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Perceived attributes of instructional computer use in early childhood education: A scale adaptation and validation study[1,2]

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Abstract. Based on Rogers' (2003) Diffusion of Innovations Theory, this study aims to describe the construction and validation of the "Perceived Attributes of Computer Use" (PACU) scale to measure the pre-service early childhood teachers' (N=581) tendency towards computer use for instructional purposes in the early childhood settings. The development and validation process of the PACU scale, reworking on the structure and item numbers of the original English scale 'Perceived Characteristics of Innovating' (Moore & Benbasat, 1991), was accomplished in four steps, namely (1) translation and adaptation procedure, (2) Q-Sort method, (3) exploratory factor analysis, and (4) confirmatory factor analysis. A five-factor scale (i.e., relative advantage, compatibility, complexity, trialability, and observability with eigenvalues of 8.1, 3.1, 2.3, 1.5, and 1.2, respectively) was revealed including 23 items and a good fit between the data set and the proposed Turkish version scale was confirmed (NNFI=.92, CFI=.93, RMSEA=.97, $\chi 2/df=2.58$). Moreover, the reliability value of the scale was found .90. In the end, the overall measures and evidence validated a ready-to-use scale for prospective early childhood teachers.

Keywords: Perceived attributes, instructional technology, prospective early childhood teachers, scale validation, reliability

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INTRODUCTION

Since the 1980s, many schools have been equipped with technological tools and computers (Mundy, Kupczynski, & Rick Kee; 2012). It was thought that teachers would use technology to enhance their teaching practices (Ertmer & Ottenbreit-Leftwich, 2010). However, research studies revealed that the teachers' Information and Communication Technologies (ICT) use in teaching is low (Ifenthaler & Schweinbenz, 2013; Somekh, 2008) and more than half of the teachers use computers only for administrative purposes (Mundy, Kupczynski, & Rick Kee; 2012). Ponticell (2003) also states that teachers generally hesitate in adopting innovations related to the instruction which may cause minimal changes in teaching and learning practices. Nonetheless, the success of a change in education would be achieved by teachers (Fullan, 1991). As Zhao and Tella (2002) underline, "They [teachers] are the "gatekeepers" of technology, who not only determine whether it enters the classroom, but also affects how it is used in the classroom" (p. 1). Thus, given the importance to the crucial role of educators, there is a need to understand their views in order to achieve a successful technology integration. Indeed, some researchers (e.g. Davis, 1989; Francis et al., 2000; Huang & Liaw, 2005; Paraskeva, et al., 2008; Van Braak, Tondeur, & Valcke, 2004) found that teachers' attitudes and perceptions toward computers had a significant impact on their behaviors related to computer use for instructional purposes. That is, teachers having positive thoughts on the perceived attributes of computer use would tend to adopt computer use in their teaching practices. In order to better understand how teachers perceive the instructional computer use and their intentions, researchers have benefited from an increasing literature about the definition, dimensions and theoretical foundations of teachers' computer use in education. For example, to understand people's behavior changes, Theory of Reasoned Action (TRA) was proposed by Fishbein and Ajzen (1975). Then, based on TRA, Technology Acceptance Model (TAM) by Davis (1986) and Theory of Planned Behavior (TPB) by Ajzen (1991) were developed. Further, with the combination and adaptation of TRA and TPB, Venkatesh, Morris, Davis, and Davis, (2003) proposed Technology

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[2] This study was presented as an abstract paper at the 4th International Conference on Preschool Education.

Acceptance Model 2 (TAM2). Similarly, to explore the technology use in education different models were presented by Teo (2009) and Van Braak, Tondeur, and Valcke (2004). Different from these theories and models, Rogers (2003) proposed Diffusion of Innovation Theory is widely used as a conceptual framework in the diffusion and adoption of technology. As considering both the characteristics of the innovation and the individuals, this theory draws a whole picture of the innovation-decision process.

Rogers (2003) states that individuals' views about the perceived attributes of an innovation have a significant role in order to explain the adoption and diffusion of an innovation. Therefore, if teachers have positive views regarding the perceived attributes of computer use, their decision lead them to adopt computer use. For this purpose, many researchers have benefited from Rogers' (2003) theory to explore different aspects of technology use by teachers' (e.g., El Shaban, 2017; Aşkar & Koçak-Usluel, 2003; Brahier, 2006; Isleem, 2003; Rosetti, 2012; Kuskaya-Mumcu, 2004; Moore, 2007; Owens, 2009; Samiei, 2008) and prospective teachers (e.g., Chong, 2012; Gökçearslan, Karademir & Korucu, 2017; Kılıçer, 2011; Ogilvie, 2008; Yüksel, 2015). It was reported that previous studies mostly focused on some variables such as self-efficacy, pedagogical beliefs, attitude, and individual characteristics to understand pre-service teachers' integration of computer technologies in education (So, Choi, Lim, & Xiong, 2012). Moreover, there is little evidence of the studies investigating pre-service early childhood teachers' views and intentions (Angeli, 2004; Laffey, 2004; Yelland, Grieshaber, & Stokes, 2000) while there is no research to explain pre-service early childhood teachers' perceived attributes of technology use in education. Defining pre-service early childhood teachers' perceived attributes of technology use in education is important because they will become in-service teachers in the near future and their perceptions can give an idea regarding the adoption of computers in education. Therefore, its important to identify the favorable or unfavorable attitudes of pre-service early childhood teachers towards computer use to contribute to the effective use of computers in early childhood education. In order to assess perceived attributes of computer use as intended, it is crucial to have a valid and reliable scale as well as to present detailed information about scale development procedure. Therefore, based on the gap and urgent need mentioned above, the current study aims to adapt and validate a "perceived attributes of instructional computer use" scale for pre-service early childhood teachers considering Turkish culture.

