Computers in Human Behavior 61 (2016) 176–185

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Teachers' perceptions towards ICTs in teaching-learning process: Scale validity and reliability study

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ARTICLE INFO

Article history:
Received 5 July 2015
Received in revised form
5 March 2016
Accepted 8 March 2016
Available online 17 March 2016

Keywords:
Perceptions
Information and communication technologies (ICTs)
Scale development
Teachers
Questionnaire

ABSTRACT

The purpose of this study was to develop a scale for measuring teachers' perceptions towards ICTs in teaching-learning process in the classroom. The sample of the study consisted of volunteering Turkish teachers (n = 200). This study developed a new scale for measuring teachers' perceptions towards ICTs in teaching-learning process. In order to test the validity of the scale, the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were carried out in the research. A result of the EFA, the scale consisted of three factors: attitude, usage, and belief with 25 items. It was also seen that there were positive correlations amongst the three factors of the scale. Cronbach's Alpha reliability coefficient value was found as 0.92 and Spearman-Brown split-half correlation value was found as 0.85 in the study. It was seen that reliability coefficient values of the factors of in the scale ranged between 0.88 and 0.72 in the research. Lastly, as a result of the CFA, it was understood that the obtained values ($\Delta\chi^2$ (n = 200)/df = 4.85/3; GFI = 0.96; AGFI = 0.94; RMSEA = 0.026; CFI = 0.97; TLI = 0.98) confirmed the three-factor structure of the scale.

1. Introduction

Information and communication technologies (ICTs) have got still very impact on the teaching-learning process, their effect was also in the past at the beginning of the century, when Richards (2005) wrote, that many teachers find that interesting and well-planned tasks, projects, and resources provide a key to harnessing the educational potential of digital resources, Internet communications and interactive multimedia to engage the interest, interaction, and knowledge construction of young learners. There is a growing demand on educational institutions to use ICTs to teach the skills and knowledge students need for the 21st century. Realising the effect of ICTs on the workplace and everyday life, today's educational institutions try to restructure their educational curricula and classroom facilities, in order to bridge the existing technology gap in teaching and learning (Buabeng-Andoh, 2012).

There are many benefits to using ICTs as an educational tool. ICTs help students visualise abstract ideas and makes it easy to find reliable information (Qing, 2007). Students' motivation and confidence are increased when technology is integrated into classroom instruction (Torff & Tirotta, 2010). Computer engagement also improves student's academic achievement (House, 2012; Mercier & Higgins, 2013). Teachers at any grade level can easily create collaborative activities for students on the web (Holcomb & Beal, 2010).

Many of devices are still on the beginning of their using in the education, but they have got high potential as iPads and tablets (Sullivan, 2013). Researchers found that iPads help special needs students improve basic skills, such as reading and writing, and increase their attention and interests in learning (Fernández-López, Rodriguez-Fortiz, Rodríguez-Fórtiz, Rodríguez-Almendros, & Martínez-Segura, 2013).

It is seen, the ICTs are important for educational process, so the teachers should play the main role in the adoption and integration of ICTs in teaching-learning process. There are many factors, which are influencing this process. These factors are developing from the previous century till today. Teachers' integration of ICTs into teaching-learning is also influenced by organisational factors, attitudes towards technology and other factors (Chen, 2008; Tondeur, Van Braak, & Valcke, 2008; Lim & Chai, 2008; Clausen, 2007).

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http://dx.doi.org/10.1016/j.chb.2016.03.022
0747-5632/

Personal characteristics such as educational level, age, gender, educational experience, experience with the computer for educational purpose and attitude towards computers can influence the adoption of a technology (Schiler, 2003). For example Tondeur, Valcke, and Van Braak (2008) found out, that male teachers have got more positive attitudes toward ICTs and their using of ICTs in education process is more frequent in comparison with female teachers. Among the factors that influence successful integration of ICTs into teaching are teachers' attitudes and beliefs towards technology (Hew & Brush, 2007; Keengwe & Onchwari, 2008). If teachers' attitudes are positive towards the use of educational technology then they can easily provide useful insight about the adoption and integration of ICTs into teaching and learning process. Research has shown that teachers' attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching and learning (Huang & Liaw, 2005). Teachers' computer experience relates positively to their computer attitudes. The more experience teachers have with computers, the more likely that they will show positive attitudes towards computers (Rozell & Gardner, 1999). Positive computer attitudes are expected to foster computer integration in the classroom (Van Braak, Tondeur, & Valcke, 2004). According to Woodrow (1992), for successful transformation in educational practice, user need to develop positive attitudes towards the innovation.

There is needed to remember, teacher's attitude plays an important role in influencing the effectiveness of ICTs education from a variety of perspectives (Kusano et al., 2013). Voogt (2010) found that teachers who use technology extensively in their lessons tend to have a high level of confidence in pedagogical technology skills and focus on a learner-centered approach. They are more engaged in professional development activities and collaboration with colleagues than teachers who don't use technology very often. Other research shows that teachers' pedagogical beliefs (e.g., philosophies of teaching and learning) are correlated to their technology integration. In order to change teachers' beliefs, schools must develop strong leaderships. Also, school principals should not only be an official supervisor, but be a personal advisor to provide assistance to individual teachers and staffs (Kim, Kim, Lee, Spector, & DeMeester, 2013).

