a scale can be said to include six main headings (Scaledevstat, 2007; McMillan & Schumacher, 2006).

Below is presented the details of these steps explaining the process of scale development.

2.3.1 Building the conceptual framework phase

The related literature is limited in terms of the related studies on teachers, therefore the conceptual framework is limited as well. Accordingly, two steps were followed in order to build the conceptual framework to shed light on the generation of the item pool for TTLDS.

The first step was literature review. In this step, the studies on the reasons for techno-stress (Ahmad, Amin & Ismail, 2014; Ayyagari, Grover & Purvis, 2011; Shu, Tu & Wang, 2011; Fudail ve Mellar, 2008; Salanova, Llorens, Cifre & Nogareda , 2007; Tu, Wang & Shu, 2005; Brillhart, 2004; Weil & Rosen, 1997; Champion, 1988; Brod,1984), the relationship between technology use and techno-stress (Salanova, Llorens ve Cifre, 2013; Ahmad & Amin, 2012; Fudail & Mellar, 2008; Shepherd, 2004; Champion, 1988; Brod, 1984), and the problems experienced by teachers during the process of technology integration (Aktas, Gokoglu, Turgut & Karal; 2014; Banoglu, Madenoglu, Uysal & Dede, 2014; Genc & Genc, 2013; Pamuk, et al., 2013) were reviewed.

For the second step, in order to build the conceptual framework for TTLDS, 64 teachers working in a different province than the participants were asked for their opinions on the reasons for techno-stress. An open-ended question form (Form for Defining the Reasons for Techno-stress Among Teacher) was utilized accordingly (Creswell, 2007; Gay, Mills & Airasian, 2006). Open-ended question form was conducted at 12 different schools on teachers of 16 different branches. Content analysis method, which is qualitative data analysis method, was employed for the analyses of the obtained data. With content analysis, 117 different codes were obtained from 64 teachers, and these codes for utilized for the generation of item pool.

2.3.2 Item pool generation phase

The researcher re-analysed 117 codes obtained from the teachers in accordance with literature review. During the process of generating items based on the criteria obtained from the literature review conducted by the researcher, 51 items were generated from the 117 codes stated by the teachers, considering that some of these statements shouldn't be evaluated within the context of techno-stress, and some of these should be stated more generally and so should be combined.

2.3.3 Getting expert opinion (content validity) phase

Following item pool generation step, the scale developed was presented to 2 experts on Psychological Counselling and Guidance, and 3 experts on Computer and Educational Technologies for their opinions. In addition, these experts were provided with literature review on techno-stress, and some documents on the purpose of the present research. The experts revised 13 of the items, excluded 4 of the items, considering that they have / can have the same meaning, and suggested adding 1 more item. This way, the scale took its ultimate form of 48-items. In addition, the items were also presented to an expert on Turkish language, and given their ultimate form accordingly.

2.3.4 Pilot administration phase

Pilot administration of the 48-item 5-point likert type scale ("1-Totally Disagree", "2-Disagree", "3-Undecided", "4-Agree", "5-Totally Agree"), which took its final form after expert opinions, was carried on 30 teachers of various branches who work for the Ministry of National Education schools in Konya province of Turkey in 2015. The purpose of pilot administration was finding out how the scale was understood and responded by the teachers. These teachers were asked to answer items in TTLDS, and to develop suggestions for the items, they had difficulty in understanding. Following the pilot administration, some items were revised in terms of language, expression and structure, and given its final form.

2.3.5 Testing validity and reliability phase

In order to test validity and reliability, first it was analysed whether data collected from 395 teachers exhibited normal distribution. As measures of central tendency to be used for this purpose, Kolmogorov Smirnov test, which is used to test normality with Kurtosis and Skewness values. Kurtosis (0.049) and skewness (.110) values for 395 participants' scale average scores indicate that data set presents normal distribution (Pallant, 2007). Additionally, one of the normality tests, Kolmogorov Smirnov test results show that data collected from the teachers have normal distribution [$D_{(395)}$=.745, p>.05]. Finding out that scale has normal distribution, validity and reliability were tested for the data.

