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Teachers' ICT Skills Scale (TICTS): Reliability and Validity

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Abstract

The purpose of this study is to assess the reliability and validity of a scale developed to measure teachers' skills for using information and communication technologies (ICT). The study consisted of three stages. In the first stage, the researchers developed an item pool including 18 items based on a five-point Likert-type style. During the second stage, we collected data from 304 teachers. To demonstrate the reliability and validity of the scale, researchers conducted an exploratory factor analysis using maximum likelihood with oblimin rotation. The factor analysis resulted in a 16-item and three-factor construct that explained 61.5% of the total variance. The researchers also conduct the parallel analysis to confirm the results of eigen value criterion. In terms of the reliability of the scale, we calculated the Cronbach's alpha values for the overall survey, Factor-1 (3 items), Factor-2 (5 items), and Factor-3 (8 items) as .91, .74, .85, and .89, respectively. Thus, the instrument is a reliable and valid scale to investigate teachers' ICT skills.

Öğretmenlerin Bilgi ve İletişim Teknolojileri Becerileri Ölçeği: Güvenirlik ve Geçerlik

Makale Bilgisi

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Anahtar Kelimeler:
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teknoloji entegrasyonu,
öğretmenler

Öz

Bu çalışmanın amacı öğretmenlerin bilgi ve iletişim teknolojilerini kullanma becerilerini ölçmek amacıyla geliştirilen ölçeğin geçerlik ve güvenirlik çalışmasını yapmaktır. Çalışma üç aşamadan oluşmaktadır. Birinci aşamada, araştırmacılar 5'li Likert tipine uygun 18 maddelik bir madde havuzu oluşturmuştur. İkinci aşamada, 304 öğretmenden veri toplanmıştır. Ölçeğin geçerlik ve güvenirliğini göstermek için açımlayıcı faktör analizi yapılmıştır. Analiz sonucunda 3 faktörlü ve toplamda 16 maddeden oluşan ölçek %61.5'lik kısmı açıklamıştır. Araştırmacılar sonuçların doğruluğunu kontrol etmek amacı ile paralel analizde yapmıştır. Çalışmanın Cronbach Alpha değeri birinci faktör için (3 madde) .91, ikinci faktör için (5 madde) .74 ve üçüncü faktör için (8 madde) .89 olarak tespit edilmiştir. Analizler, geliştirilen ölçeğin amacı için geçerli ve güvenilir olduğunu göstermektedir.

Introduction

Recently, there have been substantial developments in the field of information and communication technologies (ICT), which have affected many fields, including educational sciences (Cure & Ozdener, 2008; Capar & Vural, 2013). In parallel with the developments in the field of ICT, there seems to have been an increase in social information chunks as well as easy and economical access to information (Ciftci, Taskaya, & Alemdar, 2013). Thus, it has become more important to truly and effectively use and present information rather than to access information. In addition, all these changes have had an effect on teachers' roles. Today, instead of acknowledging teachers merely as information sources, approaches that regard teachers as models who teach the ways of learning have become more prevalent (Guven, 2001;Yilmaz, 2007; Kogce, Aydin & Yildiz, 2010; Yorulmaz, Altinkurt, & Yilmaz, 2015). As a natural consequence of these developments, ICT-supported instructional methods have substituted for traditional ones in the transmission of information. In this regard, many countries (Ezziane, 2007; Jhurree, 2005) have shown an effort to update their curricula and to modernize the technical substructures of their schools in order to meet the demands of innovative instructional methods (Aydin, 2000). The main objective in updating the curricula is to educate individuals who think scientifically, question the cause–effect relationships of events, produce information, maintain effective solutions to problems with accurate analysis, use decision-making skills, and have a high level of self-confidence instead of those who memorize information (Yavuz & Coskun, 2008). Therefore, countries endeavor to support ICT integration into education by restructuring both their curricula and infrastructures (Ezziane, 2007; Jhurree, 2005). As reported by Jonassen and Reeves (1996), technology integration was initially regarded as using computers in instructional environments. However, today it is considered to be a process that positively contributes to students' learning (Belland, 2009; Borokhovski, Bernard, Tamim & Schmid, 2017; Davies, Dean & Ball, 2013; Wang & Woo, 2007).

