Assistive Technologies Usage Skills Assessment Scale: Validity and Reliability Study

Omaç RUŞTİOĞLU
Department of Special Education, Faculty of Education, Cyprus International University, Nicosia, Northern Cyprus via Mersin 10 Turkey, orustioglu@ciu.edu.tr

Hasan AVCIOĞLU
Department of Special Education, Faculty of Education, Cyprus International University, Nicosia, Northern Cyprus via Mersin 10 Turkey, hasana@ciu.edu.tr

Tolgay KARANFİLLER
Department of Computer Education and Instructional Technology, Faculty of Education, Cyprus International University, Nicosia, Northern Cyprus via Mersin 10 Turkey, tkaranfiller@ciu.edu.tr

Ahmet ADALIER
Department of Computer Education and Instructional Technology, Faculty of Education, Cyprus International University, Nicosia, Northern Cyprus via Mersin 10 Turkey, aadalier@ciu.edu.tr

ABSTRACT
This study aims to develop an Assistive Technologies Usage Skills Assessment Scale (ATUSAS) that measures teacher candidates' assistive technologies usage skills. This study group consists of 510 teacher candidates' (282 female, 228 male). The scale's validity and reliability were statistically tested by computing the KMO and Bartlett tests, and via an exploratory factor analysis, descriptive statistics, Cronbach's alpha, a confirmatory factor analysis. As a result of the exploratory factor analysis, a construct consisted of 20 items, and three factors have been attained. The confirmatory factor analysis results have shown the adjustment to the sample that the scale applied to is at a reasonable level. The ATUSAS's Cronbach's alpha internal consistency reliability coefficient has been found as .90 for factor 1, .89 for factor 2, .73 for factor 3, and .92 for the whole test. The results show that ATUSAS is a valid and reliable measurement tool.
Keywords: Assistive technologies, technology, skills, teacher candidates, validity, reliability

INTRODUCTION

Today, it has become inevitable that technology developments take place in the learning-teaching processes at schools, as in all other areas of our lives. The expectation from today's schools is to reach information by using technology and educating individuals who can use technology effectively. Teachers, school administrators, and supervisors, who are the common stakeholders, play a crucial role in realizing the potential benefits of using technology in schools at a high level. This rapid change in science and technology also affects individual and community life. The current education system aims to educate individuals who are open to change, are creative, and produce and use information. The term Assistive Technologies (AT), in the broadest sense, "refers to any set of scientific achievements (products, environmental modifications, services, and processes) useful to overcome limitations and/or improve function for an individual" (Cook and Polgar, 2014). Assistive devices and technology (ADT) "is any form of external tool specially designed and produced or generally available, whose primary purpose is to maintain or improve an individual's functioning and independence, to facilitate participation, and to enhance overall well-being" (World Health Organization [WHO], 2014). Assistive technology is the tools used to facilitate the life skills of individuals affected by disability, to improve these skills and to boost their interaction with the environment as a whole (Fok, Polgar, Shaw and Jutai, 2011; Pettersson and Fahlstrom, 2010; Reed and Bowser, 2005). Assistive technologies that are used to overcome the difficulties that these individuals face during daily life due to their inadequacy is also used to increase their academic success (Lancioni, Sigafoos, Reilly and Singh, 2013).

In recent years, rapid advancements and developments in technology have made use of assistive technology a necessity in in-class applications (Çakmak et al, 2016). Regardless of general education or special education, technological applications have been reflected in many fields and brought along significant transformations (Erdem, 2017). The technologies used in general education have also started to be used frequently in the special education field (Özdamar, 2016). However, the technologies used in special education vary according to the type or degree of individuals being affected by disability and vary from person to person (Çakmak et al., 2016; Erdem, 2017).

With the introduction of technology into educational environments, the teaching processes in classroom environments started to be conducted with technology support. Technology-supported educational environments aim to design instructional materials appropriate to different learner characteristics. It enriches the teaching environments by adopting the methods and techniques used, thus creating easily accessible, effective, and efficient learning environments (Atanga, Jones, Krueger, & Lu, 2019). Technology-assisted learning environments and assistive technologies in planning the teaching process are recruited, and the motivation and success of the learner increase. Assistive technologies; These are special tools, services, and methods used to individualize the teaching of individuals with special needs, increase their independence and improve their quality of life (Atanga, Jones, Krueger, & Lu, 2019; Reed and Bowser, 2005).

Technological tools made it possible to use new methods and techniques in the learning process tools. Researchers emphasize that effectively used instructional technologies can improve the education system (Federici, & Scherer, (Eds.), 2012; Atanga, Jones, Krueger, & Lu, 2019). The spread of technology in the education process has led to changes in the faculties' education programs that train teachers and increase the number and hours of computer and instructional technology courses. Nevertheless, it can be said that in education faculties, technology education is generally limited to knowledge and skills, and it is tried to be provided with a technology course presented without any relation to other fields (Federici, & Scherer, (Eds.), 2012; Bausch & Ault, 2012).

In scale development studies, researchers need to define the property they want to measure well and clearly describe the appropriate items for this definition. From this point of view, it aims to develop a measurement tool for determining the assistive technologies usage skills assessment by considering the features related to assistive technology. There are some studies and instruments in the literature to discuss and measure various aspects of assistive technologies (Al-Dababneh, & Al-Zboon, 2020; Tofani et al., 2020; Leo, Medioni, Trivedi, Kanade, & Farinella, 2017; Zapf, Scherer, Baxter, Rintala, 2016; Federici, & Scherer, (Eds.), 2012). However, not much scale was developed in Turkish literature to determine assistive technologies usage skills. In this respect, it can be said that the issue of determining assistive technologies usage skills assessment has not been mentioned much by the researchers. In order to fill this gap in the literature, this study aims to develop an Assistive Technologies Usage Skills Assessment Scale that measures teacher candidates' assistive technologies usage skills.

