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Education Technology Standards Self-Efficacy (ETSSE) Scale: A Validity and Reliability Study[1]

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Abstract

Problem Statement: The educational technology standards for teachers set by the International Society for Technology in Education (the ISTE Standards-T) represent an important framework for using technology effectively in teaching and learning processes. These standards are widely used by universities, educational institutions, and schools. The contemporary ISTE standards for teachers proposed in 2008 have five dimensions. The standards created a vision for the educational technology field, so it is important that how prospective teachers or in-service teachers meet these standards is measured with valid and reliable instruments.

Purpose of the Study: The purpose of this study was to develop and validate the education technology standards self-efficacy (ETSSE) scale, which is based on the ISTE Standards-T.

Method: Confirmatory factor analyses (CFA) were conducted in order to determine the factor structure of the scale. The scale items were constructed based on the ISTE Standards-T and performance indicators. To define the content validity values of the scale items, the researchers asked the opinions of 12 specialists. The data was collected from prospective teachers (CFA1 group, n=473) and teachers (CFA2 group, n=394). Owing to the theoretical structure of the standards being defined

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by ISTE, both first order and second order confirmatory factor analyses were applied to the datasets of the two groups separately and without exploratory factor analysis.

Findings: The ETSSE scale was validated in five dimensions as ISTE Standards-T 2008 identified. According to the results of the first order and second order confirmatory factor analyses (CFAs) of the two different groups, the scale is considered reliable (CFA1 1st order [χ^2 (734, n= 473)= 1857.23, p< .001, RMSEA=.057, SRMR=.053, NFI= .95, NNFI=.97, CFI=.97, IFI=.97]; CFA2 1st order [χ^2 (727, n= 394)= 1886.31, p< .001, RMSEA=.064, SRMR=.056, NFI = .95, NNFI=.97, CFI=.97, IFI=.97]). Concurrent validity results showed a positive and significant correlation between the two scales .83 (p<.01). Cronbach's Alpha was at .95 and McDonald's Omega was .96. The item analyses showed that each item correlated with the overall score from the scale both for prospective teachers and teachers (Corrected Item-Total Correlation >.30). Independent group t-tests for the 27% upper and 27% lower groups in the five sub-factors showed significant difference (p<.01).

Conclusion and Recommendations: The research results have demonstrated that the developed ETSSE scale consisting of 40 items and five subscales is valid and reliable for both teachers and prospective teachers.

Keywords: Education technology standards, ISTE standards, scale development, confirmatory factor analysis

Introduction

Predictions suggest that qualified educational institutions with international standards will be replacing institutions lagging behind in near future (Özcan, 2013). Studies using current theoretical frameworks identify skills as standards that students, teachers, and administrators should have, and effective use of information and communications technology (ICT) is widely considered to be a basic skill in the 21st century (Voogt & Roblin, 2010; Voogt & Roblin, 2012).

Training the teachers who are in key position of integrating ICT in instructional processes (Kabakci & Odabasi, 2007; Ilgaz & Usluel, 2011; Kabakci Yurdakul, 2013; Goktas, Yildirim & Yildirim, 2009) is just as important as equipping educational institutions with the proper technological resources (Akpinar, 2003). The International Society for Technology in Education (ISTE) has been carrying out international level research on the standardization of educational technology skills for using technology effectively in education for different groups (students, teachers, and administrators). ISTE emphasizes the effective use of technology in educational settings and sets standards for the integration of technological knowledge, pedagogical knowledge, and content knowledge into courses. ISTE has provided certain standards and performance indicators for teachers and prospective teachers for using technology, especially in instructional processes and in teaching subject

areas (ISTE, 2014; Seferoglu, 2009; Coklar & Odabasi, 2009; Morphew, 2012). The ISTE Standards-T represent an important framework for using technology effectively in teaching and learning processes and are widely used by universities, educational institutions, and schools (ISTE, 2000). Performance indicators in the standards are specific, measurable outcomes that assess what teachers should be able to do to show that they have achieved competency in the standard (Morphew, 2012).

According to the ISTE Standards-T proposed in 2008, teachers should be able to:

1. Facilitate and inspire student learning and creativity. Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

2. Design and develop digital age learning experiences and assessments. Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to help students develop the knowledge, skills, and attitudes identified in the ISTE standards.

3. Model digital age work and learning. Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.

4. Promote and model digital citizenship and responsibility. Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.

5. Engage in professional growth and leadership. Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources (ISTE, 2014).

These standards can be taken as 21st century teacher competencies (ISTE, 2014). Because digital learners demand digital teaching, competent teachers who meet the requirements of these learners should be trained to international standards (Skoretz & Cottle, 2011; Özcan, 2013). In the modern transformation of the education system, it is important to deal with effective technology integration models in the classroom and to configure the curriculum accordingly. Thus, appropriately customizing curriculum to meet the international standards will provide a positive contribution to the teacher training policies.

As theoretical constructs of the ISTE Standards-T that cannot be observed directly, the aforementioned standards should be tested on both prospective teachers and in-service teachers to determine reliability and validity. The purpose of this study is to develop and validate the five-factored structure of the education technology standards self-efficacy (ETSSE) scale based on the ISTE Standards-T.

Method

Participants

The research study groups consist of junior (third year) and senior (fourth year) prospective teachers (Confirmatory Factor Analysis - CFA1 group; n= 473) studying at a faculty of education of a state university, and teachers (CFA2 group; n= 394) at secondary or high schools in the center districts of Diyarbakır during the spring semester of the 2014-2015 academic year in Turkey. A total of 510 surveys were distributed to prospective teachers, 480 appropriate responses were obtained, and 473 (for the CFA1 group) of them were used in the data analysis process. Similarly, 431 forms were distributed to the in-service teachers, 408 of whom completed the forms precisely, resulting in 394 (for the CFA2 group) observations that were taken into account in the data analysis process.

Table 1.