Adapting ICTs in education is not merely the inclusion of technology-supported instructional materials in instructional settings, but also a multi-dimensional process that requires the consideration of a variety of variables in managerial, instructional, and theoretical domains (Yurdakul, 2011). Tinio (2003) describes effective ICT integration as a process that includes the curriculum, pedagogical approaches, sufficient financial resources, and the readiness level of the organization. Alev and Yigit (2009) maintained that achieving the goals regarding integrating ICT into education depends on learners embracing and internalizing innovations in instructional methods and techniques. Considering teachers' resistance to novelty, teachers who are inexperienced in the use of ICT in their classes might cause delays in the ICT integration into education. Many studies examining ICT integration into instructional settings have revealed problems caused by the lack of teachers' knowledge, skills, and competencies related to such integration (Bingimlas, 2009; Chen, Looi, & Chen, 2009; Oncu, Delialioglu, & Brown, 2008). More specifically, Ertmer (1999) focused on various barriers, including personal fears, technical/logistical issues, organizational issues, and pedagogical concerns. Although teachers may not face all of these barriers at once, even one barrier can significantly impede the effective use of ICT in classrooms.

The literature classifies the barriers as first-order, second-order, and third-order barriers. First-order barriers include a lack of time and training as well as institutional support for ICT use; second-order barriers include teachers' pedagogical beliefs and willingness to change (Ertmer, 1999). Tsai and Chai (2012) introduced the third-order barriers, which include teachers' design thinking.

Qualifications of all components in the system, such as teachers' competencies, are related to reaching the determined goals (Yalin, 2001). In contemporary educational systems, schools' and teachers' ICT utilization levels are associated with the realization of their instructional goals (Akin, 2007). However, several studies in this context have demonstrated the existing problems of transferring ICT-supported instructional materials into instructional settings (Akin, 2007; Baki & Ersoy, 1998; Shiengold, 1995). Similarly, Hawkridge (1983) clarified that practitioners' adaptation and implementation of information technologies are more difficult and time-consuming tasks than other instructional technologies (Ertmer, 2005; Hawkridge, 1983; Selwyn, 2011; Ucuncu, Uzun & Berkli, 2015). The researchers concluded that teachers' perceptions and attitudes related to ICT skills and competencies are essential for comprehending the integration of ICT in school settings.

With the increase in teachers' use of computers, teachers' attitudes toward computers are being positively changed (Galanouli, Murphy, & Gardner, 2004). However, Manoucherhri (1999) underscored the lack of teachers' knowledge about ICT and, consequently, the ability to transfer new technologies to learning settings. In other words, teachers need to have sufficient knowledge and skills about ICT as a prerequisite for integrating ICT into learning settings (Manoucherhri, 1999). The European Commission (2010) acknowledged the ICT integration process as a new digital agenda for all European countries. In fact, 28 European countries have defined strategies to provide ICT integration into education and started to apply those strategies in 2000.

Within the framework of the EU's adjustment laws, Turkey has accelerated ICT integration into its education process. To support the ICT integration, Turkey initiated several projects, including Education for the Future (Gelecek icin Egitim), Basic Education Project (Temel Egitim Projesi), and FATIH Project. Turkey's Ministry of National Education (MoNE) defined the skills that teachers should have in regard to ICT integration (MoNE, 2006). Those skills are generally about the skills to organize classrooms – physical environment and classroom management – for ICT integration, to make necessary changes in curriculum for ICT integration, to use ICT for professional purposes and so on.