Background of the Study

Theoretical Framework

In the current study, Rogers' (2003) Diffusion of Innovations theory was used as a theoretical framework. Rogers' (1983; 2003) theory is considered as the most appropriate theory to explore the adoption of technology in educational settings (Medlin, 2001; Parisot, 1995) and used in a variety of disciplinary fields such as education, communication, anthropology, geography, medicine, marketing, sociology, and political science (Dooley, 1999; Stuart, 2000).

The adoption and integration of technologies in the educational environment may be difficult because there are some factors that influence educators' decision (Buabeng-Andoh, 2012). According to Rogers (2003), all the innovations are not adopted in a desirable way and the perceived attributes of innovation (i.e. relative advantage, compatibility, complexity, trialability, and observability) have an important role in order for the individuals to decide whether to adopt or reject an innovation. To explain, relative advantage of perceived attributes is "the degree to which an innovation is perceived as being better than the idea it supersedes" (p. 229). In other words, it means that in which degree a new idea is better than an existing one. Specific types of relative advantage are mostly expressed as social prestige, economic profitability, comfort, saving of time, saving of effort, and the likes. Second, compatibility is "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of the potential adopters" (p. 240). That is, if an innovation is more compatible, then it is less uncertain and it fits close individual's situation. Thus, an innovation can be either compatible or incompatible with the individuals' socio-cultural values and beliefs, previous ideas, and the needs for the innovation. On the other hand, complexity is "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 257). Therefore, it plays an important role to be a barrier for the adoption of an innovation. In other words, the complexity of an innovation is negatively related to its rate of adoption. The other attribute is trialability and it's defined as "the degree to which an innovation may be experimented with on a limited basis" (p. 258). Although some innovations are more difficult to try than others, a personal trial can eliminate ambiguity about new ideas. In other words, if people are able to try an innovation, they gain more information about how it works, and they find it more meaningful. The last attribute, observability, refers to "the degree to which the results of an innovation are visible to others" (p. 258). That is, if an innovation is easy to observe and to communicate with other individuals, it is generally adopted rapidly. As a result, considering the five characteristics of innovations, explained above, the innovation having a greater relative advantage, compatibility, trialability, and observability and less complexity refer more rapid adoption than other innovations (Rogers, 2003).

METHODS

Design of the study

This is a scale adaptation study ensuring the validity and relialitiy of the scale of the "Perceived Attributes of Computer Use" (PACU) to measure future early childhood teachers' (N=581) tendency towards computer use for instructional purposes in early childhood (DeVellis, 2003). This process was started reworking on the structure and item numbers of the original English scale 'Perceived Characteristics of Innovating' (Moore & Benbasat, 1991). Then, the process was comleted in four phases, namely (1) translation and adaptation procedure, (2) Q-Sort method, (3) exploratory factor analysis, and (4) confirmatory factor analysis. Moreover, the reliability of the scale was evaluated to have a valid and reliable ready-to-use scale for preservice early childhood teachers.

Participants

In the current study, "Perceived Attributes of Computer Use" (PACU) scale was adapted and validated to be used for pre-service early childhood teachers who are almost ready to be a teacher. In total, 581 junior and senior early childhood teacher candidates enrolled in early childhood education programs at four different universities located in the Central Anatolia region of Turkey were purposefully chosen for this study (i.e. 8 participants for Q-Sort, 137 participants for EFA, and 436 participants in CFA procedure). This specific sample was selected on purpose because the junior and senior students in early childhood teacher education programs had already taken the courses related to the technology and school experience in Turkey. For example, students take "Computer I" course in the first semester, "Computer II" course in the second semester, and "Instructional Technology and Material Design" course in the fourth semester. Moreover, they attend "School Experience" course in the fifth semester and "Practice Teaching I" in seventh semester and "Practice Teaching II" in the eighth semester in the Early Childhood Education undergraduate programs.

The majority of the participants are female (90.58%). The age of the participants was on an average of 21.80 and among them, 59.17% of them were junior and 40.83% of them were senior. Almost all of the participants had computers (94.94%) and 82.20% of the participants had an Internet connection at home. Moreover, in terms of computer usage, some of the pre-service early childhood teachers responded that they had used computers for 8 to 10 years (34.21%) while 28.80% of them had used computers for 5 to 7 years, 21.82% of them had used more than 10 years, 14.31 % of them had used computers for 2 to 4 years. Only 0.7% of the participants stated that they have only used computers less than a year. Also, the majority of the participants did not attend seminars or workshops related to computer use (85.69%).

Data Collection Protocol

To be able to collect data, first, the ethical permission was taken from the Research Center for Applied Ethics ethical committee. Then, the course instructors were met and the time schedule was arranged according to the departments' course schedules. Data were collected in the participants' regular classroom and applied as a paper-based instrument by the first author. Before implementing the survey, all participants had been informed about the aim of the study, the content of the survey, and the method of responding to the items. Moreover, participants were told that there was no right or wrong response in the survey and their opinions were important. Furthermore, in order to keep the confidentiality of the data, the participants were informed that any of the data will not be shared with the third person and the data gathered will be used only for scientific research studies.