Demographic Characteristics of the Participants in CFA1 and CFA2 Groups

CFA1 (Prospective Teachers)		f	%	CFA2 (Teachers)		f	%
Gender	Female	277	58.6	Gender	Female	151	38.3
	Male	196	41.4		Male	243	61.7
Departments	Preschool Ed.	79	16.7	Branches	Physical Ed.	15	3.8
	Elementary Ed.	32	6.8		Information technology	17	4.3
	Foreign language (English)	31	6.6		Science and math fields	96	24.5
	Social studies	82	17.3		Arts	13	3.3
	Turkish language and literature	34	7.2		English	33	8.4
	Geography	31	6.6		Vocational and technical fields	35	8.9
	Secondary mathematics	16	3.4		Music	7	1.8
	Turkish	37	7.8		Psychological counseling and guidance	14	3.6
	Physics	11	2.3		Health education	2	0.5
	Chemistry	28	5.9		Social science fields	137	34.9
	Biology	27	5.7		Technology and design	16	4.1
	Philosophy	29	6.1		Others	7	1.8
	Pedagogical formation mathematics	36	7.6				

Table 2. *Continued*

CFA1 (Prospective Teachers)		f	%	CFA2 (Teachers)		f	%
Level	Junior (3rd year)	241	51	School Stage	Secondary	239	60.7
	Senior (4th year)	232	49		High School	155	39.3
Program	Faculty of education	342	72.3	Teaching experience	1 – 5 year	65	17.1
	Pedagogical formation	131	27.7		6 – 10 year	93	24.5
					11 – 15 year	102	26.8
					16 – 20 year	72	18.9
					20 year up	48	12.6

The demographic characteristics of the prospective teachers (the CFA1 group) indicate that the majority of the participants were female (58.6%), the participation of junior and senior level prospective teachers was very close (49% and 51%, respectively), and the number of prospective teachers registered in the pedagogical formation program (27.7%) was much lower than those in the education program (72.3%). The CFA1 group, which involved 13 different departments, had the most respondents from the Social Studies department (17.3%) and the least from Physics (2.3%).

In the CFA2 group comprising of in-service teachers, there were more male teacher (61.7%) respondents than female teachers, secondary school teachers (60.7%) were more than high school teachers, and teachers from 34 different branches grouped into 12 overarching branches participated in the research. The most participation was by social science fields' teachers (34.9%).

Research Instrument and Procedure

Based on the purpose of the scale, the related literature initially reviewed and an item pool generated from the ISTE Standards-T. Some items were eliminated based on lack of clarity, questionable relevance, or undesirable similarity to other items. The next step in the process was asking a group of specialists in the content area to review the item pool. This review serves multiple purposes for maximizing the content validity of the scale (DeVellis, 2003). The scale, which was designed in accordance with experts' opinions, was a five point likert type: Strongly Disagree (1), Disagree (2), Mildly Agree (3), Agree (4), and Strongly Agree (5). The ETSSE questionnaire consisted of 40 items and five sub-dimensions, took 8-10 minutes to complete, and had no reverse scoring items. The sub-scales of the ETSSE scale are: (F1) Facilitating and inspiring student learning and creativity; (F2) Designing and developing digital age learning experiences and assessments; (F3) Modelling digital age work and learning; (F4) Promoting and modelling digital citizenship and responsibility; and (F5) Engaging in professional growth and leadership.

Data Analysis

Owing to the theoretical structure of the standards defined by ISTE, both first and second order confirmatory factor analyses were applied to the datasets of the CFA1 and CFA2 groups separately to define construct validity without exploratory factor analysis (EFA). In EFA, the underlying latent variable structure is not known. Thus,

the focus of the investigation is directed toward uncovering the minimal number of factors that underlie the observed variables. In CFA, on the other hand, the researcher has some knowledge of the underlying latent variable structure (Byrn, 1989), therefore CFA is based on past evidence and theory (Brown, 2006). In CFA specific hypotheses about the structure of and relations between the latent variables are tested (Field, 2009).

Researchers typically use CFA after an instrument has already been assessed using EFA to test if the factor structure produced by EFA fits the data from a new sample. An alternative, less typical approach is to perform CFA to confirm a theoretically driven item set without the prior use of EFA. However it is stated that a CFA that would ultimately need to be followed by a second CFA could be used rather than using only a CFA (Worthington and Whittaker, 2006). Thus two CFAs are implemented in two different samples in the present research.

Chi-square (χ^2), RMSEA, RMR, SRMR, NFI, CFI, and IFI fit values were considered to evaluate good fit of the ETSSE scales' sub factors and their relation to the overall scale. To identify the reliability, Cronbach's Alpha and McDonald's Omega internal consistency coefficients were investigated. In order to identify the item discrimination, corrected item total correlation was analyzed. For discriminant validity, upper and lower distinct group based t-tests were conducted, and the means difference between the upper 27% and the lower 27% were identified.

Concurrent validity and reliability studies and item analyses were performed using the PASW Statistics (formerly SPSS) 18 Software package. The LISREL 8.54 Software package was used to calculate CFAs.

Results

Findings Regarding Validity

Content validity. A literature review of the ISTE standards for teachers was analyzed to specify the extent to which the defined set of items reflects the ETSSE content. Next, an item pool containing 86 declarative sentences was designed, taking into consideration the studies of Morphew (2012) and Cennamo, Ross, and Ertmer (2010) representing ISTE-T (2008) standards and performance indicators. Twenty-four sentences were eliminated from the item pool based on lack of clarity, questionable relevance, or undesirable similarity to other items. The initial item pool with a total of 62 items was presented to 12 experts in the content area to determine the content validity.

Content validity concerns item sampling adequacy - that is, the extent to which a specific set of items reflects a content domain (DeVellis, 2003). Usually, an instrument's standing with respect to content validity is determined simply by having experts carefully compare the content of the test against a syllabus or outline that specifies the instrument's claimed domain (Huck, 2012). Croker and Algina (1986) claimed that the most commonly used method is to consult expert views in the

process of determining content validity (as cited in Kan, 2007), and it is important to understand the content consistency among the expert opinions (Yurdugul, 2005). While many indexes have been developed to define content validity, Lawshe's (1975) content validity ratio (CVR) technique is calculated by quantifying subject matter experts' responses to determine "Essential, Useful but not essential, or Not necessary" (Lawshe, 1975; Yurdugul, 2005; Kan, 2007). The minimum value of the CVR is 0.56 for 12 experts at a .05 level of significance (Lawshe, 1975).

A total of 22 items were eliminated after the domain experts' assessment. The whole content validity indexes of the 40 items and five-sub dimensions of the initial scale are as follows: F1=.80, F2=.72, F3=.80, F4=.75, and F5=.74. The content validity indexes of the sub-dimensions are above the minimum value of the CVR.

Construct validity. Before implementing CFA, the assumptions specified by Tabachnick and Fidell (2007) were examined for the datasets of the two CFA groups.

1. Sample size and missing data. Kass and Tinsley (1979) recommended having between five and ten participants per variable, up to a total of 300 participants (as cited in Field, 2009). In this research, both the CFA1 group (n=473) and the CFA2 group (n=394) met this assumption. To assess the factorability of the scale, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used. KMO verified the sampling adequacy for the groups (CFA1= .95 and CFA2= .94). The KMO values are above the cut off of .60 as suggested by Pallant (2001) and Tabachnick and Fidell (2007). Bartlett's test of sphericity value is significant for both CFA1 and CFA2 (CFA1 χ^2= 7335.049, df=780, p< .01; CFA2 χ^2 =8356.177, df= 780, p< .01) as well. There is no missing data in the two datasets.

2. Linearity and normality. To identify the linearity and normality, a normal p-p plot of standardized residual regression and histogram charts were reviewed.