In a similar vein, the International Society for Technology in Education (ISTE) defined teachers' ICT skills as follows:

- Facilitate and inspire student learning and creativity
- Design and develop digital age learning experiences and assessments
- Model digital age work and learning
- Promote and model digital citizenship and responsibility
- Engage in professional growth and leadership(ISTE, 2008)

Critical developments have recently and consistently emerged in ICT, and these changes have also affected the educational settings at a great pace. Today, people discuss the integration of Internet-based applications—such as social networks, file-sharing tools, and video-sharing websites—into education. At this point, it seems beneficial and necessary to develop a scale in order to determine teachers' ICT skills and competencies. In addition to identifying teachers' fundamental ICT skills, it is essential to determine the level of teachers' skills on contemporary web-based applications. In the literature, researchers found only one Turkish scale that was designed based on ISTE's new technology standards. It was designed and validated by Simsek and Yazar (2016). The researchers worked with teacher candidates as well as teachersto develop the scale. Also, another scale was developed by Akbulut, Kesim and Odabasi. They worked with only teacher candidates. However, the current study aimed to design a reliable and valid scale that was consisted of items developed by ICT teacher candidates and data for reliability and validity was collected from in-service teachers. Although ISTE standards are universal, there needs to be a scale that is designed based on in-service teachers' current technology use and knowledge level. To this end, we worked with pre-service teachers to benefit from their views and with in-service teachers knowledge and needs. As a result, we designed a scale that can be used in Turkey.

The Study

Stage 1: Development of item pool

Before we started the study, the necessary permissions were gathered from the university and the Ministry of Education in order to conduct the study. As a starting point, all seniors in the university's Department of Computer Education and Instructional Technologies (CEIT) were informed about the study and asked about their willingness to participate. Among 48 teacher candidates, only 20 agreed to participate. During the first stage, teacher candidates generated a list of items in response to the following prompt: ___ is an ICT skill that a teacher should have. It took participants approximately 20 to 30 minutes to complete the task, and they ultimately provided an average of 12 items. We did not use ISTE standards to come up with the original items; the reason is that those teacher candidates already knew the ISTE standards as well as what Turkish teachers need in terms of ICT due to their major. After conducting a research review related to teachers' ICT skills (i.e., Altun, 2012; Kutluca, Arslan, & Ozpinar, 2010; Korkmaz & Demir, 2012), ICT skills identified in the literature were compared with those that the teacher candidates listed in order to maximize the representativeness of the initial items. As a last step in the first stage, the final draft of the skills was checked by three information technologies teachers, one teacher serving in a middle school, one teacher serving in an elementary school, and a Turkish language expert. The final lists included 18 items and were restructured to be a five-point Likert-type questionnaire. According to Dawes (2008), none of the 5-, 7-, and 10-point scales were less desirable than the others in terms of analysis purposes. Thus, the scale for this study ranged from strongly disagree (1 point) to strongly agree (5 points). In addition, there was no negative item in the scale.

Stage 2: Data Collection

Participants

In order to reach a high number of participants, professional development seminar timelines were obtained from the Ministry of Education. Depending on the seminar topic, teachers working in elementary and middle public schools located in the city center were required to attend. At the end of the 2012–2013 school year, the Ministry of Education organized a professional development session for 357 teachers; only 346 teachers attended. Participants were informed about the study and signed the consent form to indicate their voluntary participation. Researchers collected data during this session. As 42 teachers did not fully complete the questionnaire, they were dropped from the analysis, leaving 304 participants (199 males and 105 females).

Table 1.
Demographic Characteristics of the Participants

		f	%
Gender	Female	105	34.5
	Male	199	65.5
Teaching experience	Less than 2 years	36	11.84
	2-5 years	55	18.09
	6-10 years	62	20.39
	11-15 years	82	26.97
	16-20 years	16	5.26
	More than 21 years	53	17.43
Teaching focus	Elementary school teacher	120	39.47
	Mathematics teacher	98	32.24
	Science teacher	86	28.29

Procedure

The researchers introduced the study to the participants and asked for their permission. None of the teachers refused to participate. The printed form of questionnaire was provided to them. The first section of the questionnaire included demographic questions related to teachers' gender, school type, teaching experience, education level, and ownership of a computer with Internet access. The following section aimed to obtain data about teachers' ICT skills. Participants responded to the items on a 5-point scale ranging from completely disagree to completely agree. It took them approximately 10 to 15 minutes to complete the questionnaire.