Procedure

The original "perceived characteristics of innovating" scale

The original scale, the Perceived Characteristics of Innovating, was developed by Moore and Benbasat (1991). The main purpose of this scale was to measure the perceptions of adopting Personal Work Stations (PWS). The development of the original scale was completed in three phases. First, the item pool comprising eight components was created from existing scales to ensure content validity. The components were mainly designed according to Rogers' extensive study (1983) which defines five general attributes of innovations namely relative advantage, compatibility, complexity, trialability, and observability. Besides Rogers' classification (1983), two further constructs, image, and voluntariness, were added to the instrument. Second, the card sorting method was utilized to determine the categories and then factor analysis was used in order to ensure construct validity. Third, pilot and field tests were conducted to accomplish a final version of the instrument. Finally, the reliable instrument comprising eight components was developed along with both long versions with 38 items and a short version with 25 items. In the current study, the long version was adapted and validated (see Table 1). In this process, since it was aimed to focus on Roger's (2003) Diffusion of Innovations Theory, two components (i.e. Image and Voluntariness) were excluded and two components (i.e. Result Demonstrability and Visibility) which are identical in terms of Roger's theory, were combined and named as Observability. As a result, based on experts' views, including one of the developers of the original scale, in the current study 5 components with 35 items were utilized.

Table 1. *Cronbach alpha coefficient of the original scale*

	Long Version
Relative Advantage	.92
Compatibility	.83
Ease of Use (i.e. Complexity)	.80
Trialability	.71
Result Demonstrability (i.e. Observability)	.77
Visibility (i.e. Observability)	.73
Image	.80
Voluntariness	.87

Translation and Adaptation Procedure

According to Vijver and Leung (1997), "If the construct is not fully covered in the new group, the instrument can be adapted by rephrasing, adding, or replacing items that measure the missing aspects" (p.265). Therefore, in order to cover the target population characteristics and field requirements, the researchers needed to make some modifications. Moreover, Hambleton

(2005) suggests that when an instrument is adopted into another language, it is important to include words and expressions which are culturally and psychologically appropriate in the second language rather than to follow simple literal translation procedure and to avoid particular words or expressions, multiple translators are recommended rather than a single translator. Thus, as an initial step, the scale was translated and then sent to seven experts with Ph.D. degree specialized in Early Childhood Education and Computer and Instructional Technology for their expert views. Hence, one of the experts was the developer of the original English scale who was requested to review the adapted scale. The others were already conducted research studies focusing on pre-service teachers and faculty instructional computer use (e.g. perceived attitudes, adopter categories, support, and obstacles in the diffusion of informatics technologies) and also similar studies in early childhood teacher education. As a result, the experts who are interested in similar research subject and proficient in both languages examined the items in detail and made comments on the most appropriate meaning of the field and the sample of the study. After ensuring the content validity, two experts who have Ph.D. degrees in Turkish language also consulted in order to ensure appropriateness of the final version of the scale items into Turkish culture and grammar rules (see Table 2).

Table 2. *Example changes between the original and the adapted statements* [1,2]

The Original Statement	The Adapted Statement
Using a **PWS** *improves* the quality of work I do.	In early childhood education, **using computer** *will improve* quality of work I do
Using a **PWS** *is* completely compatible with my current **situation.**	In early childhood education, **using computer** *will be* completely *compatible* with my current **experiences.**
I think that using a **PWS** *fits* well with **the way** I like to work.	In early childhood education, **using computer** *will fit* well with **the teaching methods** I like to work.

Notes:
1 In the table, the bold phrase refers to word change, the italic phrase refers to tense change, and underlined phrase refers to adding in the sentence.
2 ***PSW*** is the abbreviation for Personal Work Stations

Q-Sort Method Procedure

Q-Sort Method was developed by William Stephenson in 1935 and used to evaluate the construct validity and reliability of the questionnaire items (Nahm, Solis-Galvan, Rao & Ragun-Nathan, 2002; Moore & Benbasat, 1991). Therefore, Q-sort method is seen as unique and special due to the fact that it enables the researcher to collect data both qualitatively and quantitatively (Amin, 2000; Brown, 1996; Valenta & Wigger, 1997).

For this study, four judge groups (including two participants in each) were formed as similar as possible to the target population including junior preservice early childhood teachers, senior preservice early childhood teachers, and newly graduated from early childhood teacher education programs. At the beginning of the card sorting process, the participants were informed about the standards of the process and the tasks. Moreover, the participants were allowed to ask questions in order to prevent any misunderstandings. Therefore, comprehensiveness of the items was aimed to be ensured. As it is seen in Figure 1, names of the attributes (e.g., complexity, trialability) were written on rectangular-shaped cards while the items were written in square-shaped cards. There were five attribute labels (relative advantage, compatibility, complexity, trialability, and observability) and thirty-five item cards related to these five labels. Each item printed on index card was numbered, rearranged randomly and prepared as two sets for the Q-Sort method.