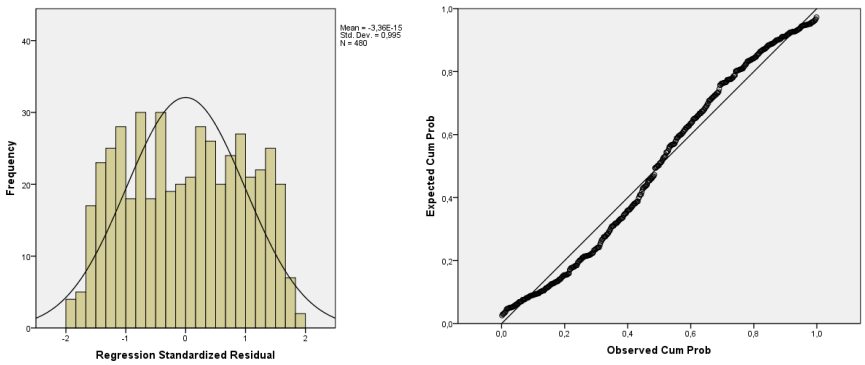

Figure 1. Normal P-P plot of standardized residual regression and histogram for CFA1

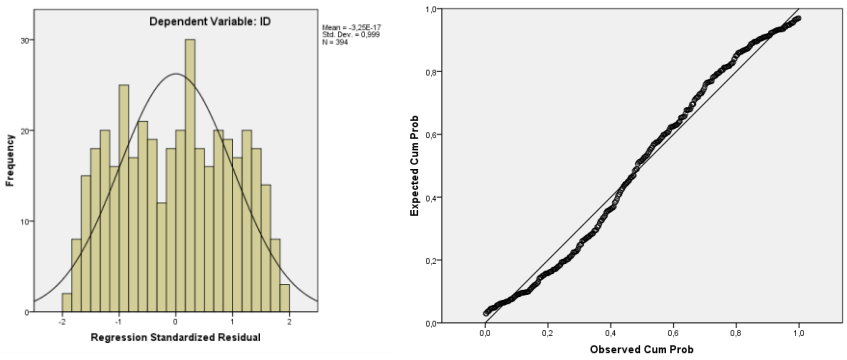

Figure 2. Normal P-P plot of standardized residual regression and histogram for CFA2

According to the figures, the datasets of CFA1 and CFA2 appear to be both linear and normal. In addition to identifying the normality assumption, the relative multivariate kurtosis values were reviewed; the values were 1.264 for CFA1 and 1.206 for CFA2 datasets. According to Kline (1998), multivariate normality kurtosis values of < 2 show normality (as cited in Aşkar & Mazman, 2013).

3. Multicollinearity. Moderate to high intercorrelations among the independent variables present a problem referred to as multicollinearity (Pedhazur & Schmelkin, 1991; Stevens, 2009). Some diagnostics of multicollinearity are tolerance and the variance inflation factor (VIF). Values below 0.1 indicate serious problems in tolerance, and VIF values should be below a value of 10 (Akbulut, 2010; Field, 2007). These values were within the appropriate range in both datasets (CFA1: minimum tolerance=.38, maximum VIF=1.79; CFA2: minimum tolerance=.28, maximum VIF=3.60).

4. Detecting univariate and multivariate outliers. To identify univariate outliers, critical t values (-1.96; +1.96) at a .05 level of significance were investigated, and no outliers were found for the two CFA datasets. However, when the Mahalanobis distance values were analyzed for CFA1's seven observations of 480 and for CFA2's 14 observations of 408, these values were identified as exceeding the critical value of five independent variables of 20.52 in the multivariate outliers (Tabachnick & Fidell, 2007).

As a result of meeting the assumptions of CFA, the two datasets met the criterion of implementing CFAs. Consequently, the 473 observations of CFA1 and the 394 observations of CFA2 were analyzed for construct validity.

Implementation of the Confirmatory Factor Analyses

The CFA1 group. The first order analysis of fit indices values for the CFA1 group were χ^2 (729, n= 473)= 1781.64, p< .001, RMSEA= .055, SRMR= .049, NFI= .95, NNFI= .97, CFI= .97, and IFI= .97. A second order confirmatory factor model was formulated to show if the five first order factors were indicators of the theoretically proposed

higher order factor ETSSE. The resulting analysis of fit indices values were found to be χ^2 (734, n= 473)= 1857.23, p < .001, RMSEA= .057, SRMR= .053, NFI = .95, NNFI=.97, CFI= .97, and IFI= .97. According to the cut-off values indicated in Table 2, both the first order and second order CFAs yielded indications of acceptable or good fit for the proposed model. All these values for the proposed models of CFA1 group indicated that the models are appropriate.

Table 2.

The Standard Fit Criteria and Fit Values of CFA1 for the Proposed Model

Values	Good Fit Values	Acceptable Fit Values	1st order CFA	2nd order CFA
X^2/df	.00 < X^2/df < 3	3.01 < X^2/df < 5.00	2.44	2.53
RMSEA	.00 < RMSEA < .05	.05 < RMSEA < .08	.055	.057
SRMR	.00 < SRMR < .05	.05 < SRMR < .10	.049	.053
NFI	.95 < NFI < 1.00	.90 < NFI < .95	.95	.95
NNFI	.97 < NNFI < 1.00	.95 < NNFI < .97	.97	.97
CFI	.97 < CFI < 1.00	.95 < CFI < .97	.97	.97
IFI	.95 < IFI < 1.00	.90 < IFI < .95	.97	.97

* 1st order CFA for CFA1: χ^2 =1781.64; df=729; for RMSEA 90% confidence interval = (.050, .56)

When the relationships of the sub factors with general structure of the ETSSE model reviewed, the values accordingly found to be as (F1) Facilitating and inspiring student learning and creativity =.79, (F2) Designing and developing digital age learning experiences and assessments =.90 (F3) Modelling digital age work and learning =.96, (F4) Promoting and modelling digital citizenship and responsibility =.85 (F5) Engaging in professional growth and leadership =.90.