Data analysis

In terms of the face and content validity of the scale, items were reviewed by four experts from various fields (two teachers, one from language, and two instructional technologists). After making the necessary changes according to the experts' opinions, several procedures were followed, including item analyses, calculation of correlation coefficients, and factor analyses suggested by Gerbing and Anderson (1988). When conducting an item analysis, it is important to check an item's relevance with other items and with the entire scale, which is called item-total correlations. Thompson (2004) suggested .20 as a cut-off criterion while Buyukozturk (2007) recommended a value of .30. Thus, values under the .30 cut-off criterion were excluded from the scale.

Furthermore, in order to be sure about the convenience of data for the factor analysis, the results of Barlett and Kaiser-Meyer-Olkin (KMO) tests were examined. In addition, an exploratory factor analysis (EFA) using the maximum likelihood (ML) method was conducted. Although there is a misunderstanding that Principal Component Analysis (PCA) is a type of EFA (Henson & Roberts, 2006; Joliffe & Morgan, 1992; Suhr, 2006), de Winter and Dodou (2012) stressed that there are two most popular types of EFA: "Maximum Likelihood (ML)" and Principal Axis Factoring (PAF). According to Cudeck and O'Dell (1994), when data are normally distributed, ML method is regarded as the best choice for EFA since it gives researcher an opportunity to test statistical significance of factor loadings and calculate the confidence intervals. Thus, after conducting the Maximum Likelihood method with direct oblimin rotation, Cronbach's Alpha coefficients were found for each factor based on EFA and for the entire scale. A split-half method was also used to reveal the reliability of the scale. The results of these analyses are presented in detail in the next section.

Stage 3: Scale Development

Descriptive statistics

For each item in the scale, the descriptive statistics were examined in order to be able to clearly explain the results. Means and standard deviations of each item are presented in Table 2.

Table 2.
Descriptive statistics.

Items	N	Mean	SD
Item-1	304	3.61	1.33
Item-2	304	3.23	1.36
Item-3	304	3.63	1.28
Item-4	304	3.45	1.19
Item-5	304	3.60	1.24
Item-6	304	3.28	1.29
Item-7	304	3.40	1.26
Item-8	304	3.75	1.13
Item-9	304	3.72	1.16
Item-10	304	3.82	1.07
Item-11	304	3.66	1.17
Item-12	304	3.31	1.26
Item-13	304	3.39	1.24
Item-14	304	3.35	1.25
Item-15	304	3.48	1.24
Item-16	304	2.95	1.37
Item-17	304	3.07	1.35
Item-18	304	3.57	1.28

As seen in Table2, the means of almost all items are between the "Neither Agree nor Disagree" and "Agree" intervals. In addition, Item-16, "I can perform the settings of Network, Modem, and Internet by myself," had the lowest mean (X = 2.95) while Item-10, "I use presentations (PowerPoint) when delivering instruction in class" had the highest mean score (X = 3.82).

Item Analysis

In this part of the analyses, the item-total correlations were examined based on the cut-off criterion (.30) as suggested by Buyukozturk (2007). The item-total correlations for each item ranged between .44 and .68; therefore, no item was excluded from the scale due to its correlation level.