FIGURE 1. *The cards used in the Q-Sort method*

Notes: The corresponded English translation of the examples written in Turkish are as below:
For green set: The label *"Karmaşıklık"* means *"Complexity"* and the item 5 *"Okul öncesi eğitimde bilgisayar kullanmak, yaptığım işin kalitesini arttıracaktır."* means *"In early childhood education, using a computer will improve the quality of work I do."*
For blue set: The label *"Denenebilirlik"* means *"Trialability"* and the item 3 *"Okul öncesi eğitimde bilgisayar kullanmanın zor olacağını düşünüyorum."* means *"I think, in early childhood education, a computer is cumbersome to use."*

Then, the judges asked to read the cards and sort them in the most suitable categories according to their thoughts. Moreover, at any stage of the sorting process, judges were free to make any change of item arrangement. During the process, the researchers just observed and did not intervene in any way. The process took approximately twenty minutes for each round and Q-Sorting Method was completed in four rounds. At the end of each sorting round, item numbers and the related labels were noted and then, the judge groups were allowed to compare and discuss their individual sorting results. Considering feedbacks received from the participants, some changes were made on the items. For example, word order was reorganized to get better expressions.

To assess the reliability of Q-Sorting Method, two different measurements were used: Level of agreement (Cohen's Kappa) and Inter-Judge Agreement (Hit Ratio of Placement) (Nahm et. all, 2002). Cohen's Kappa is defined as "a measure of agreement can be interpreted as the proportion of joint judgment in which there is agreement after chance agreement excluded" (Nahm et. all, 2002, p.3). Although there is not a general agreement for required scores, some research shows that the acceptable score is greater than 0.65 (e.g. Jarvenpaa, 1989; Moore & Benbasat, 1991; Vessey, 1984). In this study, Cohen's Kappa was found 0.82, greater than 0.65, at the end of the fourth round. Therefore, it can be stated that the measure of agreement was assured. Second, Inter-Judge Agreement was examined. Nahm et al. (2002) define that "The item placement ratio (the Hit Ratio) is an indicator of how many items were placed in the intended or target category by the judges" (p.4). That is, the degree of inter-judgment agreement across the panel depends on the degree of the percentages of the items placed in the target construct. Although maximum value corresponds to "1", the higher percentage means the higher degree of inter-judge agreement. Therefore, there is not any rule for defining a good degree of placement (Moore & Benbasat, 1991). In the current study, the values for each sub-scale were found as 1.00 for Relative Advantage, 1.00 for Compatibility, and 1.00 for Complexity while 0.71 for Trialability and 0.71 for Observability at the end of the fourth round. Moreover, the overall placement ratio was measured as 0.88 (see Table 3).

Table 3. *The measurements to assess reliability of Q- sort method*

Agreement Measure	Round 1	Round 2	Round 3	Round 4
Raw Agreement (%)	0.76	0.86	0.77	0.97
Cohen's Kappa	0.58	0.68	0.60	0.82
Placement Ratio Summary (%)				
Relative Advantage	0.88	0.88	1.00	1.00
Compatibility	0.75	1.00	0.75	1.00
Complexity	0.50	0.33	0.67	1.00
Trialability	0.71	0.29	0.71	0.71
Observability	0.50	0.60	0.60	0.70
Average (%)	0.67	0.62	0.75	0.88

At the end of the Q-Sort, as presented in Table 4, the original length of the scale with 35 items was reduced in 26 items.

Table 4. *The changes on item numbers after Q-sort method*

Scale	Original Length	Reduced Length	
		Number of Items	*Related Items*
Relative Advantage	8	7	Item 1 to 7
Compatibility	4	4	Item 8 to 11
Complexity	6	5	Item 12 to 16
Trialability	7	5	Item 17 to 21
Observability	10	5	Item 22 to 26
TOTAL	35	26	

Exploratory Factor Analysis (EFA) Procedure

To conduct EFA, the required assumptions were tested. The strength of relationships among the items was checked by examining Bartlett's test of sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) results. According to Tabachnick and Fidell (2007), the strength of relationships should be greater than .3 at least in some correlations, Bartlett's test of sphericity value should be significant at $p < .05$ and the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) value should be .06 or above. In this study, all of these values were sufficient since Bartlett's test of Sphericity ($\chi 2$=2026, 325 and p=.000), KMO measure was found to be .847 and correlation coefficients were greater than 0.3 among the majority of the pairs of items. As a result, for this study, all issues were ensured to perform.

In order to display the construct of the Turkish version of "Perceived Attributes of Computer Use" (PACU) scale, exploratory factor analysis was conducted. Tabachnick and Fiddell (2007) recommend that "Perhaps the best way to decide between orthogonal and oblique rotation is to request oblique rotation with the desired number of factors and look at the correlations among factors…If correlations exceed .32, then there is 10% (or more) overlap in variance among factors, enough variance to warrant oblique rotation unless there are compelling reasons for orthogonal rotation." (p. 646). Thus, based on this recommendation, the oblique rotation was requested, and the component correlation matrix was examined. As it is seen in Table 5, the correlation between three factors was above .32. For example, it was .35 between factor1 and factor2, .41 between factor1 and factor4, and .42 between factor1 and factor5. As a result, EFA was conducted by using maximum likelihood extraction technique method and oblique rotation method (direct oblimin) to 26 items and 137 participants for the present study.