The basic results of some researches regarding to presented problematic are described below. As it is possible to see, all authors described some problems with the adoption and integration of ICTs into education process, but nearly all authors see the big importance of ICTs in the education process. For example Cavas, Cavas, Karaoğlan, and Kısla (2009) realised research among Turkish science teachers. The results indicated that Turkish science teachers had positive attitudes towards ICTs and although teachers' attitudes towards ICTs did not differ regarding gender However, it differed regarding age, computer ownership at home and computer experience. Martinovic and Zhang (2012) examined pre-service teachers' expectations of and attitudes towards the learning and integrating of ICTs into their teaching and their perceptions of the availability and usage of ICTs. The main results were, there was not enough comfort with ICTs usage among future teachers, despite skill level; future teachers had high expectations in learning and teaching with ICTs; access to ICTs was limited in the schools. Al-Zaidiyeen, Mei, and Fook (2010) found out teachers had a low level of ICTs usage for educational purpose, teachers hold positive attitudes towards the usage of ICTs, and a significant positive correlation between teachers' level of ICTs usage and their attitudes towards ICTs was found. Peeraer and Van Petegem (2011) found out among Vietnamese teachers the usage of ICTs applications in teaching practice remains limited, mostly replacing traditional teaching practices. The factors currently determining the usage of ICTs in teaching practice are ICTs skills and computer confidence. Rana (2012) made research among teachers from India. The results showed that most of the teacher educators had positive attitudes towards the general role that ICTs could play in education and in the educational process. The findings showed no gender differences on attitudes towards ICTs in teacher training, but it is possible to see differences in attitudes with respect to age. Alazam, Bakar, Hamzah, and Asmiran (2012) found out that teachers' ICTs skills were at moderate levels, and that a vast majority of teachers who participated in this study were moderate users of ICTs in classroom teaching. There were significant differences of teachers' ICTs skills as a function of demographic factors: gender, age, years of teaching experience. Similar problems is possible to find in the study of Buabeng-Andoh (2012). Ndibalema (2014) found that African teachers had positive attitudes towards the usage of ICTs as a pedagogical tool but they did not integrate it in their teaching effectively. Also, low familiarity with ICTs usage as a pedagogical tool amongst teachers was found to be a problem.

There is one crucial question. Why is needed other tool regarding to ICT? After careful searching and reading of literature, that not all concepts, which were described below are functional in the conditions of Turkey. Other reason was, that it is very important to take into account local conditions. So, if some research tool is valid and reliable in some country, for example in USA, it need not be functional in other country. So this the reason why we are trying to create and validate research tool focused on teachers' perceptions of ICT.

The research goals of the study were: 1. to create research tool; 2. to validate and to determine reliability of the research tool.

2. Methodology

2.1. Sample

The sample of the study consisted of volunteering teachers (n = 200), selected according to cluster sampling method from three layer groups (high-middle-low socio-economic structure) (McMillan & Schumacher, 2006) of six different public high schools in Nigde province (37°57′N, 34°40′E), a rather small province with a population of 343.658 (Turkish Statistical Institution [TSI], 2013), in the central Anatolia region of Turkey. Of the participants, 46.50% (n = 93) were men and 53.50% (n = 107) were women in the study. According to Kline (1994), a sample group of 100–200 subjects is suitable for scale development so that the quality of the sample group can be stated to be suitable for such a study. In the research, Anatolian high school teachers (n = 96, 48.00%) constituted the largest group, followed by vocational and technical high school teachers (n = 74, 37.00%), and science high school teachers (n = 30, 15.00%). With regard to occupational experience, 12 (6.00%) teachers had 1–5 years of experience, 54 (27.00%) teachers had 6–10 years of experience, 79 (39.50%) teachers had 11–15 years of experience, and 55 (27.50%) teachers had an experience of above 16 years in the study. Finally, the participants' age ranged from 25 to 52 years (M = 29.6, SD = 1.13) in the research.

2.2. The development of the scale

First, an extensive literature review was made and some items were written for trial based on the relevant literature. A pool consisting of 35 items were formed by the researchers. Then, the first form of the scale consisting of 35 items was presented to the views of a group of experts in order to test the content validity of the scale. Experts from the fields of curriculum and instruction, educational measurement and evaluation, psychological guidance, instructional technology, and linguistics were asked to comment on the items prepared for the scale. Based on the views of these experts,

necessary changes and/or improvements were made in regard of language and intelligibility of the expressions of the items in the scale. The items in the scale were designed according to 5-point Likert (1932) type scale ranging from 1 (totally disagree) to 5 (totally agree) to indicate teachers' level of agreement or disagreement with each of these items. The scale, then, was finalised as consisting of 30 items for pilot study. Five items were removed from the scale because of the negative views of the suggestions of the experts. The final form of the scale was prepared and then applied on a group of high school teachers. All of the items were presented in the Turkish language. The translation between English and Turkish in this study was completed by one of the authors. In order to sustain the content validity of the scale, the exploratory factor analysis (EFA) based on a principal component analysis (PCA) was applied (Murphy & Davidshofer, 1991; Reuterberg & Gustafsson, 1992), then the confirmatory factor analysis (CFA) was conducted to determine whether the defined construct was valid (Jöreskog & Sörbom, 1993; Tabachnick & Fidell, 2001).

In the first phase of the validity and reliability studies of the scale, studies regarding the EFA were carried out. In the evaluation of the EFA, Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity were used in the study. KMO sampling adequacy and Bartlett's test of sphericity are used as a criterion for the EFA. KMO sampling adequacy and Bartlett's test of sphericity values were examined in order to test the eligibility of the data obtained for the EFA (Fraenkel & Wallen, 2000; Murphy & Davidshofer, 1991). In the related literature, it is stated that KMO value should be greater than 0.60 (Fraenkel & Wallen, 2000; Tabachnick & Fidell, 2001) as well as Bartlett's test of sphericity should be significant to conduct a factor analysis (Murphy & Davidshofer, 1991; Reuterberg & Gustafsson, 1992). Also, the eigenvalue and Scree plot were used to determine the number of factors extracted as a result of the EFA (Kline, 1994). In the EFA, factors with eigenvalues equal to 1.00 or more than this value are accepted as important factors (Kline, 1994; Tabachnick & Fidell, 2001). Besides, in the related literature factor loads ranging between 0.30 and 0.40 can be taken as the lowest limits in determining whether the items were included in the scale (Diekhoff, 1992; Ferguson & Takane, 1989). According to Diekhoff (1992), a factor loading is considered as “excellent” if it is 0.71 (which explains 50% of the variance). According to Tabachnick and Fidell (2001), it is considered as “pretty good” if it is 0.63 (which explains 40% of the variance), as “good” if it is 0.55 (which explains 30% of the variance), as “average” if it is 0.45 (which explains 20% of the variance), and “poor” if it is 0.32 (which explains 10% of the variance). As there are different views in determining the lowest factor loading limit (e.g., Diekhoff, 1992; Tabachnick & Fidell, 2001), Ferguson and Takane (1989) indicate that 0.40 should be taken as the lowest factor loading limit in order to create factor patterns. Therefore, 0.40 was accepted as the lowest factor loading limit in this study. On the other hand, the total factors were not limited in this study and factors with eigenvalues above 1.00 were included in the scale. In the related literature, eigenvalues above 1.00 were defined as important factors (Tabachnick & Fidell, 2001). In this study, the eigenvalue was adopted as 1.00 so that three factors were determined which had eigenvalues more than 1.00.