Exploratory factor analysis

In order to provide the structural validity of the scale and to uncover hidden dimensions in it, EFA was employed. Sample size is an important indicator when initiating EFA procedures. Hair, Anderson, Tatham, and Black (1995) suggested a minimum of 5 to 10 cases per variable. In this study, the ratio of cases and variables was approximately 17 (18 items and 304 participants), which represents an adequate sample size for EFA. Before conducting EFA, the KMO measure of sampling adequacy and Barlett's test of sphericity were also analyzed. As Tabachnick and Fidell (2001) suggested, Barlett's test should be significant, and the KMO value is expected to be over .60 to conduct EFA. In addition, a KMO value of .90 and over is regarded as the perfect level. In this study, a significant value of Barlett's test of sphericity, 2897.083 ($p = .000$), was obtained; the KMO value was calculated as 0.904, which suggested good indicators for EFA. Finally, the skewness, kurtosis, and P-P graphics of the data were examined to provide the normality assumption required for the maximum likelihood (ML) method of EFA.

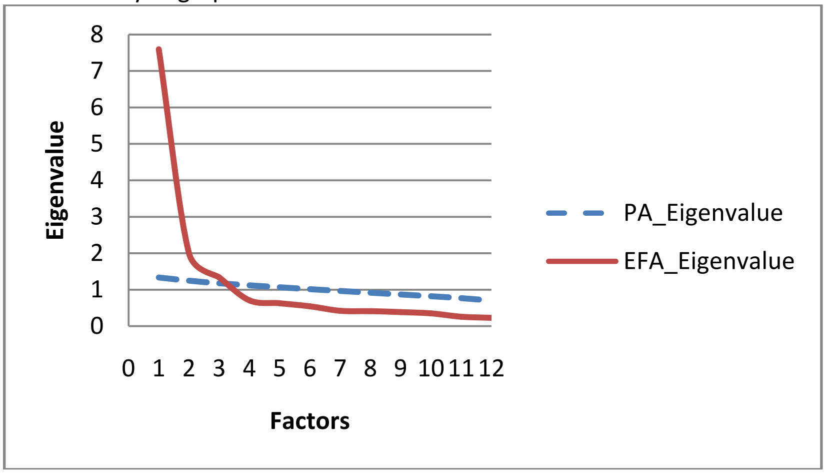
After addressing these assumptions, ML with direct oblimin rotation for EFA was applied. The EFA results were examined based on the criteria (cut-off limit = .30 and eigenvalue > 1) recommended by Buyukozturk (2007). The first results revealed three factors whose Eigenvalues were greater than 1; the lowest factor loadings were .38. At this level, the acquired three-factor structure explained 60.73% of the total variance. Eigenvalues and variances for each factor are presented in Table 3.

Table 3.
Eigenvalues and variances for each factor based on the first EFA result.

Factor	Eigenvalues	Variances (%)	Total Variances (%)
1	7.598	42.213	42.213
2	1.997	11.097	53.309
3	1.335	7.415	60.725

Since the "eigenvalue greater than one" criterion to determine the number of factors extracted from data has been criticized for over-extracting factors than warranted, alternative methods such as parallel analysis (PA) have been proposed by Horn (1965). Hayton, Allen, and Scarpello (2004) asserted that parallel analysis is the one of the most reliable factor extraction methods. Thus, the researchers also conduct the parallel analysis to confirm the results of eigenvalue criterion. The researchers determined the 1000 repetitions based on Monte Carlo system as recommended by Lautenschlager (1989). The intersection of the PA and EFA eigenvalues gives us how many factors retained based on the parallel analysis. As seen in Figure 1, the PA dashed line crosses the EFA line right at three factors.

Figure 1.
Parallel analysis graph



In general, EFA procedures were performed continuously and iteratively by excluding the items from the scale until the expected results were achieved. A three-factor structure was found as a result of the first analysis and identified a coherency within each factor in terms of their items. However, by getting experts' approval, two items in the factor "Use of ICT for Teaching" were not appropriate for the context of the scale as well as their factor. The first item was Item-14, "I can install an operating system (i.e., Windows XP, Windows 7, Linux) on my personal computer." The installation of an operating system is not a pressing need for teachers as computers already come with installed operating systems or an IT person generally takes responsibility for such work. The second item that was excluded from the scale was Item-16, "I can perform the settings of Network, Modem, and Internet by myself." Although the context of this item was related to the first factor, called "Basic Hardware Operations," it was dropped in the third factor, "Use of ICT for Teaching." Items in the first factor also included Item-1, "I can troubleshoot basic technical problems in my computer," and Item-2, "When I buy new computer hardware or device, I can install it into my computer by myself." An overlap was found between these two items and Item-16 in terms of their context. Thus, it was concluded that these two items in the first factor could be substituted for Item-16. Furthermore, by excluding Item-16 from the scale, a more concise structure for the third factor was achieved. In the end, a 16-item scale with three factors was obtained. This three-factor solution explained 61.45% of the total variance, as seen in Table 4.