Table 5. *Correlations between the factors of Turkish version of PACU*

Factor	1	2	3	4	5
1	1.000	**.350**	.161	**.411**	**-.428**
2	**.350**	1.000	.262	.298	-.096
3	.161	.262	1.000	.013	-.058
4	**.411**	.298	.013	1.000	-.067
5	**-.428**	-.096	-.058	-.067	1.000

Confirmatory Factor Analysis (CFA) Procedure

Using LISREL statistical program (Jöreskog & Sörbom, 2006) with 436 participants, Confirmatory Factor Analysis (CFA) was conducted to decide if the model data well fit between the item-factor structures produced by the exploratory factor analysis. The LISREL output presented various goodness of fit statistics that could be used to evaluate the fit between the hypothesized model and the data set. Brown (2006) grouped these fit indices into three categories, namely "absolute fit, fit adjusting for model parsimony, and comparative or incremental fit" (p. 82). The absolute fit consists of three indexes such as chi-square ($\chi 2$), the standardized root mean square residual (SRMR), and the root mean square residual (RMR). For the fit adjusting for model parsimony, root mean square error of approximation (RMSEA; Steiger & Lind, 1980) is widely used and the value lower than .05 refers a close fit, the value .08 implies a marginal fit and the value greater than .10 indicate a poor fit (Browne & Cudeck, 1993). The comparative or incremental fit indexes are considered more affirmative because it assesses the model fit with a solution supporting relationships among the variables. There are four variables, namely comparative fit index (CFI) (Bentler, 1990; Jöreskog & Sörbom, 1981), non-normed fit Index (NNFI) (Brown, 2006), incremental fit index (IFI), and the normed fit index (NFI) (Hu & Bentler, 1995) for comparative fit indexes. However, CFI and NNFI most commonly used indexes ranging from 0 to 1 values and the values closer to 1 refers to a better fit for CFI and NNFI (Brown, 2006). Brown (2006) recommends to include at least one index from each category (i.e. absolute fit, fit adjusting for model parsimony, and comparative fit) because each of these groups gives different information about model fit, Therefore, in order to better interpret the results of Confirmatory Factor Analysis, four variables namely, chi-square, RMSEA, CFI, and NNFI values were evaluated considering the recommendations and cutoff criteria.

RESULTS

Exploratory Factor Analysis (EFA) Results

To interpret the EFA results, the items factor loadings of the Turkish version of Perceived Attributes of Computer Use (PACU) scale were examined. It was seen that almost all of the items (except from four items) clearly loaded with the related five components. To explain, two items Q14 (In early childhood education, using a computer will fit into my work style) and Q12 (In early childhood education, I am permitted to use a computer on a trial basis long enough to see what it could do) loaded in a different factor. Moreover, the other two items Q13 (In early childhood education, using a computer will improve my job performance) and Q26 (I have not seen many others using a computer in early childhood education) did not load on any factor. Therefore, considering the content of the all items, three items (Q12, Q14, Q26) were removed from the scale and one item (Q13) was kept without any change in the scale. After these changes, as a result, the scale including five factors with 23 items was designed and factors account for 35.04% of the total variance with eigenvalues of 8.1, 3.1, 2.3, 1.5, and 1.2, respectively. Table 6 illustrates the final version of the items and factor loadings.

Table 6. *Turkish version of perceived attributes of computer use item factor loadings*

Item	Relative Advantage	Observability	Trialability	Compatibility	Complexity
Factor Loadings					
Q1	**.828**	.052	-.056	.032	-.068
Q2	**.935**	-.016	-.008	.098	-.047
Q3	**.923**	.026	-.031	.018	.012
Q4	**.909**	.006	.057	-.019	.035
Q5	**.806**	.003	.091	-.113	.057
Q6	**.524**	.041	-.030	-.298	.054
Q7	**.735**	-.004	-.019	-.080	-.050
Q8	-.061	.009	.027	**-.890**	.046
Q9	.059	.048	.053	**-.780**	-.003
Q10	.060	-.006	-.043	**-.790**	-.042
Q11	.123	-.011	-.025	**-.658**	-.176
Q12 (R)	.083	-.012	-.030	-.047	**-.637**
Q13 (R)	-.077	-.003	.048	.023	**-.851**
Q14	.018	.074	.030	-.025	**-.669**
Q15 (R)	.060	-.006	**.690**	.086	-.007
Q16	.056	-.083	**.471**	-.049	-.183
Q17	.011	-.037	**.852**	-.032	.055
Q18	-.077	.135	**.555**	-.077	.002
Q19	-.045	.011	**.700**	.011	-.008
Q20	.046	**.703**	.092	.022	.046
Q21 (R)	-.003	**.900**	-.090	.045	-.047
Q22 (R)	-.023	**.916**	-.087	-.019	-.019
Q23	.039	**.437**	.106	-.078	-.037

***Note*.** The highest factor loadings are presented in bold. Extraction method: Maximum Likelihood. Rotation method: Oblimin with Kaiser Normalization.
(R): The score of these items was reversed when performing the analysis.

Additionally, a look at the scree plot also confirms that the first five factors account for most of the total variability in the data (see Figure 2 below).