In order to test validity of the structure as a result of the EFA, the CFA was conducted in the study. As a result of the EFA, it was seen that the scale had a structure of three factors with 25 items. The CFA was used to examine whether the structure identified in the EFA worked in a new sample. Hence, the three-factor structure derived as a result of the EFA was applied on a group of 200 high school teachers similar to the sample group of the study. Also, Kline (2005) suggests that a CFA should be conducted on the model derived as a result of the EFA so that the CFA was applied to test the model derived as a result of the EFA. On the other hand, as a result of the CFA various goodness of fit indices are obtained. In the related literature, it is accepted as reasonable to use multiple goodness of fit indices instead of one single fit index so as to test the model derived as a result of the EFA (Jöreskog & Sörbom, 1993; Kline, 2005; Marsh, Balla, & McDonald, 1988; Schumacker & Lomax, 1996; Tabachnick & Fidell, 2001). As a result of teachers' perceptions towards ICTs in teaching-learning process scale, in addition to traditional chi-square ($\Delta\chi^2$) analysis, various goodness of fit indices including the goodness of fit index (GFI), the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and adjusted goodness of fit index (AGFI) are used in confirmatory factor analysis (CFA). While the ratio of chi-square – degrees of freedom ($\Delta\chi^2/df$) should be less than 3, GFI, CFI, TLI, and AGFI values can vary from 0 to 1 and the values exceeding 0.90 indicate a good fit. Also, RMSEA should be less than 0.05, with values less than 0.06 representing good fit (Hu & Bentler, 1999; Jöreskog & Sörbom, 1993; Kline, 2005; Thompson, 2004). After the CFA of the scale, Cronbach's (1990) Alpha internal consistency coefficients were calculated for reliability of the scale.

2.3. Procedure

Firstly, numerical data for teachers and schools in the high school level of the education system was obtained from the database of the Ministry of National Education (MoNE) of Turkey. Then, the questionnaires for participants were developed and prepared for the application. The questionnaires were delivered by one of the researchers visiting the high schools in the sample of the study. In the study, all participants were administrated paper and pencil questionnaires. For each item in the questionnaire, participants were asked to circle the response which best represented their level of agreement with the statements. The questionnaires with participants were conducted in their schools during weekday time. The application of the questionnaires on participants took approximately four weeks (about one month time). Also, the questionnaires took approximately 20 min to be completed by each participant. After the application of the questionnaires, they were collected by the same researcher himself visiting the high schools again. For the participants' non-responses, unintentional skips or unidentifiable marks on some items on the questionnaires, this study processes these items as missing data. The questionnaires containing missing data were discarded from the analyses. Finally, each questionnaire paper was numbered and then coded in MS Excel 2007 package and then transferred to SPSS® 11.0 and IBM AMOS™22.0 softwares for the statistical analyses. The studies regarding the EFA were made through SPSS® 11.0 and the studies in relation with the CFA were made through IBM AMOS™22.0 in the research.

3. Results

In this part of the study, the validity and reliability analyses of the scale were presented. The statistical processes were gathered under the titles of validity and reliability in the study.

3.1. Results for the construct validity of the scale

The results for the construct validity of the scale were gathered in two different titles in the study. The results for the construct validity of the scale were examined under results of the exploratory factor analysis (EFA) and results of the confirmatory factor analysis (CFA) titles.

3.1.1. Results of the exploratory factor analysis

In this part of the study, the analyses in regard of the EFA for the scale were presented. After the pilot form of the scale was applied on the selected teacher group, the EFA was conducted in order to test the structure validity of the perceptions towards ICTs in teaching-learning process scale. As a result of the EFA conducted, while the items which had 0.40 loading item value were taken into the scale, five items were calculated to be under the lowest factor loading limit so that these items were removed from the scale. After the items which were calculated to be under the lowest factor loading limit were removed from the scale, the rest of the items were numbered again. A second EFA was conducted on the items which had 0.40 or above the level of factor loading value and KMO sampling adequacy and Bartlett's test of sphericity values were determined. In this study, KMO sampling adequacy value was found as 0.91, which means excellent for testing the eligibility of the data (Murphy & Davidshofer, 1991). Bartlett's test of sphericity value was also found as significant ($\Delta\chi^2$ (n = 200) = 1949.642/ df = 300, p < 0.000). As a result of these tests, it was decided that the EFA could be applied on the data set of the scale. As a result of these analyses, it was decided that the EFA could be applied on the relevant data in the study. In this study, the eigenvalue was adopted as 1.00 so that three factors were determined as a result of the EFA. For this reason, a PCA was conducted on the data and three factors for the scale were determined as a result of it (see Table 1).