Table 4.
Eigenvalues and variances for each factor based on the final EFA result.

Factor*	Eigenvalues	Variances (%)	Total Variances (%)
3 (8 items)	6.786	42.415	42.415
2 (5 items)	1.722	10.760	53.175
1 (3 items)	1.324	8.276	61.451

Based on the EFA results, three factors were identified. The first factor is the "Basic Hardware Operations" factor; its Cronbach's alpha value was calculated as 0.74. The second factor is related to ICT knowledge and skills; thus, it was named the "Personal ICT Usage" factor. Example items of this factor included "I can resolve issues with Office software (Microsoft Office, Open Office, etc.) without assistance" (Item-4) and "I can design a simple website" (Item-6). The Cronbach's alpha value was calculated as 0.85. The last factor was called "Use of ICT for Teaching." It included eight items, all related to ICT skills for instructional purposes. Its Cronbach's alpha value was 0.89. Table 5 summarizes the correlations among the factors, which were at a medium level. The highest correlation was found between Factors 1 and 2 (r = .55), and the lowest correlation was between Factors 1 and 3 (r = .42).

Table 5.
Factor Correlation Matrix.

Factors	Factor1	Factor 2	Factor 3
Factor 1. Basic Hardware Operations	1.000		
Factor 2. Personal ICT Usage	.545	1.000	
Factor 3. Use of ICT for Teaching	.422	.458	1.000

Researchers also showed the evidence of convergent and discriminant validity to determine the convergence between similar constructs and discriminate dissimilar construct, which are calculated based on average variance extracted (AVE). As a result of EFA, factors and items with their factor loadings, Cronbach Alpha and Average Variance Extracted (AVE) coefficients for each factor were presented in Table 6.

Table 6.
Factors, items, and factor loadings for each item.

Item		**Factor Loading**
	Factor 1. Basic Hardware Operations (Cronbach Alpha = 0.74)	
Item 1	I can solve simple technical issues on my computer	.801
Item 2	When I buy a new computer hardware or device, I can install it into my computer by myself.	.721
Item 3	My typing skills are good.	.379
	Factor 2. Personal ICT Usage(Cronbach Alpha = 0.85)	
Item 4	I can resolve issues with Office software (Microsoft Office, Open Office etc.) without assistance	.835
Item 5	I use online instructional materials to figure out how to use software that I wish to learn.	.781
Item 6	I can design a simple web page.	.695
Item 7	I can assist somebody planning to buy a new computer as a technical expert.	.626
Item 8	I can perform basic picture/graphic editing.	.505
	Factor 3. Use of ICT for Teaching (Cronbach Alpha = 0.89)	
Item 9	I can find animations related to my course and deploy them.	.431
Item 10	I can use presentations (PowerPoint) when delivering instruction in class.	.550
Item 11	I can find videos from Internet to support course content and have my students watch them.	.601
Item 12	I can create online personal BLOGs (i.e., blogger and wordpress).	.701
Item 13	I can inform my students about computer ethics.	.864
Item 14	I can effectively use search engines.	.825
Item 15	I can use social networking services (i.e., Facebook, Twitter) for educational purposes.	.705
Item 16	I can share instructional materials that I find online (via e-mail, Dropbox, Google Drive, etc.) with my students	.484

According to Fornell and Larcker (1981), AVE as a measure of convergent validity should be above .5 and Ping (2009) suggest that the AVE near .5 (by 5-10%) could be regarded as acceptable. Discriminant validity is analyzed based on the square of AVE (Fornell & Larcker, 1981) and the coefficients were calculated as 0.44, 0.49, and 0.44 for each factor, respectively. Those values can be regarded as the sufficient evidence of the construct validity of the scale.

