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Developing a Scale to Measure Information and Communication Technology Utilization Levels

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ABSTRACT

The aim of this study is to develop a scale to measure candidate teachers' utilization level of Information and Communication Technologies (ICT). This study was designed as a quantitative survey research. The validity and reliability of the scale were calculated with the data coming from 300 candidate teachers. The structural validity of the scale was sought with factor analysis and reliability was checked with Cronbach Alpha analysis. The factor analysis revealed that load of the factors ranged between 0,40 and 0,80, Kaiser-Meyer Olkin value is 0,90, and Cronbach Alpha value, internal consistency coefficient calculated for the sake of reliability, was determined as 0,91. The reliability coefficient values for each factor were; Anxiety 0,75; Confidence 0,76; Attitude 0,81; Esteem 0,84. At the end of the research, it was determined that the 30-item scale towards measuring candidate teachers' state of using ICT was a scale with proper reliability and validity.

Key Words: Information and Communication Technology; Candidate Teachers; Scale Development.

INTRODUCTION

ICT is all visual, audio, printed or written means that are exploited for finding, exchanging, processing, grouping, propagating information and constructing knowledge. In this context, although ICT is primarily associated with computer and related things, actually the term includes all instructional tools. While radio and television reigned in 1930s, the new age started and ICT application in education was started to be discussed in 1970s after the rise in the computer usage.

The discussions about why, how and how much ICT should be used in education started many decades ago. Today, we have many studies in hand proving the uses and effectiveness of ICT in education (Akkoyunlu, 1995; Arslan, 2006; Sagin-Simsek, 2008; Arslan, Kutluca &

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Özpınar, 2009) and it was stated that effective ICT utilization has potential to improve educational system (Ponte, Oliveira & Varandas, 2002; Palaigeorgiou et al., 2005). So, many countries implemented projects supporting ICT application in education (Sagin-Simsek, 2008). For example, France launched a national project called Informatics for Everyone (*Plan Informatique pour Tous*) already in 1985 and aimed to exposure 11 million students with ICT and training more than 100.000 teachers. Similarly in the United States of America, in early 80s NCTM recommended that the government should invest and equip schools with calculators and computers.

Concerning the indispensable role of teacher in progress of education systems, teacher is an important factor for integration process of ICT into education. A contemporary teacher should demonstrate the skills of using technology and should integrate these technologies into learning and teaching processes. From this perspective both education faculties, charged with educating teachers, and Ministry of National Education (MoNE), the employer of the teachers have been trying to improve the quality of education by advancing the ICT application skills of teachers and candidate teachers. For this aim, while candidate teachers are trained in courses like Instructional Technologies and Developing Materials and certain elective courses (e.g. Computer Assisted Mathematics Instruction) in education faculties, MoNE tries to remedy weaknesses of teachers by means of in-service trainings.

Despite the importance of the ICT and the precautions taken, different studies stated that both in our country and in developed countries minority of the teachers apply ICT effectively (Jones & Clarke, 1994; Palaigeorgiou et al., 2005; Tondeur, van Braak & Valcke, 2007). Obviously, besides the lack of proper technical infrastructure, candidate teachers' attitude, anxiety, esteem and competences towards ICT are also important. Since, there has not been a unique and universally accepted definition for attitude; there have been lots of different definitions of attitude. Reviewing these definitions, one can anticipate that there is a close relation between attitude and behavior. Similarly, it can be said that there is a relation between esteem over something and anxiety and competence. Actually, people reflect their attitude, anxiety, and esteem onto their behavior and they more frequently demonstrate a specific behavior when they feel themselves more competent about the issue.

Concerning the relation between attitude, esteem, anxiety, competence and practice, not only experiences and skills of teachers but also their attitude, esteem, anxiety and competences towards ICT will affect their state of utilizing ICT in their instructions. For these reasons determining these characteristics of teachers is important. If candidate teachers' attitude, esteem, anxiety and competences towards ICT are determined, the education given to teachers can be arranged and reorganized by using these results and by this way teachers' and candidate teachers' applications related to ICT can be improved. At this point, a need for determining and measuring such characteristics arises. Thus the results of the present study are expected to contribute to improving the computer and technology related courses in education faculties.