As a result of the EFA, it was decided that the scale had a structure of three factors with 25 items. It was understood that the factor loads of the first factor, Attitude (ATT), consisted of 10 items and the factor loadings rotated by varimax ranged from 0.578 to 0.708. Explained variance of this factor was calculated as 21.264%. In regard of the second factor, Use (US), consisted of 10 items and the factor loadings rotated by varimax ranged from 0.483 to 0.740. Explained variance of this factor was calculated as 17.208%. Lastly, in terms of the third factor, Belief (BEL), consisted of 5 items and the factor loadings rotated by varimax ranged from 0.449 to 0.809. Explained variance of this factor was calculated as 10.161% in the study. The total explained variance of the scale was found as 48.634% in the study. Variance ratios ranging from 40% to 60% are accepted as sufficient in social sciences (Kline, 1994) so that the total explained variance of the scale was considered as sufficient. Also, Cattel's Scree test (Kline, 1994) was applied on the data in order to test the structure with the factors of the scale (see Fig. 1).

Table 1
Rotated factor loadings for the three factors of the scale.

Items	Factors[a]		
	Attitude[b]	Usage[c]	Belief[d]
Attitude			
V14	0.708		
V23	0.671		
V21	0.667		
V28	0.660		
V25	0.645		
V18	0.624		
V17	0.606		
V30	0.583		
V20	0.589		
V15	0.578		
Usage			
V8		0.740	
V3		0.671	
V6		0.633	
V1		0.607	
V24		0.585	
V2		0.576	
V7		0.547	
V12		0.514	
V9		0.486	
V11		0.483	
Belief			
V13			0.809
V5			0.633
V26			0.585
V19			0.484
V10			0.449

Note.
[a] Total variance explained = 19.97%.
[b] Total variance explained = 19.97%.
[c] Total variance explained = 19.97%.
[d] Total variance explained = 19.97%.

As a result of the Scree test result shown in Fig. 1, it was decided that the scale consisted of three factors. As looked at the graphic (see Fig. 1) again, it was seen that there were three important factors in the scale. It is understood that the point which the graphic curve falls down fast is the fourth point in the Scree test result. The next factors at the fourth and the following points are both small and the same in regard of their contribution to the total variance of the scale (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Hence, it could be said that the scale was consisted of three factors. On the other hand, the correlations matrix for the three factors in the scale was also presented in the study (see Table 2).

It is seen in Table 2 that the results demonstrate that there were positive and significant correlations amongst three factors of the scale. According to the Pearson's correlation analysis carried out, it was seen that there was a significant correlation between attitude and usage ($r = 0.658$, $p < 0.01$) and attitude and belief ($r = 0.595$, $p < 0.01$). Also, there was a significant correlation between usage and attitude ($r = 0.658$, $p < 0.01$) and usage and belief ($r = 0.574$, $p < 0.01$). Lastly, there was a significant correlation between belief and attitude ($r = 0.595$, $p < 0.01$) and belief and use ($r = 0.574$, $p < 0.01$), respectively. In general, it was seen that there were positive correlations amongst the three factors on the scale ranging between 0.574 and 0.658 in the study ($ps < 0.01$).

3.1.2. Results of the confirmatory factor analysis

According to Brown (2006), "confirmatory factor analysis is almost always used during the process of scale development to examine the latent structure of a test instrument" (p. 1). Therefore, the CFA was applied on the three-factor structure obtained from the scale's exploratory factor analysis to verify factor structure on a group of 200 teachers similar to the sample group of this study. On examining the compatibility index results of the constructed equation model, the model-data compatibility was found out to be high enough (see Table 3).

As a result of the CFA, chi-square – degrees of freedom ratio was found as 1.12 ($\Delta\chi^2/df = 1.25/1$). In the study, GFI value was found

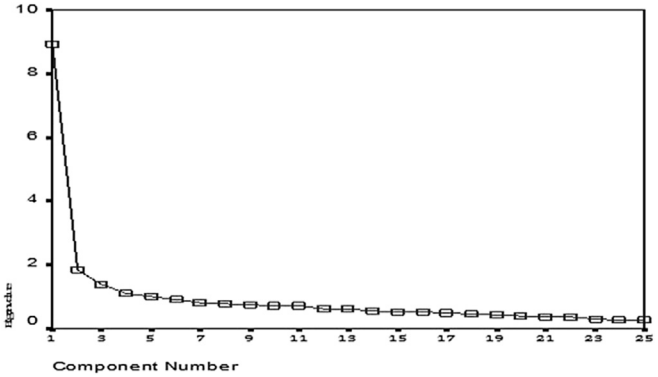

Fig. 1. Scree plot of the eigenvalues of the factors.

Table 2
Correlations matrix of the three factors of the scale.

Factors	*M*	*SD*	1	2	3
1. Attitude	4.11	6.89	–	0.658**	0.595**
2. Usage	3.93	7.90	0.658**	–	0.574**
3. Belief	3.74	4.29	0.595**	0.574**	–

Note. $^{**}p < 0.01$.

Table 3
Goodness of fit indices as a result of the CFA.

Fit indices	Perfect fit	Acceptable fit	Obtained fit
$\chi^2(df)$[a,b,h]	≤3	≤4–5	4.85 (3)
RMSEA[c,d]	≤0.05	≤0.06–0.08	0.026
CFI[a,e,f]	≥0.95	≥0.90	0.97
GFI[g,h]	≥0.95	≥0.90	0.96
AGFI[g,h]	≥0.95	≥0.90	0.94
TLI[e]	≥0.95	≥0.90	0.98

Note.
[a] Tabachnick & Fidell, 2001;
[b] Kline, 2005.
[c] Jöroskog&Sörbom, 1993.
[d] Brown, 2006.
[e] Hu & Bentler, 1999.
[f] Thompson, 2004.
[g] Schumacker & Lomax, 1996.
[h] Hooper et al., 2008.

out as 0.96 and AGFI vale was found as 0.94 so that they can be perceived as sufficient. In this research, RMSEA value was found as 0.026 so that it is considered as a perfect goodness of fit. Besides, in this study, CFI value was found out as 0.97. Lastly, TLI value was 0.98 in this study. It is seen in Table 3 that the results demonstrate that all the values obtained through the CFA were satisfactory for acceptable fit ($\Delta\chi^2$ ($n = 200$)/$df = 4.85/3$; GFI = 0.96; AGFI = 0.94; RMSEA = 0.026; CFI = 0.97; TLI = 0.98). Thus, according to these findings, the values obtained in this study can be considered as sufficient goodness of fit (Brown, 2006; Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999; Jöreskog & Sörbom, 1993; Kline, 2005; Schumacker & Lomax, 1996; Tabachnick & Fidell, 2001; Thompson, 2004). These findings provide evidence that the scale can be used for measuring teachers' perceptions towards ICTs in teaching-learning process at school.