First procedure to test validity for TTLDS was to test content validity of the item pool. Then, factor analyses (Exploratory Factor Analysis- EFA and Confirmatory Factor Analysis- CFA) for the construct validity to present factor construct of the scale; and item validity in order to present the item discrimination index of each item, were conducted. In order to test reliability for TTLDS, internal consistency coefficient (Cronbach Alpha), and consistency coefficient between two halves of scale data (Spearman–Brown) were calculated.

Data collected to develop the scale were analysed in SPSS 17.0 (Statistical Package for the Social Sciences), and confirmatory factor analyses were conducted in AMOS 16.0 programs.

3. Findings

Construct validity and item validity were tested in order to define the validity of TTLDS. Item validity and discrimination index were calculated in order to define construct validity of the scale.

3.1 Construct Validity and the Factors of TTLDS

The total of 395 teachers, who work in two different provinces of Turkey (Ankara and Eskisehir) in 2014-2015 school year. Demographic data related to participants are presented in Table 1.

3.1.1 Findings related to the validity of TTLDS

As the conceptual framework of the scale, which will define the reasons for techno-stress among teachers, was not very clear, first factor constructs were presented through Exploratory Factor Analysis (EFA) then, the validity of the construct was confirmed through Confirmatory Factor Analysis (CFA).

In order to present the construct of the scale, first Exploratory Factor Analysis (EFA) was conducted on the collected data. Because there wasn't a conceptual framework to define techno-stress levels among teachers for the present research, defining the factor construct of the scale was important as it were to draw the conceptual framework for the literature.

Some statistical requirements should be met in order to conduct exploratory factor analysis on a data set. Some of these include studying the group sample number based on the number of items through Kaiser-Meyer-Olkin (KMO) value, and Bartlett Sphericity test. In this context, first Kaiser-Meyer-Olkin (KMO) was calculated. KMO value was found as 0.921. According Field (2005), this value is acceptable, furthermore considered as perfect. Secondly, Bartlett's Sphericity test results were analysed. Results for Bartlett's Sphericity test were significant [$X^2_{(1128)}$=8040.516, p<.05], which indicated that data set was appropriate for factor analysis (Pallant, 2007; Field, 2005; Tabachnick & Fidell, 1996). Finally, the convenience of factor analysis procedure was tested in terms of the sample size. Related literature suggests that, a number of over 300 participants, or 3 to 5 times of the number of items are convenient (Field, 2005; Tabachnick & Fidell, 1996). Accordingly, data set collected with a 48-item scale from 395 participants indicates the convenience for factor analysis procedure in terms of sample size.

Principal Component Analysis, which one of the factoring techniques, frequently used in social sciences, was utilized in order to define exploratory factors. Additionally, Varimax Rotation was conducted in order to provide explicity and significance for the correlations between factors. Eigen Value lower bound was taken as 1.0 while defining the number of factors. Additionally, factor load lower bound was taken as 0.40 for each item, and the lower bound for the differences between load values in factors was taken as 0.10 for each item (Pallant, 2007; Field, 2005; Tabachnick and Fidell, 1996).

According the results of the first factor analysis conducted on the 48 items in the scale, there were 10 factors with eigenvalue over 1.0 (Table 2). Table 2 presents factor structure and variance values for each factor after the first factor analysis procedure.