Concerning all above, the aim of this study is to develop a scientifically valid and reliable Likert type scale to determine of candidate teachers towards ICT.

Literature Review

The scale by Akbaba-Altun (2002) to determine attitudes of school managers had 9 subdivisions as: internalize technology, technology and development, following technology, technology and management, fear of technology, technology and internet, trust for technology, technology and pessimism, using technology. The research showed that the sampled school managers had tendency to have positive attitudes towards technology (Akbaba-Altun, 2002). Frantom, Green and Hoffman (2002) developed a scale to determine

children's attitude towards technology. The scale had two factors named as; "interest / skills" and "alternative options." As a result of this study a significant difference was determined between the student scores in interest part and alternative options when comparing elementary and middle school students. Besides, the sub-scale scores were also diverged in terms of gender. Yavuz (2005), developed a scale to determine attitudes of candidate chemistry teachers towards technological tools. The 19 item scale had 5 factors as; not using technological tools during instruction, using technological tools during instruction, effects of technology on education, teaching how to use technological tools, and assessing technological tools.

Albirini (2006) investigated the attitudes of high-school English teachers' towards ICT. Additionally the relation between computer attitude and five independent variables (computer attributes, cultural perceptions, computer competence, computer access and personal characteristics-including computer training background) were investigated in the study. The results of the study showed that teachers feed positive attitudes towards using ICT in instruction. Çelik & Kahyaoğlu (2007) tried to determine clustering tendency of the attitudes of candidate teachers towards ICT. The study was conducted with 317 candidate teachers and "Technology Attitude Scale" by Yavuz (2005) was used as the data gathering tools in the study. Çavaş et al. (2009) aimed to determine attitude of science teachers in Turkey towards ICT in education and correlations between teacher attitudes and personal profile (gender, age, owning a computer at home and experiences with computers). For this aim they devised a scale and applied it in seven different regions in Turkey. At the end, they came up with; science teachers have positive attitudes towards ICT and even though there was no gender based difference over ICT attitudes, there were difference in terms of having a computer at home and computer experience.

When the related literature reviewed we came across studies investigating attitudes of school managers (Akbaba-Altun, 2002), lecturers (Kısa & Kaya, 2006), teachers (Albirini, 2006; Pala, 2006), candidate teachers (Ponte et. al. 2002; Yavuz, 2005) and students (Frantom, Green & Hoffman, 2002; Akbulut, 2008; Bebetsos & Antoniou, 2009) towards technology. However we faced no studies searching; attitude and anxiety of candidate teachers towards ICT, the esteem they put on ICT and their ICT using states. It is clear that a valid and reliable measuring scale developed for this aim will contribute to literature.

METHODOLOGY

a) Design of Research

This study was designed as a quantitative survey research. Survey research can simply be defined as a means of gathering information, usually through self-report, using questionnaires or interviews. However, most survey research falls within the framework of no experimental or correlation research designs in which no independent variable is experimentally manipulated (deMarrais & Lapan, 2004).

b) Sample

The sample of the study was composed of 300 candidate teachers from Karadeniz Technical University, Fatih Faculty of Education; mathematics (N=70), physics (N=32), chemistry (N=32), biology (N=33), classroom teacher (N=61) and social sciences (N=72) education departments. The sample size of 300 can be accepted as a sufficient number based on the idea the sample size should be five fold of variable numbers in the scale (Tavşancıl, 2002).

c) Forming the items in the scale

ICT literature was reviewed (Albirini, 2006; Çavaş et al., 2009; Frantom et al., 2002; Kısa & Kaya, 2006; Sagin Simsek, 2008). 45 candidate mathematics teachers who were at the faculty of education secondary school science and mathematics field education department in 2006-2007 educational year were asked to write an article about their feelings and thoughts related to computers and technology. The articles were examined and objected to a content analysis. Then, 57 items were determined based on the related literature and the articles. Concerning the review by researches and evaluation of two field education experts in CEIT department, some expressions were corrected and 5 items excluded. After this correction, 52 items were placed into the draft scale. Excluding the article writers, the draft scale was applied twice, two weeks between each, to 47 candidate mathematics teachers who were at the last year (5^{th} year) of faculty of education secondary school science and mathematics field education department in 2006-2007 educational year and the correlation coefficient was calculated 0,88. In order to generalize this pilot scale for all candidate teachers, not only for candidate mathematics teachers, 9 items only related to mathematics teachers were dropped from the scale and 41-item draft scale about ICT utilization was prepared.