3.2. Results for the validity and reliability of the scale

The items of the scale were analysed via computing item-total correlations for each factor and the independent samples *t*-test values were computed to compare both the item and factor scores of upper and lower 27% groups. In this sense, the scores were ranked from the smallest value to the largest value so as to calculate the upper and lower 27% groups. Thus, the scores of the participants fell in upper and lower 27% were compared with each other (see Table 4).

When looked at Table 4, it was seen that the test scores of the upper group were significantly different compared to lower group. According to the analysis conducted, it was understood that the test scores of the upper group were significantly higher than the scores of the lower group ($ps < 0.01$). These results showed that the items had a high level of distinctiveness as well as had an internal validity in the scale. On the other hand, Cronbach's Alpha internal consistency coefficients were calculated in order to test the reliability of the factors of the scale (see Table 5).

As looked at the results in Table 5, it was seen that Cronbach's Alpha internal consistency coefficients of the factors obtained range between 0.88 and 0.72 in the study. When looked at the alpha values of the factors, it was seen that ATT factor was calculated as 0.88, US factor was found as 0.85, and the last factor, BEL was calculated as 0.72, respectively. Also, the general reliability coefficient value for the scale was found as 0.92 in the study. Reliability coefficients in reliability studies values between 0.60 and 0.70 are accepted as sufficient Cronbach (1990). However, it is generally accepted that the reliability coefficient must be 0.70 in a lesser extent (Anderson, 1988; Peers, 1996; Scherer, 1988).

Secondly, Spearman-Brown correlation coefficient for the scale

Table 4
Determination of the inter validity of the scale.

Factors	Items	Groups	*M*	*SD*	*t*
Attitude	V13	$Upper_{27\%}$	4.57	0.60	9.280**
		$Lower_{27\%}$	2.83	1.24	
	V16	$Upper_{27\%}$	4.74	0.48	8.922**
		$Lower_{27\%}$	3.14	1.21	
	V24	$Upper_{27\%}$	4.64	0.51	8.879**
		$Lower_{27\%}$	3.03	1.22	
	V20	$Upper_{27\%}$	4.70	0.50	9.373**
		$Lower_{27\%}$	3.25	1.30	
	V18	$Upper_{27\%}$	4.62	0.55	9.093**
		$Lower_{27\%}$	2.85	1.32	
	V22	$Upper_{27\%}$	4.62	0.52	8.104**
		$Lower_{27\%}$	3.03	1.34	
	V15	$Upper_{27\%}$	4.40	0.90	6.714**
		$Lower_{27\%}$	2.94	1.32	
	V17	$Upper_{27\%}$	4.79	0.45	8.179**
		$Lower_{27\%}$	3.12	1.42	
	V14	$Upper_{27\%}$	4.59	0.53	11.139**
		$Lower_{27\%}$	2.70	1.12	
	V25	$Upper_{27\%}$	4.64	0.51	9.854**
		$Lower_{27\%}$	2.79	1.27	
Usage	V7	$Upper_{27\%}$	4.64	0.70	4.954**
		$Lower_{27\%}$	3.66	1.27	
	V3	$Upper_{27\%}$	4.53	0.50	7.129**
		$Lower_{27\%}$	3.29	1.17	
	V5	$Upper_{27\%}$	4.59	0.56	7.411**
		$Lower_{27\%}$	3.11	1.35	
	V1	$Upper_{27\%}$	4.33	0.75	3.861**
		$Lower_{27\%}$	3.51	1.35	
	V6	$Upper_{27\%}$	4.66	0.51	8.821**
		$Lower_{27\%}$	3.14	1.15	
	V21	$Upper_{27\%}$	4.70	0.50	8.255**
		$Lower_{27\%}$	3.25	1.18	
	V2	$Upper_{27\%}$	4.70	0.46	4.710**
		$Lower_{27\%}$	3.77	1.36	
	V11	$Upper_{27\%}$	4.72	0.45	7.218**
		$Lower_{27\%}$	3.35	1.31	
	V8	$Upper_{27\%}$	4.79	0.40	8.257**
		$Lower_{27\%}$	3.37	1.20	
	V10	$Upper_{27\%}$	4.51	0.86	5.994**
		$Lower_{27\%}$	3.18	1.38	
Belief	V12	$Upper_{27\%}$	4.45	0.57	7.975**
		$Lower_{27\%}$	2.94	1.21	
	V23	$Upper_{27\%}$	4.50	0.77	7.432**
		$Lower_{27\%}$	2.87	1.41	
	V9	$Upper_{27\%}$	4.55	0.69	7.259**
		$Lower_{27\%}$	3.03	1.37	
	V4	$Upper_{27\%}$	4.61	0.56	8.003**
		$Lower_{27\%}$	3.14	1.21	
	V19	$Upper_{27\%}$	4.51	0.69	10.002**
		$Lower_{27\%}$	2.62	1.20	

Note. $^{**}p < 0.01$.

Table 5
Cronbach's alpha values of the three factors in the scale.