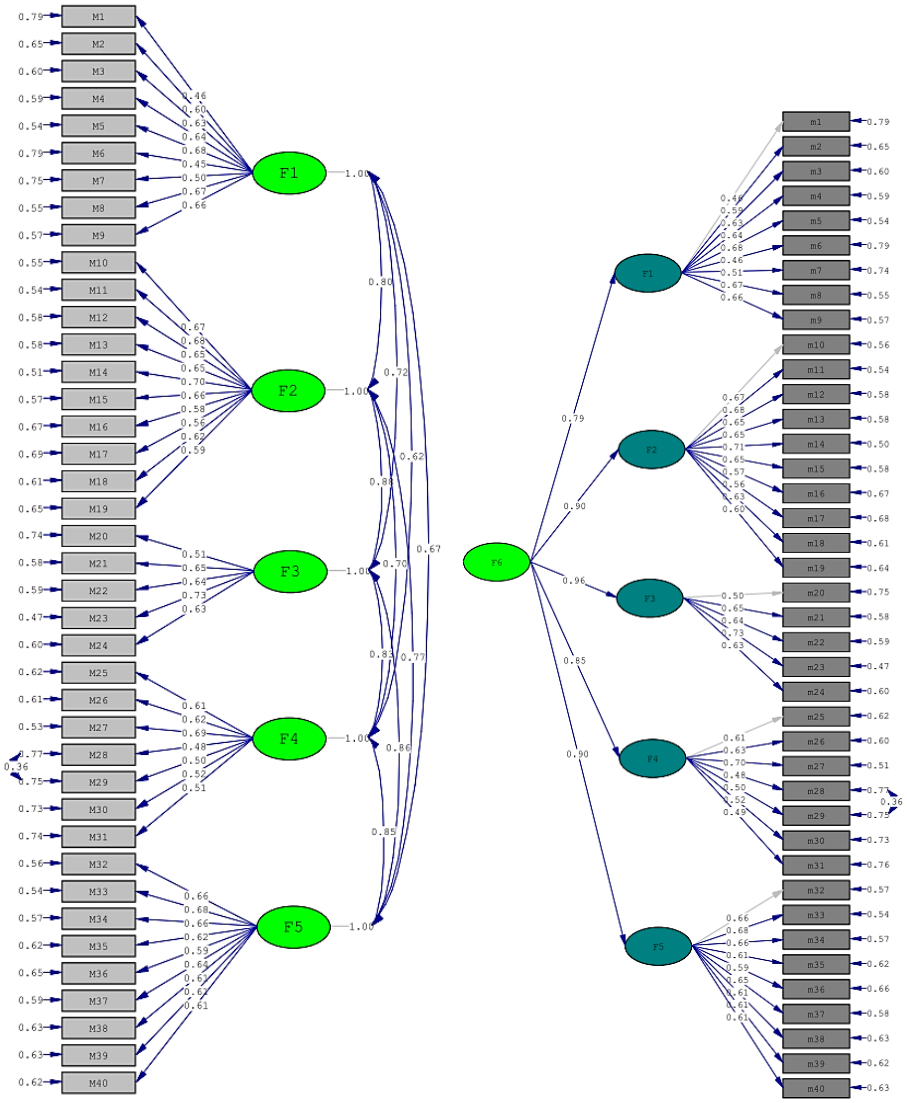

Figure 3. The standardized solution screen of the factor loads of first and second order CFA's for the CFA1 group

The path diagrams of the CFA1's first order and second order models are depicted in Figure 3 using a standardized solutions screen. The F3 sub-factor was determined to be the most closely related to the ETSSE. When the factor loads of the scale were reviewed, the lowest one found to be .46 and the highest .73.

The CFA2 group. As a result of the analysis, the first-order fit indices values for the CFA2 group were found to be χ^2 (727, n= 394) = 1886.31, p<.001, RMSEA= .064, SRMR= .056, NFI= .95, NNFI= .97, CFI= .97, and IFI= .97. A second order confirmatory factor model was formulated to show if the five first order factors were indicators of the theoretically proposed higher order factor ETSSE. As a result, the fit indices values were found as χ^2 (732, n= 394) = 2362.77, p< .001, RMSEA= .069, SRMR= .059, NFI= .95, NNFI= .97, CFI= .97, and IFI= .97.

Table 3.

The Standard Fit Criteria and Fit Values of CFA2 for the Proposed Model

Values	Good Fit Values	Acceptable Fit Values	1st order CFA	2nd order CFA
X^2/df	.00 < X^2/df < 3	3.01 < X^2/df < 5.00	2.59	3.23
RMSEA	.00 < RMSEA < .05	.05 < RMSEA < .08	.064	.069
SRMR	.00 < SRMR < .05	.05 < SRMR < .10	.056	.059
NFI	.95 < NFI < 1.00	.90 < NFI < .95	.95	.95
NNFI	.97 < NNFI < 1.00	.95 < NNFI < .97	.97	.97
CFI	.97 < CFI < 1.00	.95 < CFI < .97	.97	.97
IFI	.95 < IFI < 1.00	.90 < IFI < .95	.97	.97

* 1st order CFA for CFA2: χ^2 =1886.31; df=727; for RMSEA, the 90% confidence interval = (.062, .69)

According to the cut-off values in the Table 3, both the first and second order CFAs yielded indications of acceptable or good fit for the proposed model. All these values for the proposed models of the CFA2 group indicated that the models are appropriate.

When the relationships between the sub factors and the general structure of the ETSSE model were reviewed, the values were found to be: (F1) Facilitating and inspiring student learning and creativity= .72; (F2) Designing and developing digital age learning experiences and assessments= .91; (F3) Modelling digital age work and learning= .97; (F4) Promoting and modelling digital citizenship and responsibility = .84; and (F5) Engaging in professional growth and leadership= .85. The F3 sub-factor was found to be the most closely related to the ETSSE. The factor loads of the scale ranged from .48 to .75.