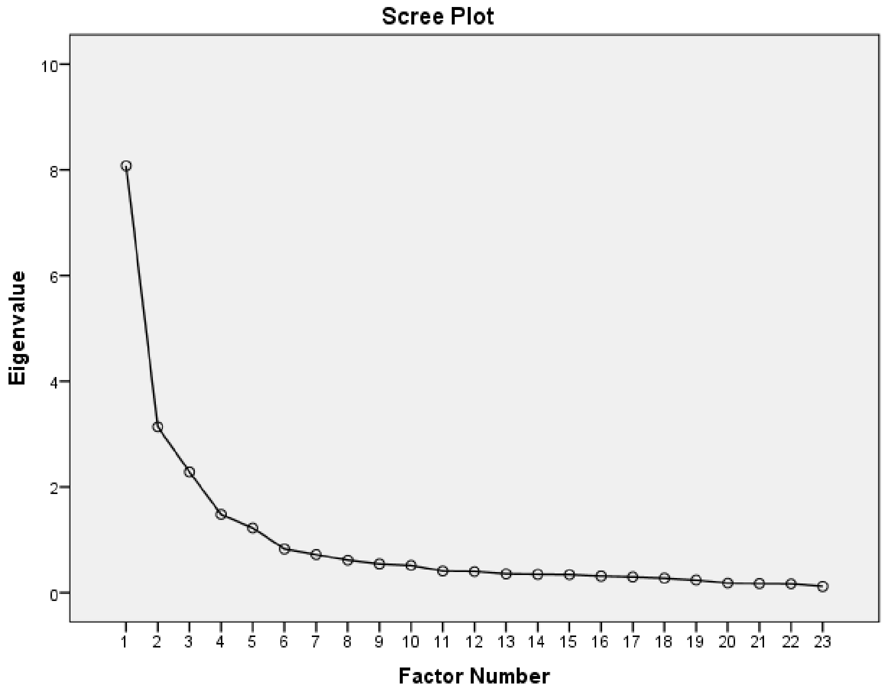

FIGURE 2. *Scree plot results*

Confirmatory Factor Analysis (CFA) Results

After EFA results, it was proposed that the observed variables PA1, PA2, PA3, PA4, PA5, PA6, PA7 loaded on the latent variable "relative advantage", the observed variables PA8, PA9, PA10, PA11 loaded on the latent variable "compatibility", the observed variables PA13, PA15, PA16 loaded on the latent variable "complexity", the observed variables PA17, PA18, PA19, PA20 loaded on the latent variable "trialability", and the observed variables PA21, PA22, PA23, PA24, PA25 loaded on the latent variable "observability". This hypothesized model for the Turkish version of Perceived Attributes of Computer Use (PACU) scale was demonstrated in Figure 3.

Moreover, multiple goodness-of-fit tests were used to evaluate the fit between the proposed Turkish version of PACU instrument and the data set. As presented in Table 7, the indices such as *NNFI, CFI, RMSEA* and χ^2/df were calculated and then found as .92, .93, .97, and 2.58, respectively.

Table 7. *Goodness-of-fit indicators of the models for the Turkish version of PACU scale*

Model	df	χ^2	χ^2/df	NNFI	CFI	RMSEA
Five Factor	220	568.07*	2.58	0.92	0.93	0.97(with a 90% confidence interval)

Note. *NNFI* = non-normed fit index; *CFI* = comparative fit index; *RMSEA* = root mean square error of approximation.
**p* < .001.