Factors	Item number	Alpha (α)
Attitude	13 16 24 20 18 22 15 17 14 25	0.88
Usage	7 3 1 5 6 21 2 11 8 10	0.85
Belief	12 23 9 4 19	0.72

was calculated and the result in regard of the analysis was found as 0.85 in the study. In the related literature, values above 0.80 are accepted as good for reliability (Anderson, 1988; Kline, 1994). According to Özen, Güçaltı, and Kandemir (2006), Spearman-Brown correlation coefficient is a good was when it is hard to use the test for two times and/or prepare two equivalent forms of the similar test. Thus, the value obtained in regard of Spearman-Brown correlation coefficient for the scale can be defined as good (Murphy & Davidshofer, 1991; Reuterberg & Gustafsson, 1992). Also, the item-total correlations were calculated for the total scale and the analyses were presented in Table 6.

In Table 6, participants' perception scores (mean and standard deviation) towards ICTs in teaching-learning process as well as item-total correlation values were given. As a result of Pearson's correlation analysis, all the items in the scale were understood to be correlated significantly with the total score at 0.01 level.

4. Discussion

The purpose of this study was to develop a valid and reliable scale for determining teachers' perceptions towards ICTs in teaching-learning process. So, this study analyses the validity and reliability of an instrument – the perceptions towards ICTs in teaching-learning process scale – that can facilitate research in this scope. The developed scale is an instrument with validity and reliability according to the conducted analyses in the study. The scale is designed to measure the perceptions of teachers' towards ICTs in teaching-learning process at school. The scale is thought to be effective in measuring teachers' perceptions towards ICTs in teaching-learning process in terms of attitude, use, and belief.

This study focuses on addressing preliminary psychometric properties as well as on confirming the factor structure of the scale by considering in-service teachers. In the research literature, although no scale studies directly similar to this scale were found, it was seen that there were some scale development studies concerning teachers' attitudes towards ICTs (e.g., Albirini, 2006; Cavas et al., 2009; Chai, 2010; Hernandez-Ramos, Martinez-Abad, Penalvo, Garcia, & Conde, 2012; Metin, Yılmaz, Coşkun, & Birişçi, 2012), beliefs about ICTs (e.g., Chai, 2010; Deng, Chai, Tsai, & Lee, 2014), and usage of ICTs (e.g., Chai, 2010; Isleem, 2003; Papanastasiou & Angeli, 2008; Tezci, 2010). Although these scale development studies contained teachers' attitudes and beliefs towards ICTs and usage of them separately, this study contained all those factors in one study.

Table 6
Item analysis calculations for the total scale.

Item	*M*	*SD*	Item-correlation
V1	4.04	1.01	0.44
V2	4.42	0.94	0.48
V3	4.06	0.97	0.53
V4	4.01	1.07	0.55
V5	3.88	1.12	0.51
V6	4.03	1.05	0.60
V7	4.20	0.98	0.44
V8	4.18	1.00	0.63
V9	3.81	1.27	0.47
V10	3.98	1.29	0.48
V11	4.15	1.01	0.60
V12	3.55	1.29	0.43
V13	3.82	1.15	0.55
V14	3.78	1.09	0.68
V15	3.90	1.14	0.52
V16	3.94	1.06	0.57
V17	4.13	1.15	0.60
V18	3.97	1.15	0.62
V19	3.64	1.25	0.54
V20	3.97	1.11	0.57
V21	4.11	1.01	0.61
V22	3.96	1.16	0.58
V23	3.69	1.30	0.42
V24	3.92	1.07	0.57
V25	3.88	1.19	0.57

According to the results obtained in the research, KMO value was calculated as 0.91, and Bartlett's test of sphericity was found as significant. As a result of these tests, it was decided that the EFA could be applied on the relevant data. As a result of the EFA, it was seen that the scale had a structure of three factors with 25 items since the lowest factor loading limit was accepted as 0.40 in order to create factor patterns in the study. In regard of the first factor, ATT consisted of 10 items and the factor loadings rotated by varimax ranged from 0.578 to 0.708. Explained variance of this factor was calculated as 21.264%. In terms of the second factor, US consisted of 10 items and the factor loadings rotated by varimax ranged from 0.483 to 0.740. Explained variance of this factor was calculated as 17.208%. Lastly, the third factor, BEL consisted of 10 items and the factor loadings rotated by varimax ranged from 0.449 to 0.809. Explained variance of this factor was calculated as 10.161% in the study. The total explained variance of the scale was found as 48.634% in the research. Although there appeared 10 items for ATT and US factors each, BEL was consisted of only 5 items because of the factor loadings were under 0.40 in this construct, which was determined as the lowest factor loading limit in the study (see Ferguson & Takane, 1989; Tabachnick & Fidell, 2001). On the other hand, it was seen that there were positive correlations amongst the factors ranging between 0.574 and 0.658, respectively. When Cronbach's Alpha internal consistency coefficients calculated for the scale, the following coefficients were seen to be obtained; ATT = 0.88, US = 0.85, and BEL = 0.72 in the study. In the literature, reliability coefficients between 0.60 and 0.70 are accepted as sufficient (Cronbach, 1990). When Spearmen-Brown correlation coefficient of the scale was examined, it was understood that the correlation coefficient of the two forms of the scale in result of Spearman-Brown correlation analysis was 0.85 in the study. In the related literature, values above 0.80 are accepted as good for reliability (Anderson, 1988). Hence, the accounted value for Spearman-Brown correlation analysis, 0.85 can be considered as a good value (Murphy & Davidshofer, 1991; Reuterberg & Gustafsson, 1992). Although a scale gives very good results in the end of the EFA, it may not give the same results in the end of the CFA (Şimşek, 2007). Hence, it was considered the CFA could be applied on the three-factor structure of the scale as well as the EFA.