Table 2. Variance Values after the first Factor Analysis Procedure

Factors	Variance values after the first rotation procedure		
	Eigenvalue	Variance (%)	Cumulative Variance (%)
1	12.825	26.719	26.719
2	3.555	7.406	34.125
3	2.247	4.681	38.806
4	2.115	4.407	43.212
5	1.630	3.397	46.609
6	1.332	2.775	49.384
7	1.144	2.382	51.766
8	1.086	2.263	54.029
9	1.066	2.221	56.250
10	1.011	2.107	58.357

Factor analysis procedure presented in Table 2 was repeated for three times, in order to detect items, which didn’t fit factor construct and decrease correlation value, and remove these items from the scale, to minimize the correlations between factors in the scale construct and so ease the interpretation procedure. Accordingly, Varimax Rotation was conducted three times, and consequently 20 items were removed from the scale. After the first rotation 8 items (1, 2, 3, 15, 16, 17, 30, 44), after the second rotation 6 items (5, 7, 22, 23, 31, 33), and after the third rotation (4, 13, 19, 29, 38, 40) items were removed from the scale. After removing these items, a five-factor construct was found for the scale. Eigenvalues and variance values for the ultimate form of the scale are presented in Table 3.

Table 3. Variance values after the third rotation

Factors	Variance values after rotation procedure		
	Eigenvalue	Variance (%)	Cumulative Variance (%)
1	8.734	31.192	31.192
2	2.584	9.228	40.420
3	1.833	6.547	46.967
4	1.576	5.629	52.596
5	1.065	3.805	56.400

In the five-factor construct for the developed scale, eigenvalue for the first factor, which has the most variance, is 8.734, and it explains is 31.192% of the variance. Eigenvalue of the second factor is 2.584 and it explains 9.228% of the variance; eigenvalue of the third is 1.833, and it explains 6.547% of the variance; eigenvalue of the fourth factor is 1.57, and it explains 5.629% of the variance; and eigenvalue of the fifth factor is 1.065, and it explains 3.805% of the variance. The items of five-factor “Teachers’ Techno-stress Levels Defining Scale” were examined (Table 5), and the factors of the scale were named as “Learning-Teaching Process Oriented”, “Profession Oriented”, “Technical Issue Oriented”, “Personal Oriented”, and “Social Oriented”.

There are seven items (9, 18, 24, 32, 42, 45 and 47) in the first factor of Teachers' techno-stress levels defining scale "Learning-Teaching Process Oriented". These items were examined and it was found that these items were related to technology use in learning-teaching process. Second factor is "Profession Oriented", which includes 6 items (6, 8, 10, 11, 14 and 41). There are 6 items (25, 34, 35, 36, 37 and 46) in the third factor, and it was named as "Technical Issue Oriented" because of the items included. The other factor, which was named as "Personal Oriented", includes 5 items (12, 21, 26, 43 and 48). The last factor named as "Social Oriented" includes 4 items.

Because there wasn't a clear conceptual framework for techno-stress among teachers, confirmatory factor analysis was conducted on the data set on AMOS 16.0 program, in order confirm the validity and construct of the obtained data (Figure 1).