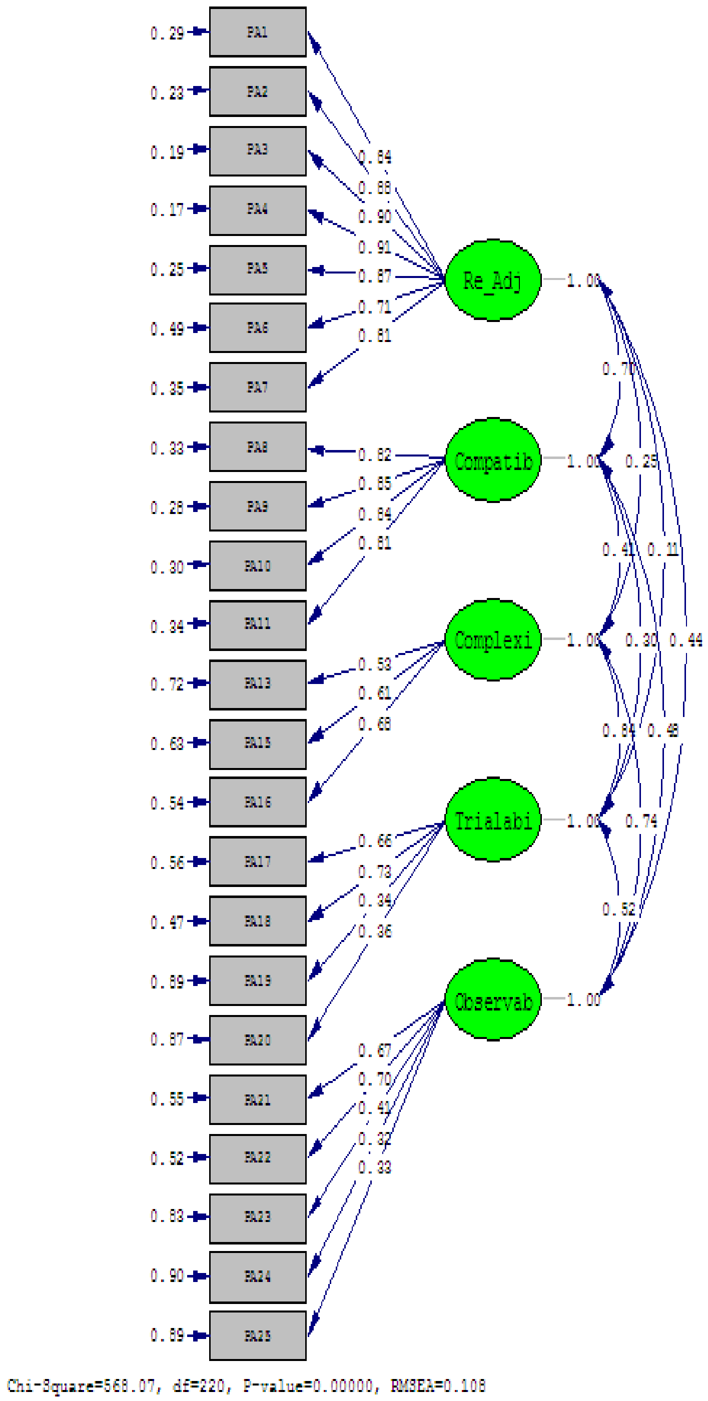

FIGURE 3. *Hypothesized model for the 23-Item Turkish version of PACU scale*

***<u>Note</u>*.** Re_Adj = relative advantage; Compatib = compatibility; Complexi = complexity; Trialabi = trialability; Observab = Observability.

Reliability Analysis

In this study, in order to establish reliability, DeVellis' (2003) recommendations were followed (greater than .70) and Cronbach's coefficient alpha was computed for each factor of the Turkish version of Perceived Attributes of Computer Use (PACU) with 23 items and 436 participants. The Cronbach alpha coefficient was calculated and found as .96 for relative advantage, .89 for compatibility, .79 for complexity .77 for trialability, and .87 for observability dimension. Moreover, for the whole scale, the reliability of efficacy scores was .90.

DISCUSSION and CONCLUSION

The purpose of the current study was to establish a valid and reliable measurement instrument to examine pre-service early childhood teachers' perceived attributes regarding computer use for instructional purposes (The instrument can be seen in the appendix). In order to develop Turkish "Perceived Attributes of Computer Use" (PACU) scale, the original English scale, "Perceived Characteristics of Innovating" was benefited. Although the main purpose of the original scale was to measure the diverse perceptions of using Personal Work Stations (PWS) by individuals, the researchers recommend that this scale can be used by removing the word PWS from the items. Moreover, they stated that making slight modifications, the instrument is appropriate for other diffusion studies. Based on this information, this scale was chosen for three reasons. First, the scale mainly focuses on how potential users' perceptions affect their information technology adoption. Moreover, it can be used for other information technologies. Similarly, the present study intends to sample the potential users' (i.e. pre-service teachers) views on adopting computer technology use in early childhood education. Second, the scale focuses on the perception of using the innovations rather than perceptions of innovation itself. In a similar way, this study aims to investigate perceived attributes of computer use rather than the computer itself.

In the existing literature, although there were not directly similar scale studies to this scale, it was reviewed that there were some scale development studies including pre-service teachers, their attitudes, and ICTs in Turkey. For example, Tınmaz (2004) developed a scale to explore prospective teachers' perception of technology, including eight different subject areas such as Early Childhood Education, Classroom Teaching, Social Studies Teaching, Science Education, Arts Education, Music Education, Department of Physical Education and Sports, and Department of Turkish Education. The scale was constructed as two factors after EFA and the reliability of the scale found as .89 for factor 1 and .81 for factor 2. Similarly, Arslan (2006) developed a scale to explore the pre-service primary education teachers' attitudes towards computer-based education. This scale was formed as one factor after conducting EFA and the reliability of the scale reported as 0.93. However, it is seen that CFA was not conducted and the validation of the scale was missing. On the other hand, Öz (2015) adapted a scale to assess the pre-service English teachers' perceptions regarding mobile learning. The scale was adapted from the Mobile Learning Perception Scale (MLPS) developed by Uzunboylu and Özdamlı (2011) to assess secondary school teachers' perception of mobile learning. The scale reported reliability values of each construct of the scale; however, there was no information about the adaptation process as well as factor analysis (i.e. EFA and CFA). In contrast, Şad and Göktaş (2014) developed their own scale to examine the preservice teachers' perceptions related to the using mobile phones and laptops in education. While the scale has validity information, has no information about reliability issues. Although these scale development studies contained preservice teachers' attitudes or perceptions towards ICT tools in education or for educational purposes, there are apparent and serious problems including either validity or reliability issues. Moreover, any of the papers created their instruments based on the appropriate theoretical basis which also causes a major problem to the diffusion of incomplete knowledge.

In the current study, however, the scale development procedure included in some deliberate steps (i.e. translation and adaptation, Q-sort method, explanatory factor analysis, and confirmatory factor analysis) which contributed to achieving desirable results. For example, during the translating and adaptation procedure, the researchers could have a great opportunity to consult with the experts working in a similar area. What is more, the researchers could take the expert view from one of the developers of the original scale, which made the scale more powerful than imagined. Indeed, the reliability values of the scale were so close to the original scale, even higher. As seen in Table 8, the Cronbach Alpha Coefficient for the Turkish version of the PACU scale shows a good reliability as having the value greater than .70 (DeVellis, 2003).