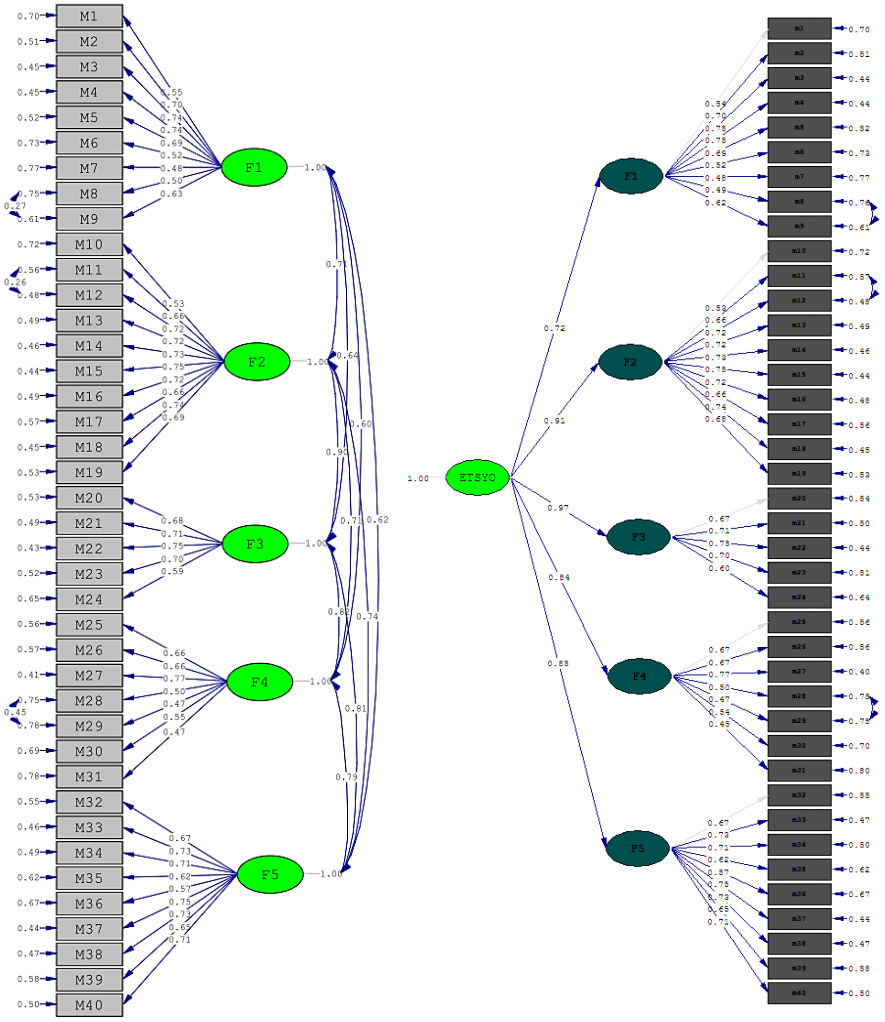

Figure 4. The standardized solution screen showing factor loads of first and second order CFA's for the CFA2 group

Concurrent validity. In order to identify the concurrent validity of the ETSSE scale, the researcher used the Educational Technology Standards Determination Scale (ETSS) based on the 2000 ISTE National Educational Technology Standards for teachers (NETS-T) developed by Coklar and Odabasi (2009). The ETSS has 41 items and six sub-factors and was used in a study with 460 senior level prospective teachers in the 2005 and 2006 fall semesters in Turkey.

Coklar and Odabasi (2009) summarized the ETSS under six sub-factors similar to the ISTE NETS-T of 2000. The sub-factors of ETSS are: 1. Technology operations and

concepts; 2. Planning and designing learning environments and experiences; 3. Assessment and evaluation; 4. Productivity and professional practice; 5. Social, ethical, legal, and human issues; and 6. Planning of teaching according to individual differences and special needs.

The ETSSE and the ETSS scales were applied in a study with 114 senior level prospective teachers at the same time. The Pearson correlation coefficient calculated between the scores of both scales were found to be .83 ($p<.01$). As a result, a high, positive, significant correlation was found between the ETSSE and ETSS scales. Thus, the ETSSE scale can be said to provide concurrent validity.

Findings Regarding Reliability

Item analysis. The item-total correlation of the ETSSE scale corrected for item discrimination was calculated using the Pearson product-moment correlation coefficient.

Table 3.
The Values of Corrected Item Total Correlation (CITC) for the ETSSE Scale

Sub dimensions	Item number	CFA 1			CFA 2		
		CITC	α	ω	CITC	α	ω
(1) Facilitating and inspiring student learning and creativity	m1	.36	.83	.83	.43	.85	.85
	m2	.45			.53		
	m3	.50			.53		
	m4	.48			.56		
	m5	.58			.55		
	m6	.34			.37		
	m7	.47			.45		
	m8	.56			.42		
	m9	.57			.61		
(2) Designing and developing digital age learning experiences and assessments	m10	.58	.87	.87	.55	.90	.90
	m11	.58			.60		
	m12	.55			.67		
	m13	.57			.63		
	m14	.63			.63		
	m15	.61			.67		
	m16	.51			.62		
	m17	.54			.62		
	m18	.58			.67		
	m19	.54			.59		
(3) Modelling digital age work and learning	m20	.46	.77	.77	.61	.82	.82
	m21	.59			.62		
	m22	.57			.66		
	m23	.66			.65		
	m24	.57			.56		

Table 4. (*Continued*)
The Values of Corrected Item Total Correlation (CITC) for the ETSSE Scale

Sub dimensions	Item number	CFA 1			CFA 2		
		CITC	α	ω	CITC	α	ω
4) Promoting and modelling digital citizenship and responsibility	m25	.51	.78	.76	.54	.80	.80
	m26	.52			.50		
	m27	.60			.66		
	m28	.40			.43		
	m29	.40			.40		
	m30	.45			.46		
	m31	.47			.48		
(5) Engaging in professional growth and leadership	m32	.59	.85	.86	.59	.89	.89
	m33	.61			.63		
	m34	.59			.62		
	m35	.52			.52		
	m36	.54			.49		
	m37	.59			.64		
	m38	.56			.65		
	m39	.52			.56		
	m40	.56			.64		

According to Table 4, the corrected item-total correlations (CITC) of the CFA1 dataset range from .34 to .66, and the CFA2 dataset ranges from .37 to .67. Generally, item total correlation values above .30 are accepted to mean that the item is appropriately effective (Buyukozturk, Cakmak, Akgun, Karadeniz & Demirel, 2008). Both of these values are above .30, showing that all the items correlate with the total score of the scale and are reliable.

Reliability

In order to assess the reliability of the scale's internal consistency, both Cronbach's Alpha and McDonald's Omega coefficients were calculated. As seen in Table 4, the Cronbach's Alpha values for the overall scale and sub-scales ranged from .77 to .87, and the McDonald's Omega coefficients ranged from .76 to .87 for the CFA1 dataset. For the CFA2 dataset, both the Cronbach's Alpha and the McDonald's Omega values ranged from .80 to .90. These results indicate that the internal consistency and reliability of the composite and sub-scales were adequate.

Another technique used to determine reliability is to identify differences in the arithmetic means of the scores with high or low self-efficacy levels. Differences in the mean scores of the upper and lower 27% groups can be reviewed for the discriminant validity (Atilgan, Seckes, Yurdugul & Cirak, 2007). For discriminant validity, upper and lower distinct group based t-tests were conducted, and the results are presented in Table 5.

Table 5.

Discriminant Validity, Upper and Lower 27% Distinct Groups-Based Independent Samples t-test Scores

		CFA1						CFA2					
Factors	Group	n	$\bar{X}$	Sd	df	t	p	n	$\bar{X}$	Sd	df	t	p
F1	Lower	128	3.39	.21	254	44.04	.00	106	3.17	.30	210	-31.59	.00
	Upper	128	4.69	.26					4.46	.30			
F2	Lower	128	3.21	.31	254	-41.55	.00	106	2.94	.36	210	-32.47	.00
	Upper	128	4.58	.21					4.39	.29			
F3	Lower	128	3.17	.34	254	-41.84	.00	106	2.98	.32	210	-37.29	.00
	Upper	128	4.65	.33					4.48	.26			
F4	Lower	128	3.06	.35	254	-42.48	.00	106	2.95	.34	210	-34.61	.00
	Upper	128	4.57	.20					4.43	.28			
F5	Lower	128	3.28	.34	254	-40.49	.00	106	3.02	.32	210	-36.33	.00
	Upper	128	4.68	.19					4.46	.25			
ETSSE	Lower	128	3.35	.25	254	-43.85	.00	106	3.13	.27	210	-34.67	.00
	Upper	128	4.52	.17					4.32	.22			

According to the independent samples t-test results, the self-efficacy scores of the upper and lower 27% groups in either CFA1 or CFA2 were significantly different for all sub-scales and total scales at.01. Thus these results provide adequate evidence for the discriminant validity.