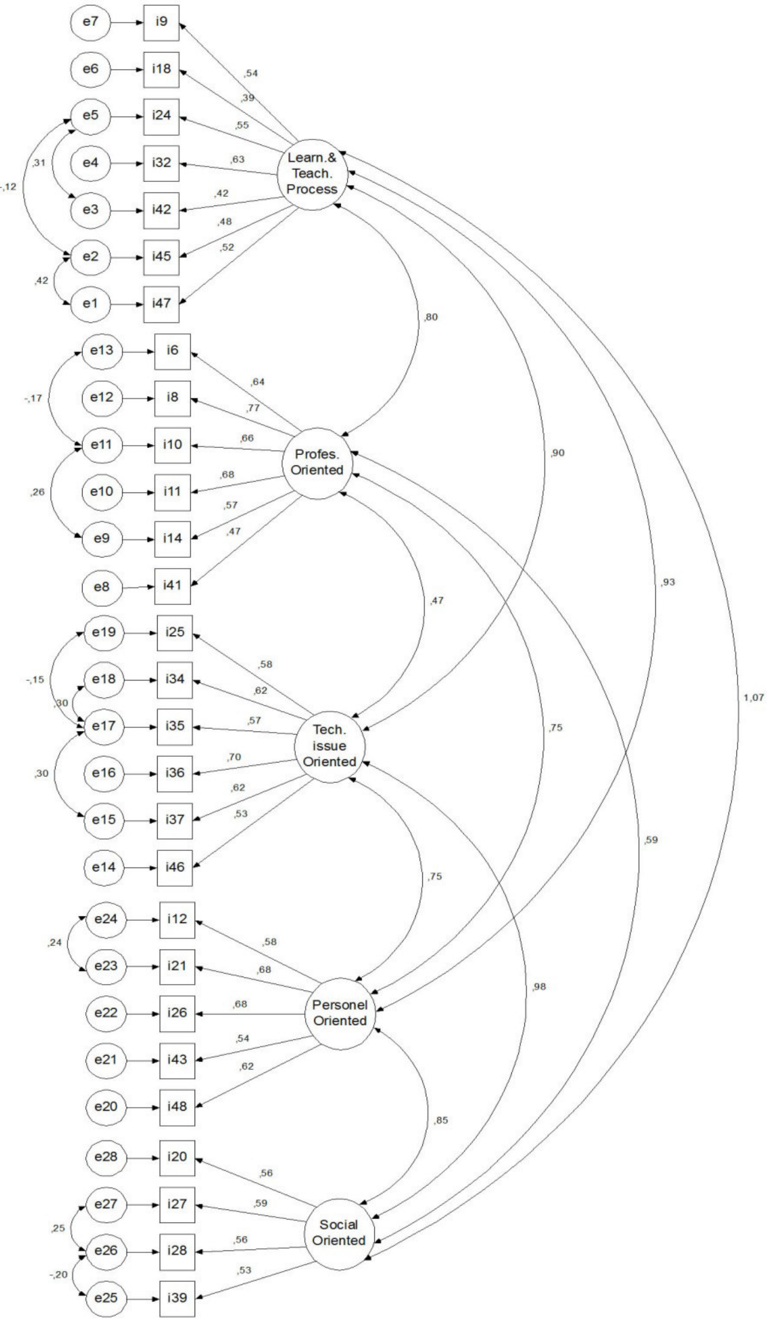

Figure 1. Confirmatory factor analysis modelling for the scale.

There are frequently used statistics in the literature to define the fitness of a developed model (Arbuckle, 2009; Aricak, 2009; Tabannick & Fidell, 1996). Within the scope of the present research, Chi-square Goodness of Fit ($\chi2$), Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) statistics, which were suggested in the related literature, were analysed. First, fit index values were calculated as χ^2/df=3.967 (χ^2= 1348.78; df=340), RMSEA=0.073; NFI=0.89, TLI=0.90 and CFI=0.93). Some of these were within the acceptable range, while some were very close the acceptable range (Table 4). After the first confirmatory factor analysis, suggestions in Modification Indices (Arbuckle, 2009) were taken into consideration to provide a better fit for the model, and the model was re-tested in order to re-study fit index values. In the model developed for the scale within the context of modification indices, some modifications for co-variance definition between the errors of the variables were observed in AMOS output. Of these; the modifications for items 24-42, 24-45 and 45-47 in "Learning and teaching process oriented" latent variable; items 6-10 and 10-14 in "profession oriented" latent variable; items 25-35, 34-35, and 35-37 in "technical issue oriented" latent variable; items 12-21 in "personal oriented" latent variable, and items 27-28 and 28-39 in "social oriented" latent variable were taken into consideration (Figure 1). Item-pairs suggested in these modifications are items included in the same latent variables. This way, modifications for the co-variance related to the errors in the model were added to the model, and then the model was re-tested. After the modification procedure, values obtained from the model were within the acceptable range, which are presented in Table 4.