What is more, including Q-Sort method while shaping the scale provided both qualitative and quantitative responses from the participants and deep understandings about participants' thoughts underlying behind the sorting procedures. For example, they explained the reasons for the categorization of the items and their responses created valuable data for the researchers to make meaningful changes. In addition to the qualitative data, the Q-Sort Method gives some quantitative measures such as inter-judgment agreement and the degree of placement. For example, Relative Advantage (1.00), Compatibility (1.00), and Complexity (1.00) showed a "very good" degree of placement while Trialability (0.71) and Observability (0.71) showed a "good" inter-judgment agreement at the end of the fourth round. Moreover, the overall placement ratio was measured as 0.88 which can be considered as a "very good" degree of placement. Therefore, before conducting EFA, scale developers and researchers may use Q-Sort (i.e. Card Sorting) method to benefit from its unique contribution.

Table 8. *Cronbach alpha coefficient of Turkish version of PACU scale*

Scale	Turkish Version	Original English Version *(Long Scale)*
Relative Advantage	.96	.92
Compatibility	.89	.83
Complexity	.79	.80
Trialability	.77	.71
Observability	.87	.73

Furthermore, EFA and CFA can be used to explain the constructs of the scale. In this study, EFA findings suggested a five-factor scale with 23 items based on the responses of 137 pre-service early childhood teachers. To confirm these suggested constructs, CFA was conducted with 436 prospective early childhood teachers who were not included in EFA but sharing similar sample characteristics. The results of CFA confirmed the five-factor scale with multiple goodness-of-fit tests. The NNFI (.92) and CFI (.93) values showed good fit values as being greater than .90 (Kline, 1998). The RMSEA (.97) value could be considered a mediocre fit since it was between .80 and .10. The value of $\chi 2/df$ (2.58) indicated a good fit since it was less than 5 (Kelloway, 1998). So, when the overall indices were considered, it could be concluded that the five-factor Turkish version of PACU scale has a good fit.

We believe that as presenting a detailed information about scale development procedure as well as confirming the validity and reliability of the scale, the current study may have a unique contribution to the developing technology integration in teacher education literature. As clearly emphasized in the previous studies, (e.g. Davis, 1989; Francis et al., 2000; Paraskeva, et al., 2008; Sang et al., 2011; Van Braak et al., 2004), whether teachers perceive positive or negative perception towards computers had a significant effect on their decisions regarding the computer use for instructional purposes. Moreover, as Rogers (2003) stated that individuals' attitudes are fundamental for the adoption or rejection of an innovation. Therefore, for those who want to achieve successful technology integration in schools, first, need to understand the perceived attributes this technology considering the educators. Otherwise, without knowing teachers' and future teachers' views regarding the use of computer technology in education, a change in their computer use will result in disappointment (Office of Technology Assessment (OTA), 1995). This will contradict with countries' science, technology and innovation (STI) policies investing an amount of money and efforts to integrate the technology into their education systems.

As a result, the measures and the pieces of evidence show that the Turkish version of Perceived Attributes of Computer Use (PACU) scale is both valid and reliable to examine pre-service early childhood teachers' views regarding the perceived attributes of computer use. This result may encourage Turkish researchers as well as international researchers to use the scale with some revisions to measure the perceived attributes of computer and information technologies for instructional purposes. Therefore, future studies can be conducted to verify our findings across different early childhood teacher education programs and different cultural backgrounds. Additionally, a study can be designed as a follow-up study that will aim to determine whether or not there has been a change in the current participants' tendency towards computer use for instructional purposes in early childhood settings when they become in-service teachers.

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APPENDICES [a,b]

Turkish version of Perceived Attributes of Computer Use (PACU) scale

Factors	Items [a,b]
Relative Advantage	*In early childhood education,* 1. using a computer will make it easier to do my job 2. using a computer will increase my productivity. 3. using a computer will enhance my effectiveness on the job. 4. using a computer will improve my job performance. 5. using a computer will improve the quality of work I do. 6. using a computer will give me greater control over my work 7. using a computer will be advantageous in my job, overall.
Compatibility	*In early childhood education,* 8. using a computer is compatible with all aspects of my work. 9. using a computer is completely compatible with my current experiences 10. I think using a computer will fit well with the teaching methods I like to work 11. using a computer will fit into my work style.
Complexity	*12. In early childhood education, using a computer is often frustrating. *13. In early childhood education, a computer is cumbersome to use. 14. Overall, I believe that a computer is easy to use in early childhood education.
Trialability	*In early childhood education,* *15. I do not really have adequate opportunities to try out different things on the computer. 16. I can have computer applications for long enough period 17. I have had a great deal of opportunity to try various computer applications. 18. I have permitted to use a computer on a trial basis long enough to see what it could do. 19. before deciding whether to use any computer applications, I was able to properly to try them out.
Observability	*In early childhood education,* 20. I have had plenty of opportunity to see the computer being used. *21. I have not seen many others using a computer. *22. using a computer is not very visible. 23. I have seen what others do using their computers.

Notes.
[a] The scale is constructed with 5-point Likert type and the items are scored from 1 to 5. (Strongly Disagree = 1; Disagree = 2; Neutral =3; Agree =4; Strongly Agree = 5).
[b] The items marked with an asterisk symbol (*) are negative. Therefore, these items in the scale are coded reversibly.