Reliability

The overall Cronbach's alpha value for the scale was found to be 0.91, which can be considered good reliability. Moreover, upon examining the split-half reliability, the reliability values were found to be 0.857 (part 1) and 0.903 (part 2). In the split-half approach using the Spearman-Brown formula, the reliability estimate for the entire questionnaire was 0.753. Thus, based on these reliability scores, the questionnaire's reliability can be considered high.

Discussion and Conclusion

The investigation of teachers' ICT skills is critical for researchers. Although many studies have been conducted in this context (e.g., Harris; 1999; Smith & Kelley, 2007; Twining, 2001; 2002a; 2002b), they are neither well-rounded nor do they include contemporary discussions. When examined carefully, with the increase of ICT usage in education, some studies have investigated teachers' readiness in terms of teaching with ICT and their self-efficacy for ICT (i.e., Hakkaraine et. al., 2000; Kalayci, & Humiston, 2015; Korkmaz & Demir, 2012; Koul & Rubba, 1999; Tchanne-Moran, Woolfolk-Hoy, & Hoy, 1998; Yilmaz, Yilmaz, & Turk, 2010). For instance, Korkmaz and Demir (2012) examined teachers' self-efficacy and attitudes toward ICT. Their results revealed that teachers' attitudes and perceptions toward ICT were low. They also found that, although there is no gender effect on their self-efficacy, there is a positive relationship between teaching experience and self-efficacy and attitudes toward ICT.

Teachers' limited computer skills, limited hardware in workplaces, and insufficient technical support are considered to be the main barriers for ICT integration in learning environments (Jenson, Lewis, & Smith, 2002). From this perspective, teachers' ICT proficiency becomes critical. Specifically, in Turkey, after the start-up of the FATIH Project, teachers' ICT skills were taken into account more. Similarly, researchers (i.e., Early Adopters of Technology, 1999; Gokdas, 2003, Watson, 2001; Yuzgec, 2003) have focused on the necessary technical support that teachers need as well as hardware and educational software support and the ways to fill the identified leaks. Moore and colleagues (1999) identified four categories related to instructional technology skills, one of which was use of technology for educational purposes to enhance instruction. Other studies focusing on the integration of ICT into education have pointed out the value of using ICT for educational purposes (see Bingimlas, 2009; Chen, Looi, & Chen, 2009; Hakkarainen et al., 2000). These three important aspects were represented as factors in the instrument we developed.

As technology progresses very fast, this study provides important information for researchers, teachers, administrators, and policy-makers who focus on ICT in education. The instrument developed in this study was checked in terms of its reliability and validity. In addition, by using this user-friendly instrument, teachers' ICT skills can be easily evaluated based on the three factors. Akbulut et al. (2007) identified ten factors in their scale including infrastructure, health, ethics, special needs and the others. Also, there are other scales developed for different cultures (i.e. Hernández-Ramos et al. (2014) andHsu (2010)) with various factors, For future research, new questions could be added to the scale to address, for instance, ISTE standards and their reflection on teachers in Turkey.

Similar to other studies, this study faced several limitations. In order to recruit participants, simple random sampling was used. More specifically, participants were selected without taking their major into account. Future research is needed to replicate this study with teachers from the same major so that more specific information about teachers' ICT skills from different majors can be obtained. Although the number of participants for factor analysis was sufficient, conducting a confirmatory factor analysis with the same data set would not be preferable (Kline, 2011; Shieh, & Demirkol, 2014; van Prooijen & van der Kloot, 2001). Thus, a confirmatory factor analysis is suggested whilereplicating the study.

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