Table 4. Fit Indices for the model, and the ranges considered acceptable in the literature

Fit Statistics	Perfect fit	Acceptable fit	Fit values of the model
RMSEA	≤0.05	0.06 – 0.08	0.061
NFI	≥0.95	0.94 – 0.90	0.92
TLI	≥0.95	0.94 – 0.90	0.93
CFI	≥0.97	0.95 – 0.96	0.95
χ^2/df	≤3	≤5	2.471

As can be seen in Table 4, χ^2/df=2.471 (χ^2= 840.14; df=340) value of the model is within the range accepted as perfect fit; and the other values are within the acceptable fit range (RMSEA=0.061; NFI=0.92, TLI=0.93 and CFI=0.95), which indicate the precision of the developed model. In other words, scale construct presented with exploratory factor analysis was confirmed with confirmatory factor analysis. The scale developed to define teachers' techno-stress levels, the factors forming the scale, and the items forming the factors are presented in Table 5.

Table 5. Factors forming the scale, arithmetic average, standard deviation, item total correlation, and rotation load values for the items

	Factors and items		Arit. average	Std. dev.	Item total correlation	Rotated factor load values
Factor 1. Learning-Teaching Process Oriented (α=0.732)	47	The idea that I won't be able to teach the whole course content, because technology use takes time makes me anxious.	2.63	1.144	.586	.690
	45	I think, that technology use require more effort in the classroom, affects technology use negatively.	2.38	1.034	.554	.806
	32	I feel forced to become more dependent on the Internet in the educational process.	2.65	1.146	.682	.500
	9	I am worried because digital-technology oriented materials are becoming more common in the educational process.	2.13	1.027	.562	.680
	18	I feel uncomfortable that, technological devices are used for extra-curricular purposes during the lessons by the students.	3.78	1.216	.391	.548
	24	I feel uncomfortable that technology leads everyone in the educational environments to laziness and freeriding.	3.23	1.217	.560	.749
	42	I am worried that technology use blunts students' research skills.	3.18	1.294	.471	.542
Factor 2. Profession Oriented	8	I think technology use makes teaching profession more difficult.	1.84	.898	.570	.759
	11	I think teaching profession is losing its value, because information sources have become technology oriented.	2.26	1.138	.548	.739

	Factors and items		Arit. average	Std. dev.	Item total correlation	Rotated factor load values
	6	I am worried that educational understanding might change because of technological devices.	2.43	1.210	.557	.647
	10	I am worried that I might get unemployed in the future due to technology use.	1.87	.929	.543	.633
	14	I am worried that I might lose prestige, because newer teachers can use technology better.	1.88	.957	.463	.611
	41	I think technology use increased teachers' workload.	2.27	1.076	.512	.733
Factor 3. Technical Issue Oriented (α=0.785)	35	I feel uncomfortable, as I am constantly worried about infecting technologies with viruses.	3.55	1.151	.430	.840
	34	I am worried that data I store in digital environments (memory sticks, Internet, etc.) can be lost, or change hands.	3.11	1.251	.561	.690
	36	I am worried because there are too many information (password, account name, etc.) to remember for technological environments, and I might forget these.	3.43	1.210	.595	.694
	37	I feel uncomfortable because technology costs a lot (purchase, repair and maintenance, paid websites, etc.).	3.39	1.142	.546	.690
	25	I am worried about the negative effects of technological devices within the classroom (noise, heating, etc.).	2.69	1.202	.594	.626
	46	I am worried about the security of technological devices (storing, keeping, etc.) at the school.	3.03	1.176	.539	.544
Factor 4. Personal Oriented (α=0.767)	12	I am worried that I might not be able learn using technology, even if I want to.	2.17	1.093	.550	.666
	21	I am worried about technology use, due to the necessity to keep up with constantly developing technology.	2.68	1.194	.649	.674
	26	I feel uncomfortable for being dependant on the individuals who are better at using technology.	2.71	1.210	.652	.592
	43	I might give up on using technology, as I cannot find sufficient opportunities for technology education.	2.38	1.077	.538	.607
	48	I am uncomfortable because I am not familiar with the terminology used in defining new technologies.	3.09	1.233	.611	.461
Factor 5. Social Oriented (α=0.712)	28	I feel uncomfortable that, digital technology use takes too much time.	3.45	1.185	.538	.689
	20	I think social interaction between everyone in the educational processes is damaged due to technology use.	3.40	1.176	.573	.597
	39	I am worried that I can have problems with my colleagues about technology use.	2.48	1.090	.555	.495
	27	I am worried that technology use can cause health problems (sight, hearing, pain, etc.).	3.24	1.194	.583	.654

Scale General (α=0.917)

3.1.2 TTLDS Item Validity

In order to define item validity of 28 items forming TTLDS, item discrimination levels were analysed.