The CFA was applied to the three-factor construct obtained from the scale's EFA on a group of teachers similar to the sample group of this study. On examining the compatibility index results of the constructed equation model, the model-data compatibility was found out to be high enough. In the study, GFI value was found out as 0.96 and AGFI vale was found as 0.94 so that they can be perceived as sufficient. In this research, RMSEA value was found as 0.026 so that it is considered as a perfect goodness of fit. Besides, in this study, CFI value was found out as 0.97. Lastly, TLI value was 0.98 in this study. It is seen in Table 3 that the results demonstrate that all the values obtained through the CFA were satisfactory for acceptable fit ($\Delta\chi^2$ (n = 200)/df = 4.85/3; GFI = 0.96; AGFI = 0.94; RMSEA = 0.026; CFI = 0.97; TLI = 0.98). Thus, according to these findings, the values obtained in this study can be considered as sufficient goodness of fit (Brown, 2006; Hooper et al., 2008; Hu & Bentler, 1999; Jöreskog & Sörbom, 1993; Kline, 2005; Schumacker & Lomax, 1996; Tabachnick & Fidell, 2001; Thompson, 2004). These findings provide evidence that the scale is both valid and reliable to be used for measuring

teachers' perceptions towards ICTs in teaching-learning process at school. Thus, the scale was found to be a valid and reliable instrument for measuring the perceptions towards ICTs in teaching-learning process.

ICTs have a very strong effect in education and they provide enormous tools for enhancing teaching and learning (Cavas et al., 2009). There are many studies that the utilisation of ICTs in the classroom may support teaching-learning process (e.g., Albirini, 2006; Al-Zaidiyeen et al., 2010; Cavas et al., 2009; Leach, Ahmed, Makalima, & Power, 2005; Metin et al., 2012; Tezci, 2010; Yılmaz, 2005). These technologies become important when teachers use them in teaching-learning process at school (Tezci, 2010). Recent research has shown that the successful implementation of ICTs depends largely on the attitudes, utilisation, and beliefs of teachers (Albirini, 2006). Thus, teachers play an important role in the implementation of ICTs into teaching-learning process in the classroom (Al-Zaidiyeen et al., 2010). However, although the research literature showed that teachers had positive attitudes towards the use of ICTs (e.g., Akbaba-Altun, 2001; Al-Zaidiyeen et al., 2010; Cavas et al., 2009; Rana, 2012; Tezci, 2010), it was found out that few teachers use ICTs as an integral part of teaching-learning process at school (e.g., Pelgrum & Plomp, 1993; Pala, 2006). During the process of integration of ICTs in teaching-learning process, teachers' attitudes towards and beliefs about these technologies are thought to be a crucial factor in the utilisation of them in the classroom. As Fishbein and Ajzen (1975) and Ajzen and Fishbein (1980) indicated, attitudes can often foretell future decision-making behaviour of people. According to Al-Zaidiyeen et al. (2010), teachers' attitudes towards ICTs for educational purposes is one key factor for the successful utilisation of these technologies at school. Teachers' attitudes towards ICTs may determine the use of them in teaching-learning process (Tezci, 2010). Teachers' attitudes towards ICTs are also a major enabling or disabling factor in the adoption of these technologies (Bullock, 2004). As Woodrow (1992) asserts that any successful transformation in teaching-learning process requires the development of positive attitudes towards the new technology. Teachers' positive or negative attitudes towards ICTs all together affect the use of these technologies in teaching-learning process in the classroom (e.g., Davis, 1989; Francis, Katz, & Jones, 2000; Tondeur, Van Braak, & Valcke, 2007). If teachers have negative attitudes towards ICTs in educational processes, they will not struggle to use these technologies in the classroom. Hence, the development of teachers' attitudes towards ICTs is seen as a key factor for enhancing technology integration into teaching-learning process at school (Rogers, 1995; Watson, 1998). Although research results assert that teachers' attitudes towards ICTs can affect their use in teaching-learning process, other important factors such as beliefs about ICTs may also affect the use of these technologies in teaching-learning process in the classroom (e.g., Lim & Chan, 2007; Teo, Lee, & Chai, 2008). Previous research has indicated that teachers' beliefs about ICTs play an important role in determining the usage of these technologies in teaching-learning process by teachers (e.g., Chai, 2010; Ertmer, 2005; Ravitz, Becker, & Wong, 2000). Teachers' beliefs about ICTs can create a barrier to the usage of them in teaching-learning process as well as they can help teachers use them effectively in the classroom (Ertmer, 2005). Research literature (e.g., Kim et al., 2013; Loveless, 2003) has shown that there is a significant correlation between teachers' beliefs and the integration of ICTs in teaching-learning process. Therefore, it is understood that teachers' beliefs about ICTs strongly affect the usage of these technologies in this process. In conclusion, it can be said that attitudes towards ICTs and beliefs about them overall can highly affect their usage in teaching-learning process by teachers. As teachers are the key elements in the usage of ICTs in the classroom, their attitudes towards ICTs as well as beliefs about them must be taken into consideration in order to better apply and/or use these technologies in teaching and learning.

In light of these results driven from the related literature, it can be stated that the scale developed in this study may contribute to the understanding of teachers' attitudes and beliefs in the effective usage of ICTs in teaching-learning process in the classroom. When the related literature is reviewed, it was seen that there were many scale studies regarding teachers' attitudes towards ICTs, but it was not seen any scale development study in terms of teachers' beliefs about ICTs(e.g., Chai, 2010; Deng et al., 2014). It must be noted that the studies in relation with beliefs about ICTs are associated mostly with teachers' pedagogical beliefs, not with their beliefs about ICTs.

This study only focused on teacher' beliefs about ICTs as well as their attitudes and usage of these technologies in teaching-learning process. Also, most of the scales developed in the research literature have shown that these scales focused mostly on teachers' attitudes towards ICTs (e.g., Cavas et al., 2009; Metin et al., 2012; Tezci, 2010), not on the attitudes towards ICTs, beliefs about them, and the utilisation of them in teaching-learning process in the classroom. This study combined all these factors (i.e., attitudes, beliefs, and use) in one scale and contributed to determine the role of these factors in this process. With its psychometric proprieties, this scale is thought to be used in the determination of teachers' attitudes towards ICTs, beliefs about them, and the utilisation of them in teaching-learning process at school. It is thought that this scale is convenient for measuring perceptions of teachers towards ICTs in teaching-learning process. The scale in this study has sufficient merits to justify further research in the area. Thus, this scale development study is considered to fill the gap in the related literature regarding the perceptions of teachers towards ICTs in teaching-learning process.