d) Grading the draft scale

The draft scale was a Likert-type including 13 negative, 28 affirmative totally 41 items. Each item has 4 choices: "Strongly Disagree", "Partially Agree", "Agree", and "Strongly Agree". In order to convert answers to scores, "Strongly Disagree" was graded as 1 and "Partially Agree" as 2, "Agree" as 3, and "Strongly Agree" was graded as 4. Negative items were graded in reverse order.

e) Analysis and Data Collection

In order to suffice the validity and reliability of the scale, the main application was conducted by researchers in lecture hours with 356 candidate teachers who were at the faculty of education in 2007-2008 educational year. While the application process, the duration was set as 15 minutes and candidate teachers were given explanations about the aim of the study and they were told that they could submit papers anonymously. 312 of given 356 scales were handed back the scale. After evaluation, 12 questionnaires filled in wrong way were eliminated and 300 of them were accepted as valid. For analysis of the available data, each answer for each item was graded from 1 to 4. The higher the total score from each factor means, the more positive ideas candidate teacher have towards ICT and *vice versa*. The obtained data were analyzed with the help of SPSS 15.0.

FINDINGS

a) Validity

Prior to factor analysis, Barlett Test of Sphercity, which provides information whether there is a relation between Kaiser-Meyer-Olkin (KMO) coefficient and variables, was applied to test whether the data were suitable for factor analysis. The sample should be of adequate size, since the size of the sample affects the results of factor analysis. Related literature suggests KMO should be greater than .60 to factor analysis could be applied on the data (Pallant, 2001). KMO value for the data of this study was calculated as .90, which fell in intended range. Besides the result of Barlett Test was significant [x^2 = 3694,756, df=435, ($p<.000$)]. The results of KMO and Barlett Test implied that the adequate sample size was provided for the study and factor analysis could be carried out on these data.

The factor analysis towards ICT usage was started with 41 items. Factor analysis has two parts: factor split up and factor rotating. Principal Components Analysis was used to investigate the factor structure.

41 items were accumulated under 10 factors that had eigenvalue greater than 1 as a result of Principal Component Analysis applied. Therefore the scale can be accepted to have maximum 10 factors. However, the scale was anticipated with 4 factors considering the competence areas concerned while the scale was being prepared. 4 factors came out so as to each had eigenvalue grater than 1 and explaining 49.866 % of the total variance. For social sciences, variance rates between 40% and 60% are accepted adequate (Tavşancıl & Keser, 2002). As a matter of fact, it is suggested to apply more than one method to decide number of factors. Accepting that Scree Test was the best method, the results of Cattel's scree test results to determine maximum numbers of significant factors were shown in Figure 1.