Accordingly, upper and lower 27% of 395 participants' group (n=106) averages were compared. In this context, first scale general total score was calculated, ranked, and the difference between two groups of 106 participants with highest and lowest scores was compared with independent samples t-test (Table 6).

Table 6. T Values for upper-lower groups to define item discrimination levels

Items	Groups	$\overline{X}$	sd	df	t	Items	Groups	$\overline{X}$	sd	df	t
i1	Lower Upper	1.93 3.54	0.90 1.02	210	12.058*	i15	Lower Upper	2.21 3.96	1.04 0.92	210	12.920*
i2	Lower Upper	1.82 3.06	0.75 1.08	210	9.631*	i16	Lower Upper	2.46 4.17	1.21 0.74	210	12.335*
i3	Lower Upper	1.77 3.69	0.78 0.93	210	16.213*	i17	Lower Upper	2.49 3.99	1.08 0.88	210	10.986*
i4	Lower Upper	1.48 2.69	0.65 1.09	210	9.737*	i18	Lower Upper	1.84 3.54	0.88 1.11	210	12.286*
i5	Lower Upper	3.09 4.35	1.39 0.84	210	7.951*	i19	Lower Upper	2.32 3.80	1.10 0.99	210	10.260*
i6	Lower Upper	2.42 3.94	1.17 0.91	210	10.554*	i20	Lower Upper	1.53 2.81	0.72 1.17	210	9.604*
i7	Lower Upper	2.45 3.97	1.19 0.99	210	10.071*	i21	Lower Upper	1.77 3.58	0.82 1.02	210	14.151*
i8	Lower Upper	1.26 2.36	0.46 1.04	210	9.864*	i22	Lower Upper	1.83 3.75	0.77 1.00	210	15.539*
i9	Lower Upper	1.64 2.98	0.91 1.20	210	9.116*	i23	Lower Upper	1.63 3.03	0.66 1.12	210	10.992*
i10	Lower Upper	1.59 3.25	0.75 1.22	210	11.873*	i24	Lower Upper	2.14 3.92	1.02 0.90	210	13.327*
i11	Lower Upper	1.41 2.42	0.67 1.13	210	7.936*	i25	Lower Upper	2.58 4.05	1.17 0.93	210	10.074*
i12	Lower Upper	1.42 2.39	0.66 1.12	210	7.587*	i26	Lower Upper	2.52 4.25	1.12 0.79	210	12.941*
i13	Lower Upper	1.75 2.90	0.88 1.20	210	7.881*	i27	Lower Upper	1.82 3.31	0.77 1.09	210	11.399*
i14	Lower Upper	2.76 4.12	1.29 0.87	210	8.984*	i28	Lower Upper	2.38 4.02	1.13 0.86	210	11.870*
SCALE GENERAL	Lower Upper	2.09 3.52	0.30 0.29	210	34.764*						

* $p<.05$

Table 6 shows that, there is a statistically significant difference between upper and lower groups for each item forming "Teachers' Techno-stress Levels Defining Scale". According to these findings, the scale has item validity.

3.2 Findings related to the reliability of TTLDS

In order to test the reliability of "Teachers' Techno-stress Levels Defining Scale", internal consistency coefficient (Cronbach Alpha) of the data set, factor construct of which was defined, and coefficient of consistency between two halves of the data collected from scale (Spearman–Brown) were calculated.