5. Implications for practice

The results of this study reveal some implications for practice. Through the abovementioned analyses, a three-factor and 25-item scale with good psychometric properties for measuring teachers' perceptions towards ICTs in teaching-learning process was developed in the study. The research results emphasised the importance of assuming a multifactor analytical approach in determining teachers' perceptions towards ICTs in teaching-learning process. It is thought essential that the educational authorities should put emphasis on various factors in implementing ICTs in teaching-learning process in the classroom. Establishing strategies for the implementation of ICTs in teaching-learning process in light of the perceptions of teachers is considered to be very important for a successful educational reform by taking educational technology into account.

This study presented an empirically validated model for measuring teachers' perceptions towards ICTs in teaching-learning process. The 25-item scale that emerged demonstrated to produce acceptable reliability values as well as the empirical evidence supported its content and structure validities. The scale developed in this study can be used to assess teachers' perceptions towards ICTs in teaching-learning process. Thus, this kind of evaluation can give insights to educational authorities regarding teachers' perceptions towards ICTs in teaching-learning process and make them adjust the technology implementation in this process accordingly. It must be noted that any kind of educational technology implementation act cannot be successful, if teachers do not have positive views (i.e., attitudes, beliefs, etc.) towards that act or educational technology. As the scale developed in this study with good reliability and validity can be periodically administrated on teachers to

get information about teachers' perceptions towards ICTs in teaching-learning process and take the corrective actions if necessary for improvement.

6. Implications for research

When the related literature is reviewed, it is seen that some scales have been developed to measure teachers' perceptions towards ICTs so far. These scales have been focused especially on teachers' attitudes towards these kinds of technologies. However, according to previous literature, teachers' perceptions towards ICTs have a multifactor construct, not merely focussing on the sub-dimensions of attitude, but on other psychological traits such as beliefs about ICTs as found in this study, which cannot be measured only through attitudes. Thus, a standardised scale for measuring teachers' perceptions towards ICTs in teaching-learning process with desirable psychometric properties was developed in the study. The validated 25-item scale consists of three factors as attitude, usage, and belief.

The next step of this study should work on providing more strong evidence about the validity of the scale and further studying the affective domain. This scale was developed in the Turkish language so that further studies in terms of validity and reliability in different cultures should be carried out. The studies testing the construct validity of the scale in different cultures are considered as valuable acts to see the usefulness of the scale. Also, further model testing studies are also seen as important in order to test some variables in connection with the factors found in this scale. Future research should continue to test the possible correlations between teachers' perceptions towards ICTs in teaching-learning process and their personal characteristics and/or behaviours. The scale with good reliability and validity values can provide researchers with an instrument for measuring teachers' perceptions towards ICTs in teaching-learning process, and a basis for explaining as well as comparing differences amongst the results of the studies.

7. Limitations

Although this scale development study has good psychometric properties, this work has some limitations that should be taken into account in future studies. First, this study used 200 teachers from different high schools from a rather small province of Turkey. More research sample was expected to be reached, however, only 200 teachers accepted to participate in the study and responded positively. Hence, it can be stated that the sample group of the study is fairly small. Although the sample group seems to be fairly small, a sample group of 100–200 subjects is accepted as suitable for scale development studies (see Kline, 1994). Second, the scale was developed in the Turkish language so that further validity and reliability studies, as noted in "implications for research" part of the study, should be done by considering different cultures. Third, this study did not check the scale's criterion-related validity, that is, data were not collected on the scale as well as other similar scales concurrently. Lastly, future research may address the test-retest reliability of the scale, which is perceived as valuable for sustaining the reliability of the scale including short-and long-range stability should be further assessed using the test-retest correlation method in future research.

Appendix

Perceptions towards ICTs in teaching-learning process scale

Item	Factors/Items[a,b,c]
Attitude (ATT)	
1	The use of ICTs in teaching-learning process is important.
2	The use of ICTs makes teaching-learning process more interesting.
3	The use of ICTs in teaching-learning process is valuable.
4	The use of ICTs in teaching-learning process makes students more motivated.
5	The use of ICTs in teaching-learning process makes communication more functional.
6	The use of ICTs in teaching-learning process makes curriculum more functional.
7	Studying with ICTs makes teaching-learning process more enjoyable.
8	I reinforce my colleagues to use ICTs in teaching-learning process.
9	I consider the use of ICTs a suitable tool for teaching-learning process.
10	I am eager to participate in in-service training seminars about the use of ICTs.
Usage (US)	
11	The use of ICTs in teaching-learning process makes save energy.
12	The use of ICTs in teaching-learning process makes save time.
13	I try to use ICTs in teaching-learning process in the classroom.
14	I give priority to use ICTs more than textbooks in teaching-learning process.
15	The use of ICTs helps me organise teaching-learning process better.
16	The use of ICTs helps me integrate the curriculum and teaching-learning process.
17	I reinforce my students to use ICTs in teaching-learning process.
18	The use of ICTs assists me design teaching-learning process in the classroom.
19	I try to use educational software through the use of ICTs in teaching-learning process.
20	I am satisfied with using ICTs in teaching-learning process in the classroom.
Belief (BEL)	
21	I believe that ICTs enhance students' learning in teaching-learning process.
22	ICTs present students life-like applications in teaching-learning process.
23	I consider ICTs as valuable tools in students' learning in the classroom.
24	I believe ICTs as powerful tools helping students' understanding of abstract content.
25	I think all students should use ICTs in teaching-learning process in their classrooms.

Note.
[a] All the items in the scale were grouped under the factors and then numbered accordingly.
[b] The scale is designed in 5-point Likert type (Totally Disagree = 1; Disagree = 2; Uncertain = 3; Agree = 4; Totally Agree = 5).
[c] All the items in the scale are positive. Thus, there is no item in the scale that is coded reversibly.

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