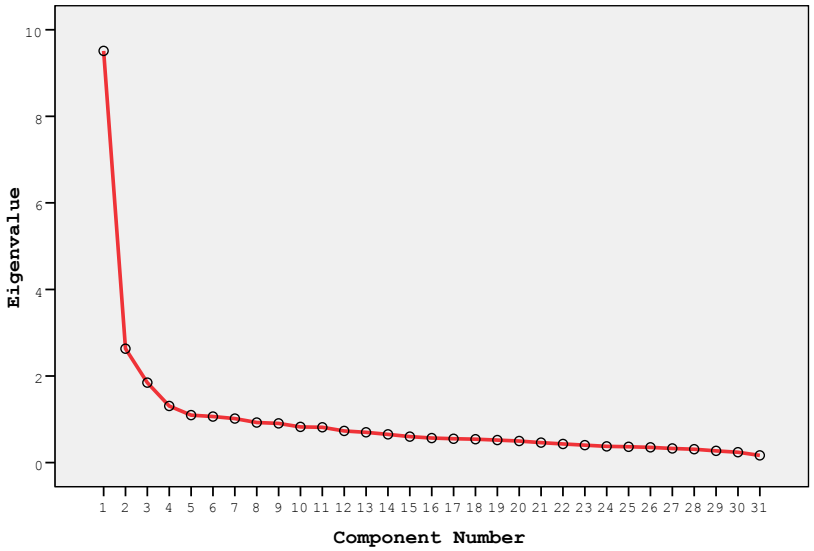

Figure 1. *Line graph about Factor Eigenvalue.*

As seen in Figure 1, the sharpest decrease on Scree test graph on 4th factor and factor number in the scale determined 4. The eigenvalues of four factors, percent variance explained by factors, and total percent variance were presented in Table 1.

Table 1. *Eigenvalues and percent variances of ICT utilization scale*

Factors	Eigenvalues	Percent Variance explained	Total Percent Variance
Factor 1	9,255	30,851	30,851
Factor 2	2,573	8,578	39,428
Factor 3	1,843	6,143	45,571
Factor 4	1,289	4,295	49,866

In order to split factors and reach independent factors as much as possible, factor analysis application was carried on by principal component analysis. In the factor analysis the items with load eigenvalue greater than .40 were taken so items 2, 15, 19, 20, 22, 27, 30, 34 and 37 were removed. After these items removed factor analysis repeated with remaining 32 items. This time items 9 and 28 fell below 0.40 and these two items were also removed. Finally the scale ended up with 30 items.

As it is seen in Table 1 these 30 items clustered in four factors with eigenvalues greater than 1. The first factor had 8 items (4, 7, 11, 12, 13, 17, 21 and 40) and this factor itself explained 30,851% of the total variance. The second factor had 9 items (1, 8, 10, 14, 16, 23, 24, 36 and 38) and this factor explained 8,578% of the total variance. The third factor with 6 items (5, 25, 31, 32, 33 and 35) and explained 6,143% of the variance. Finally, the forth factor with 7 items (3, 6, 18, 26, 29, 39 and 41) and explained 4,295% of the total variance. These four factors explained 49,866% of the total variance. This value which is grater than minimum acceptable value 0,41, let the scale can be accepted to have four factors (Kline, 1994). The higher variance rates as a result of the factor analysis show that the factor structure of the scale is strong (Tavşancıl & Keser, 2002). Scherer *et. al*. reported that variance rates between 40% and 60% are acceptable for social studies (cited in: Tavşancıl & Keser, 2002). This finding explains the considerable ratio of the total variance and variance of the scale.

Factors, their names and with final number of items can be listed as:

"Esteem", the first factor of ICT scale had 8 items; 4, 7, 11, 12, 13, 17, 21, 40. The load values of these items varied between 0,57 and 0,74. "Anxiety", the second factor of the scale had 9 items; 1, 8, 10, 14, 16, 23, 24, 36 and 38. The load values ranged 0,41 to 0,72. "Confidence" factor had 6 items; 5, 25, 31, 32, 33, 35. The load values were 0,41 to 0,76. "Attitude", the fourth factor had 7 items; 3, 6, 18, 26, 29, 39 and 41. The load values 0,48 to 0,68. Table 2 presents items of each factor and their factor loads.