3.2.1 Internal consistency coefficient (cronbach alpha value)

Internal consistency coefficient of the 28-item, 5-factor "Teachers' Techno-stress Levels Defining Scale" was calculated as α=.917. Internal consistency coefficients were also calculated for each factor, and respectively found as α=.732 for "Learning-Teaching Process Oriented" factor; α=.788 for "Profession Oriented" factor, α=.785 for "Technical Issue Oriented" factor; α=.767 for "Personal Oriented" factor; and α=.712 for "Social Oriented" factor. As internal consistency coefficient over .70 indicates reliability (Arbuckle, 2009; Pallant, 2007; Field, 2005), the scale can be considered as a reliable one, considering the calculated internal consistency coefficients.

3.2.2 Spearman-Brown coefficient (split-halves method)

Reliability coefficient calculated through split-halves method, which can be used to test reliability during scale development processes, refers to the consistency between the two halves of a scale, and this value can be calculated as low, if the scale is answered negligently or two halves of the scale measure different behaviours. This coefficient, called as Spearman-Brown in the literature, refers to this reliability testing method. Accordingly, calculated Spearman Brown coefficient for the two halves of the scale was found as 0.845. According to Field

(2005), Spearman Brown coefficient over 0.80 points indicates reliability. Accordingly, Spearman-Brown coefficient calculated for "Teachers' Techno-stress Levels Defining Scale" shows that the scale is reliable.

4. Conclusion and Discussion

Within the scope of the present research, a scale to define teachers' techno-stress levels (TTLDS) was developed with the participation of 395 teachers. Developed scale includes 28 items and five factors. For the reliability of the scale, Cronbach alpha coefficient was calculated as 0.917, and Spearman-Brown coefficient was calculated as 0.845. The minimum score to be gotten from 28-item 5-point likert type TTLDS is 28, while the highest is 140.

Five steps were followed during scale development process, in accordance with the related literature. In the first phase -building the conceptual framework- the related literature was reviewed, and in addition qualitative data were collected from 64 teachers. In the second phase –item pool generation- 51 items were written in accordance with the data obtained from conceptual framework. In the third phase –getting expert opinion- the researcher got opinions of five experts of two different fields (psychology and technology education). The number of the items was reduced to 48 in accordance with the suggestions of the experts. During pilot administration phase, five point likert type, 48-item draft was implemented on 30 teachers, and some were revised accordingly. In order to test validity and reliability, data were collected from 395 teachers, and first tested for normal distribution. After exploratory factor analysis, conducted for construct validity, 20 of the 48 items were extracted, and 28 items and five factors formed the scale. Confirmatory factor analysis showed that the model created for the scale was fit. Additionally, Cronbach Alpha and Spearman Brown were calculated to test item discrimination, and the results indicated that the scale was reliable. The items of the scale were examined, and the factors were named as Learning-Teaching Process Oriented, Profession Oriented, Technical Issue Oriented, Personal Oriented, and Social Oriented. At the end of the research, a valid and reliable scale to define teachers' techno-stress levels was developed.

According to the review of literature on measuring techno-stress, there are some instruments developed to measure techno-stress (Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Hudiburg, 1995; Rosen & Weil, 1995), and these were adapted by some other studies. In addition to these studies, some researchers developed some valid and reliable measurement instruments to define techno-stress (Longman, 2013; Popoola & Olalude, 2013). None of these measurement instruments were intended for teachers (company employees, librarians, health employees, academicians, students), and these instruments were only at questionnaire or inventory level.

As for the educational studies, most of the researchers used questionnaires adapted from the ones developed for company employees. Ragu-Nathan et al. (2008) used the instrument developed for company employees in their study. On the other hand, Jena (2015) used the scale developed to define techno-stress among academicians. As for The Computer Hassles Scale developed by Hudiburg (1995), almost all of the items are related to technical issues, and there aren't any items intended for the profession of teaching. The measurement tool developed by Booker, Rebman Jr & Kitchens (2014) includes some items that can be used to measure techno-stress among teachers (i.e. I have a higher workload because of the online learning environment). However, as the measurement was developed with students, and the items were intended for students (i.e. I find new students to this program know more about computer technology than I do), we can claim that this scale is not for teachers. The items of another scale developed by Burke (2005) are mostly related to technical issues, such as software, and hardware (i.e. hard drive crashes). Moreover, as this scale was developed with nurse trainers, it is not appropriate to measure primary school teachers' techno-stress levels.