Discussion and Conclusion

Of the existing literature on ISTE standards, Coklar's (2008) research about the ISTE NETS-T 2000 standards and performance indicators is an important resource. Of the other researchers, Misirli (2014) studied standards for students, Caglar (2012) studied standards for teachers, and Hacifazlioglu, Karadeniz, and Dalgic (2010) studied standards for administrators. Besides, Kabakci Yurdakul et al. (2014) determined teacher competencies in technopedagogical education in terms of national standards; the study listed 20 competencies and 120 performance indicators with a group of 24 faculty members. Despite the important and significant previous research on standards for teachers or other groups in Turkey, more studies specifying educational technology skills similar to ISTE or UNESCO ICT competencies will contribute to identifying national educational technology standards. These standards should also be developed in accordance with valid pedagogical and technological improvements.

The ETSSE scale presents a valid measurement system based on the contemporary ISTE standards for teachers. The standards are differentiated from the previous ISTE NETS-T in terms of highlighting creativity and innovation (Orhan,

Kurt, Ozan, Som Vural & Turkan, 2015). These standards have a constructivist focus, attach importance to globalization and cultural awareness, reflect changing perspectives, and require teachers to demonstrate leadership (Willis, 2012). Kadijevich and Haapasalo (2008) emphasized the importance of examining relevant variables concerning educational technology standards (behavior, intention, interest, attitude, support, experience, etc.) using multiple sources of evidence and combining qualitative and quantitative aspects. For these reasons, this scale is an important data gathering tool to reveal teachers' and prospective teachers' educational technology self-efficacy within the context of creativity, collaboration, innovation, and globalization, which are considered important competences in modern education frameworks.

Two different study groups were analyzed in this study: prospective teachers studying in various departments and different teacher training programs, and current teachers from 34 different branches having between 1 and 20 years of teaching experience. Therefore, the study was carried out within different populations of pre-service and in-service teachers.

The ISTE standards and performance indicators were constructed by internationally known education technology specialists (ISTE, 2000; ISTE, 2014), and the standards are included in a theoretically driven model updated by new research on technology use in education. Therefore, regardless of exploratory factor analysis, only CFA procedures were analyzed in this study. Segars and Grover (1993) allege that, as more is known about the theoretical and measurement properties of scales and their underlying constructs, methods for empirically evaluating these associations should evolve from exploratory classical techniques to more exact and confirmatory contemporary techniques. Because this study tests the ISTE standards in Turkish pre-service and in-service teachers, the formulation of the standards is a prerequisite for the application of CFA (Pedhazur & Schmelkin, 1991). However, Worthington and Whittaker (2006) stated that, rather than producing a CFA that would ultimately need to be followed by a second CFA, two CFAs should be implemented in two different study groups.

Consequently, the study examines the factor structure of the ETSSE scale via two different CFAs. The first and second order CFAs of the two datasets confirmed the structures by the fit values of two construct validity implementations. The structures are valid in terms of content, construct, concurrence, and discriminant validity and reliable in terms of corrected item total correlation, Cronbach's Alpha, and McDonald's Omega. This tool can be also utilized to assess the self-efficacy levels of teachers or prospective teachers at various educational institutions.

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Appendix

Education Technology Standards Self-Efficacy (ETSSE) Scale

		Tamamen Katılıyorum	Katılıyorum	Biraz Katılıyorum	Katılmıyorum	Tamamen Katılmıyorum
1.	Teknolojiyi, öğrencilerin yaratıcı düşünmelerini geliştirmeleri için kullanabilirim.					
2.	Gerçek yaşam problemlerini çözmede; dijital araçların nasıl kullanılabileceği konusunda öğrencileri yönlendirebilirim.					
3.	Öğrencileri, çeşitli dijital öğrenme ortamlarına katılmaları için teşvik edebilirim.					
4.	Öğrenmeyi kolaylaştırma konusunda, öğrencileri teknolojik araçları kullanmaya teşvik edebilirim.					
5.	Dijital araçları ve kaynakları kullanarak öğrencilerin gerçek yaşamla ilgili konuları araştırmalarına rehberlik edebilirim.					
6.	Belirli bir konudaki problemi çözmeleri için öğrencileri internette araştırma yapmaya yönlendirebilirim.					
7.	Öğretim sürecinde, teknoloji destekli iletişim ortamlarından (blog, forum, sohbet, e-posta vb.) yararlanabilirim.					
8.	Öğrencilerin birbirleriyle etkileşime girmeleri için çeşitli dijital ortamları kullanmalarını sağlayabilirim.					
9.	Öğrencilerin, bilgi ve iletişim teknolojisi araçlarını işbirlikli öğrenme için kullanmalarına rehberlik edebilirim.					
10.	Öğrencilere bireysel gelişimlerini aktif bir biçimde izleyebileceği teknolojiyle zenginleştirilmiş öğrenme ortamları oluşturabilirim.					
11.	Öğrencilerin kalıcı bir biçimde öğrenmesini sağlamak için konu alanıyla ilgili dijital araç ve kaynakları bütünleştirerek uygun öğrenme etkinlikleri tasarlayabilirim.					
12.	Öğrencilerin yaratıcı düşünmelerini desteklemek için konu alanıyla ilgili dijital araç ve kaynakları bütünleştirerek uygun öğrenme etkinlikleri tasarlayabilirim.					
13.	Bilgi ve iletişim teknolojilerini kullanarak farklı deneyimlere sahip öğrenciler için uygun öğrenme ortamları hazırlayabilirim.					
14.	Öğrencilerin farklı öğrenme ihtiyaçlarını daha etkili desteklemek için teknolojiyle zenginleştirilmiş öğretim stratejilerini uygulayabilirim.					
15.	Öğrencilerin öğrenme düzeylerini değerlendirmek için teknolojiyi etkili bir şekilde kullanabilirim.					
16.	Öğrenme-öğretme sürecinin içinde ve sonunda alternatif değerlendirme yöntemlerini kullanırken teknolojiden yararlanabilirim.					
17.	Teknolojik araçları, öğretim süreci ile ilgili her türlü verileri işlemek ve raporlaştırmak için kullanabilirim.					
18.	Öğretim süreci için en uygun teknolojiyi/teknolojileri seçebilirim.					