Table 2. *Factor loads of attitude scale about ICT utilization*

	Factor Loads			
Items	**F1**	**F2**	**F3**	**F4**
Factor 1 (ESTEEM) 8 items				
12- I believe that ICT would improve the quality of education.	,745			
17- I plan to use instruction materials in my lessons when I become a teacher.	,728			
13-I believe that ICT supports persistent learning.	,711			
11- I think all teachers should utilize technological tools.	,669			
40- It would be convenient to include sample ICT activities in curricula.	,634			
7- I believe that ICT is important for accessing information.	,612			
4- I follow improvements about ICT.	,573			
21- I plan to exchange information with other teachers using ICT in virtual or real environments when I become a teacher.	,570			
Factor 2 (ANXIETY) 9 items				
36- I believe that we are not allowed to access technological tools because of the worry about their break down.		,721		
10-I believe that using ICT in instruction is waste of time.		,543		
38-I believe that using ICT in crowded classrooms is hard.		,527		
8- I believe that ICT hinder searching and discovery.		,516		
1- I think that advancements in ICT undermine my role at school.		,489		
23-Applying ICT in instruction would cause extra workload.		,488		
24-I think using ICT in instruction is difficult.		,483		
14- I think ICT restricts students' creative thinking.		,473		
16- Using ICT in education is luxurious for our country.		,411		
Factor 3 (CONFIDENCE) 6 items				
25-I may use ICT in my instruction.			,768	
32- I can prepare instruction materials using computer software.			,515	
31- I know about educational software evaluation criteria.			,464	
5- I feel myself competent enough to follow advancements in ICT.			,462	
35- There are effective people around me I can ask help about ICT			,413	
33- I had proper education about using materials.			,410	

Table 2. *Continued...*

Factor 4 (ATTITUDE) 7 items				
29- I plan to use internet to prepare my instruction when I become a teacher.				,684
6- I think using ICT in instruction makes it interesting.				,670
39- I hope I will be able to integrate ICT in my instruction in the future.				,649
3- I like using ICT.				,636
18- I use ICT for my daily works.				,623
26- I plan to use computer for preparing exam questions when I become a teacher.				,621
41-I would like to have extra ICT courses.				.487
Cronbach Alpha	,84	,75	,76	,81

KMO = .90 and Barlett test= 3864,002

b) Reliability

To test reliability both internal consistency between the items were tested and the resolution of the test were monitored by test-retest reliability. For the internal consistency of the items Cronbach Alpha coefficient was calculated. As a reliability measure, Cronbach Alpha internal consistency coefficient was calculated both for the whole scale and for the factors separately. Cronbach Alpha calculated for the whole scale was 0,91. Internal reliability coefficient for each sub-dimensions were 0,75 for Anxiety, 0,76 for confidence, 0,81 for Attitude and 0,84 for Esteem (see Table 3).

Table 3. *Number of items in each factor and internal consistency coefficients obtained by validity and reliability procedures.*

Factors	**Number of Items**	**Cronbach Alpha**
Factor 1: Esteem	8	0,84
Factor 2: Anxiety	9	0,75
Factor 3: Confidence	6	0,76
Factor 4: Attitude	7	0,81
Scale Total	30	0,91

Reliability coefficients belonging to the components were given in the Table 3. According to the table attitude and esteem components had greater reliability coefficients. Reliability coefficient greater than 0,70 is acceptable for these components (Tezbaşaran, 1996).

CONCLUSION AND SUGGESTIONS

In this study it was aimed to develop a reliable and valid scale to measure the state of candidate teachers about using ICT. The draft scale had 41 items and was applied to 300 candidate teachers. As the result of the analysis conducted 11 items were excluded from the scale and final form with 9 negative, 21 affirmative, totally 30 items were reached. These items were located under esteem, anxiety, confidence and attitude factors. At the end of the study the scale was proved to be a valid and reliable scale measuring candidate teachers' states about using ICT.

The reliability coefficients calculated with Cronbach Alpha for the sub-scales were between 0,75 and 0,84. Cronbach Alpha coefficient for the whole scale was calculated 0,91. Backed with claim that anticipated reliability level for researches is 0,70 (Tezbaşaran, 1996), the reliability level of the scale and its all sub-dimensions can be accepted as adequate.

When Cronbach Alpha internal consistency coefficients of the subscales of the ICT using scale, it was found that the relation between the change in answers given for each item and the change in the total score of that factor was sufficiently high. It is necessary to reapply reliability and validity studies of this scale with candidate teachers from different disciplines educated in education departments of faculty of education at other universities and analysis should be compared.

It is possible to examine candidate teachers' attitudes towards ICT versus variables like; gender, department they are registered, computer literacy level, having a computer. Additionally, the correlation between attitudes towards computers and internet and attitudes towards ICT can also be investigated.

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