The literature includes some scales developed for the studies on teachers. For instance, "General Attitudes Toward Computers Scale", developed by Rosen & Weil (1995) with teachers, is used to define techno-stress levels (King, 2014). However, because the scale is an attitude scale, it includes some items that cannot serve the purpose of measuring techno-stress (i.e. computers create new job for people or computers will never be smarter than people). Another measurement instrument intended for teachers was developed by Longman (2013). Most of the items of Technology Survey, developed to measure techno-stress levels of primary school teachers, are related to the frequency of technological devices, and attitudes towards these.

The dimensions and items of TTLDS are in agreement with some scales in the literature (Booker, Rebman Jr & Kitchens, 2014; Tarafdar et al., 2007) to some extent. However, the factors of TTLDS (learning-teaching process oriented, profession oriented, technical issue oriented, personal oriented, and social oriented) cover multiple possible stress aspects of an individual, who is both a personal and social being conducting the profession of teaching as a member of the integration process. Additionally, dimensions of TTLDS overlap with technological capabilities stated in the standards set for teachers' use of educational technologies by ISTE (ISTE Standards-T, 2008). ISTE standards include many issues ranging from technical use to teaching process, from social use to student abilities. From this perspective, TTLDS can be claimed to be an important scale, as it deals with teacher abilities in terms of the efficient use of educational technologies.

The findings of the researches conducted in Turkey, where the present scale was developed, after the implementation of FATIH project, on teachers and the problems they experience, support the construct validity of the developed scale. In these studies, teachers stated that in-service trainings they were offered were inadequate and not practical; they couldn't develop materials; they couldn't use the technologies efficiently, the education decreased their interest and motivation for technology; the materials were nor designed well and not appropriate for their teaching styles, student profiles; a new educational environment was formed, and adaptation to this environment would take time, the might loose control over the classroom, older teachers couldn't use these technologies, there might be problems between teachers who could and couldn't use these technologies, and the profession of teaching might become more difficult (Aktas, Gokoglu, Turgut & Karal; 2014; Banoglu et al., 2014; Ozkan & Deniz, 2014; Genc & Genc, 2013; Pamuk et al., 2013). Additionally, teachers expressed that they might feel incompetent in case of any technological problems, the working environment was unhealthy, the had worried about the repair and maintenance services in case of a breakdown, the devices had connection issues, the tablets froze, tablet batteries died quickly, and touch feature didn't work well, updates erased existing files, data couldn't be transferred, technical problems couldn't be solved immediately, existing software was unsatisfying, affected eye health negatively, and they were worried about radiation (Aktas et al., 2014; Banoglu et al., 2014; Cetinkaya & Keser, 2014; Ciftci, Taskaya & Alemdar; 2013; Dursun et al., 2013; Genc & Genc, 2013; Pamuk et al., 2013). These statements of teachers indicate that, teachers experienced or worried about experiencing problems related to learning-teaching process, technical problems, personal problems, and professional problems. Consequently, techno-stress, which was defined as a distress resulting from adaptation problems to new technologies, has become a problem affecting teaching profession negatively. The construct of the scale developed in the present study (TTLDS) covers many problems offered in many related researches in the literature.

Researchers, who plan to study on defining techno-stress levels among teachers, can use TTLDS. TTLDS can also be used a data collection tools for experimental studies, to be conducted to the measure the effectuality of the environment that may create techno-stress. Item creation, implementation, and testing validity procedures were conducted in Turkish for TTLDS. However, researchers, who want to measure techno-stress levels of teachers in other countries, can adapt TTLDS into other languages.

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