19.	Öğrenme-öğretme sürecinin gerçekleştirileceği ortamı teknoloji kullanımına uygun olarak düzenleyebilirim.					
20.	Küresel toplumun bir üyesi olarak yenilikçi bir öğretmenin sahip olması gereken tutumları sergileyebilirim.					
21.	Bilişim teknolojileri ile ilgili yazılım ve donanımları etkili bir biçimde kullanabilirim.					
22.	Sahip olduğum teknoloji bilgimi yeni teknolojilere, etkili bir biçimde transfer edebilirim.					
23.	Öğrencilerin ulaştığı bilgi kaynaklarını doğru biçimde kullanmaları için dijital araçların etkili biçimde kullanılmasına rehberlik edebilirim.					
24.	Daha etkili bir öğretmen olabilmek için yeni teknolojik araçlar konusunda sürekli olarak kendimi geliştirebilirim.					
25.	Bilgi ve iletişim teknolojileri ile ilgili yasal sorumlulukları bilirim.					
26.	Bilgi ve iletişim teknolojileri ile ilgili ahlâki sorumlulukları öğrencilere kazandırabilirim.					
27.	Öğrenme-öğretme sürecinde, öğrencileri güvenilir dijital kaynaklara yönlendirerek doğru bilgiye ulaşmaları için onlara rehberlik edebilirim.					
28.	Bilişim teknolojilerini kullanırken lisanslı yazılımlar kullanmaya özen gösteririm.					
29.	Dijital kaynakları kullanırken telif hakkı konusunda hassas davranırım.					
30.	Sanal sosyal ağları kullanırken öğrencileri düşünerek onlara model olabilecek biçimde davranabilirim.					
31.	Bilgi çağının iletişim araçlarını kullanarak farklı kültürlerden öğretmenlerle iletişime geçebilirim.					
32.	Bilgi ve iletişim teknolojilerindeki yenilikleri izlerim.					
33.	Mesleki gelişimimi desteklemek için bilgi ve iletişim teknolojilerinden yararlanabilirim.					
34.	Teknoloji kaynaklarını yaşam boyu öğrenen bir birey olmak için kullanabilirim.					
35.	Öğretmenlik becerilerimi geliştirmek için çevrim içi ortamlarda (forumlar, video konferanslar, sanal sosyal ağlar vs.) öğretmenlerle bilgi alışverişinde bulunabilirim.					
36.	Ulusal ve uluslararası topluluklara katılarak öğrencilerin öğrenmesine katkı sağlayacak etkili teknoloji uygulamalarını inceleyebilirim.					
37.	Mesleğimde kendimi geliştirmek için dijital araç ve kaynakları etkili biçimde kullanabilirim.					
38.	Teknolojinin eğitimde etkili bir biçimde kullanılması için meslektaşlarıma öncülük edebilirim.					
39.	Mesleki gelişimimi sağlamak için meslektaşlarımla e-posta grupları ya da sanal sosyal gruplar oluşturabilirim.					
40.	Mesleğim ve konu alanım ile ilgili yapılan araştırmaları inceleyerek bunları, öğrencilerin öğrenmesine katkı sağlaması için kullanabilirim.					

Distribution of the items in terms of the sub factors

1. Facilitating and inspiring student learning and creativity: *1-9 items*
2. Designing and developing digital age learning experiences and assessments: *10-19 items*
3. Modelling digital age work and learning: *20-24 items*
4. Promoting and modelling digital citizenship and responsibility: *25-31 items*
5. Engaging in professional growth and leadership: *32-40 items*

Eğitim Teknolojisi Standartlarına Yönelik Öz-Yeterlik Ölçeği (ETSYÖ): Geçerlik Güvenirlik Çalışması

Atıf:

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Özet

Problem Durumu: Yakın gelecekte, diğer bazı alanlarda olduğu gibi eğitim alanında da, uluslararası standartlarda eğitim veren kaliteli okul ve üniversiteler; kalitesiz olan ve çağa ayak uyduramayan kurumların yerini alacaktır (Özcan, 2013). 21. yüzyıl becerilerinin ne olması ile ilgili ulusal ve uluslararası düzeyde yapılan çalışmalar öğrencilerde, öğretmenlerde ve yöneticilerde bulunması gereken özellikleri standartlar biçiminde ifade ederken bilgi ve iletişim teknolojilerini etkin biçimde kullanma becerisinin temel beceriler arasında olduğu belirtilmiştir (Voogt ve Roblin, 2010).

ISTE'nin yayımladığı 2008 Uluslararası Eğitim Teknolojisi Standartlarına göre öğretmenler; dijital çağın öğrenme deneyimlerini tasarlayarak öğrencilerin öğrenmelerini kolaylaştıran ve yaratıcı düşünmelerini teşvik eden, dijital çağın çalışma anlayışına öncülük eden, bir dijital vatandaşın sahip olduğu sorumlulukları bilen ve okul içinde ya da dışında mesleki gelişim ve liderlik etkinliklerine katılan, yirmi birinci yüzyıl becerisi sergileyen bireylerdir.

Bu araştırmanın amacı, ISTE tarafından öğretmen ve öğretmen adayları için en son belirlenen (2008) uluslararası eğitim teknolojisi standartlarının beş boyutlu yapısının Doğrulayıcı Faktör Analizi(DFA) ile test etmek ve Eğitim Teknolojisi Standartlarına Yönelik Özyeterlik (ETSYÖ) ölçeğini geliştirmektir.

Araştırmanın Yöntemi: Araştırmanın ölçek geliştirme sürecinde seçilen çalışma gruplarını; 2014-2015 öğretim yılının bahar döneminde Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi'nin öğrenim gören öğretmen adayları ve Diyarbakır ili merkez ilçelerinde bulunan ortaokul ve lise öğretmenleri oluşturmaktadır. Veriler öğretmen adayları (DFA1; n=473) ile öğretmenler (DFA2; n=394) olmak üzere iki farklı gruptan toplanmıştır. Araştırmada ölçeğin kapsamını belirlemek için öncelikli olarak ISTE-T (2008) standartları ve performans göstergeleri ve açıklamaları incelendikten sonra bu standartları açıklayan Morphew (2012) ve Cennamo, Ross ve Ertmer'in (2010) çalışmaları da göz önünde tutulmuş ve alan uzmanlarının değerlendirmesi için 62 maddelik bir anket formu oluşturulmuştur. 12 katılımcı uzmanın görüşlerini belirttiği kapsam geçerlik oranları(KGO) hesaplanmıştır. KGO hesaplandıktan sonra 40 maddelik bir pilot ölçek hazırlanmıştır. ETSYÖ ölçeğinin alt boyutları, (1) Öğrencilerin öğrenmelerini kolaylaştırma ve yaratıcılığı teşvik etme (2) Dijital çağa uygun öğrenme ortamları ve değerlendirme etkinlikleri tasarımlama ve geliştirme (3) Dijital çağın çalışma ve öğrenme anlayışına öncülük etme (4) Dijital vatandaşlıkta model olma (5) Mesleki gelişim ve liderlik etkinliklerine katılma şeklindedir.

Araştırmada, Hem DFA1 hem de DFA2 grubu için DFA'nın uygulanmasından önce Tabachnick ve Fidell (2007) tarafından belirtilen sayıltılara göre veri setleri incelenmiştir. Örneklem ve kayıp veri, doğrusallık ve normallik, çoklu bağlantılılık ve aykırı gözlemler ön koşulları incelendikten sonra öğretmen ve öğretmen adayları için iki farklı doğrulayıcı faktör analizi uygulanmıştır.

Araştırmanın Bulguları: DFA1 için birinci düzey DFA bulguları [χ^2 (729, N = 473) = 1781.64, p < .000, RMSEA=.055, S-RMR=.049, NFI = .95, NNFI=.97, CFI=.97, IFI=.97] kurulan modelin kabul edilebilir uyum gösterdiğini ortaya koymaktadır. ETSYÖ'nün alt ölçekleri ile tek bir yapıya yönelip yönelmediğinin belirlenmesi için DFA1 grubunun veri seti ile ikinci düzey DFA uygulanmış ve bulgulara göre ETSYÖ'nün genel yapısı da kabul edilebilir uyum göstermiştir [χ^2 (734, N = 473) = 1857.23, p < .000, RMSEA=.057, S-RMR=.053, NFI = .95, NNFI=.97, CFI=.97, IFI=.97].

DFA2 için birinci düzey [χ^2 (727, N = 394) = 1886.31, p < .000, RMSEA=.064, S-RMR=.056, NFI = .95, NNFI=.97, CFI=.97, IFI=.97]; ikinci düzey [χ^2 (732, N = 394) = 2362.77, p < .000, RMSEA=.069, S-RMR=.059, NFI = .95, NNFI=.97, CFI=.97, IFI=.97] şeklindedir ve bu sonuçlar ölçeğin kabul edilebilir olduğunu göstermektedir.

ETSYÖ ölçeğinin uyum geçerliğini ortaya koymak için Çoklar ve Odabaşı (2009) tarafından geliştirilen Uluslararası Eğitim Teknolojileri Birliği'nin öğretmen ve öğretmen adayları için belirlediği Ulusal Eğitim Teknolojisi Standartlarını (2000) temel alan Öğretmenlere Yönelik Eğitim Teknolojisi Standartlarını Belirleme Ölçeği (ETSÖ) kullanılmıştır. ETSYÖ ve ETSÖ 114 kişilik bir gruba uygulanmıştır. Her iki ölçekten alınan puanlar arasında hesaplanan korelasyon katsayısı .83 (p<.01) olarak bulunmuştur. ETSYÖ ölçeği ile ETSÖ arasında yüksek düzeyde, pozitif ve anlamlı bir ilişki olduğu belirlenmiştir.

ETSYÖ Ölçeğinin madde ayırt ediciliği için düzeltilmiş madde-toplam korelasyonu hesaplanmıştır. DFA1 ve DFA2 grupları ile gerçekleştirilen çözümlemelerde madde

toplam korelasyonuna ilişkin değerlerin .34 ile .67 arasında değiştiği görülmüştür. Ölçeğin güvenirliğine ilişkin bulguların incelenmesi için hem Cronbach Alpha hem de McDonald (Omega) katsayısı değerlerine bakılmış ve Cronbach Alpha değerleri tüm ölçek için .95, 1.boyut=.83; 2.boyut=.87; 3.boyut=.77; 4.boyut=.78; 5.boyut=.85 çıkmıştır. McDonald'ın Omega katsayısı incelendiğinde tüm ölçek için .96, 1.boyut=.83; 2.boyut=.87; 3.boyut=.77; 4.boyut=.76; 5.boyut=.86 çıkmıştır. Ayrıca, her bir alt ölçeğin ve birleşik ölçeğin (ETSYÖ) ölçtüğü eğitim teknolojisi standartları öz yeterlik boyutlarındaki %27'lik alt ve %27'lik üst grupların puan ortalamaları arasındaki farkların istatistiksel olarak anlamlı olduğu görülmüştür.

Araştırmanın Sonuçları ve Önerileri: Alanyazında ISTE'nin eğitim teknolojisi standartları ya da UNESCO'nun BİT yeterlikleri çerçevesi ile ilgili çalışmaların yeterli olmadığı söylenebilir. Zira, eğitim teknolojisi standartları uluslararası katılımcılar tarafından sürekli geliştirildikleri için güncel çalışmaların yapılmasına gereksinim vardır. Kadijevich ve Haapasalo (2008) da eğitim teknolojisi standartlarının (davranış, isteklilik, ilgi, tutum, destek, deneyim vs.) çeşitli kanıtlara dayalı kaynaklar kullanarak niteliksel ve niceliksel biçimde incelenmesi gerektiğini vurgulamıştır. Bu araştırmada geliştirilen ölçek ISTE'nin 2008 yılında ortaya koyduğu öğretmen standartlarını ve performans göstergelerini dikkate aldığı için daha güncel bir bakış açısı ortaya koymaktadır. ISTE NETS-T (2000) standartlarından farklı olarak 2008 yılındaki standartların yaratıcılık ve yenilikçilik vurgusu yaptığı (Orhan, Kurt, Ozan, Som Vural ve Türkan, 2015), yapılandırmacı yaklaşıma dayalı olduğu ve mesleki yaşamda küreselleşme ve kültürel farkındalığın geliştirilmesine önem verdiği görülmektedir (Willis, 2012). Bu nedenle, öğretmen ve öğretmen adayları için uluslararası eğitim teknolojisi standartları (ISTE-T) bağlamında geliştirilen bu ölçek, 21. yüzyıl öğretmen özelliklerini yaratıcılık, işbirliği ve yenilikçilik bağlamında incelemek için önemli bir veri toplama aracıdır. Bu maddeler ve boyutlar deneysel ve tarama modellerinde kullanılarak eğitimsel araştırmalara katkı sağlayacaktır. Hem öğretmen adayları hem de öğretmenler ile gerçekleştirilen bu çalışmada iki grup için doğrulayıcı faktör analizinin yapılması ve geçerlik – güvenirlik sonuçlarının istatistiksel olarak anlamlı çıkması nedeniyle ETSYÖ ölçeği alt boyutları ve birleşik ölçek olarak kullanılabileceğini göstermektedir.

Anahtar Sözcükler: Eğitim teknolojisi standartları, ISTE standartları, ölçek geliştirme, doğrulayıcı faktör analizi