METHOD

This research aims to develop an Assistive Technologies Usage Skills Assessment Scale that measures teacher candidates' assistive technologies usage skills. The stages followed in the development of the scale are given below.

Research Group

The research group consists of university students studying at the education faculty in TRNC in the 2018-2019 academic year. Among the students attending the education faculty, all students who have taken technology-supported teaching lessons are included in the research group. The characteristics of the students participating in the study regarding gender, age, and departments are summarized in Table 1.

Table 1: Demographic Profile

Measure	Items	Frequency	Percentage
Gender	Female	282	54.3
	Male	228	44.7
Age	21 years old and younger	150	29.4
	22 years old	140	27.4
	23 years old	94	18.4
	24 years old and older	126	24.8
Department	Classroom Teaching	122	23.9
	Special Education Teaching	190	37.3
	Pre-school Education Teaching	106	20.8
	Turkish Language Teaching	90	17.6
	TOTAL	**510**	**100**

As seen in Table 1, the sample is composed of 282 (54.3%) female and 228 (44.7%) male participants, of whom 150 (29.4%) of students are ‘21 years old or younger’, 140 (27.4%) are ’22 years old’ (21.4%), 94 (18.4%) are 23 years old, and 126 (24.8%) are 24 years old or older. 122 of the students (23.9%) are studying in the Classroom Teaching program, while 190 (37.3%), 106 (20.8%), and 90 (17.6%) are studying Special Education Teaching, Pre-school Teaching, and Turkish Language Teaching, respectively. In the literature, the number of working groups was determined by considering the criteria given for factor analysis. Tavsancil (2002) stated that “the working group's size should be at least five times the number of items in the scale”.

Development Process of the Scale

In the first stage of scale development, the conceptual framework was revealed by reviewing the scale's factors' literature and statements. Question items consisting of a total of 25 items as part of the scale were created. Three experts in the Special Education field evaluated the question items created, two in Computer Education and Instructional Technologies field, one in the Measurement and Evaluation field, and expert opinion from the Turkish Education field. The experts were asked to make sure that the question items created were clear and understandable, and that they did not contain more than one meaning, and that they included usage skills for assistive technologies. As a result of expert opinions, some items were corrected and rearranged. Pre-testing, in the items determined in line with the expert opinions, was carried out with 20 students studying classroom teacher (5 students), special education teacher (5 students), pre-school teacher (5 students), and Turkish teacher (5 students). The students were asked to indicate the items they did not understand or had difficulty understanding the scale's question items. Some questions were rearranged in line with the information obtained as a result of the pre-test. As a result of the literature review, expert opinion, and pre-test application, a test form of the scale consisting of 21 items were created. All of the question items in the scale consist of positive statements. A 5-point Likert-type "(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree)" is used in the scale.

Data Collection

In the data collection, firstly, the purpose of the research was specified, and explanations about the scale were made to the participating students. Later, volunteers were asked to fill the scale. In this process, a total of 510 teacher candidates' filled the scale.

Data Analysis

Before starting the analysis of the data collected through the scale, the scales filled, by teacher candidates', with missing, erroneous, and only with specific extreme values, were reviewed. Validity and reliability analyses were performed in line with the results obtained from the teacher candidates. The study group (510 people) was randomly divided into two separate groups, and Exploratory Factor Analysis (EFA) was performed with the data obtained from the first group (n1), and Confirmatory Factor Analysis (CFA) was obtained with the data obtained from the second group (n2). Validity analysis of the Assistive Technologies Usage Skills Assessment Scale was carried out with content validity and construct validity. In determining the content validity, the opinions of three specialists working in special education and a specialist in the field of Computer and Instructional Technologies were used. In determining the construct validity of the scale, EFA and CFA were applied. Before doing EFA, Kaiser-Meyer Olkin (KMO) and Bartlett Sphericity tests were applied to determine if the data were suitable for factor analysis. Following the confirmation of the suitability of the data for factor analysis, EFA was performed using the Promax Rotation technique and principal components analysis to determine the scale's construct validity. As a result of EFA, it was determined how many factors the scale consists of and under what factors the scale items were grouped. After determining the factors that make up the scale, it was tried to determine the appropriate title for each factor based on the expressions related to the items in each factor. CFA was performed to test the conformity of the structure revealed by EFA. The fit and error indices obtained from CFA were analysed, and the structure emerging on the scale was evaluated. In order to determine the reliability of the scale, Cronbach's Alpha reliability coefficient was analysed separately for the whole scale and the sub-factors that make up the scale. SPSS 24.0 package program was used for EFA. IBM SPSS Amos 26 package program was used for CFA.

FINDINGS

The data obtained in line with the analysis; (1) Evaluation of the suitability of the data for factor analysis, (2) Determination of the factor pattern, (3) Confirmatory factor analysis, (4) Name of the factors and (5) Reliability Analysis of the developed scale are given under the headings.

Evaluation of the Suitability of the Data for Factor Analysis

In the literature, it is stated that the number of participants (sample size) should generally be 5 to 10 times the number of items in order to perform factor analysis in scale development studies (Bryman, 2001). In this study, considering this criterion, EFA was performed on 255 participants' data, half of the entire 510 participants. Accordingly, it can be said that the recommended sample size has been adequately met. Before applying EFA, Kaiser-Meyer Olkin (KMO) and Bartlett Sphericity values were calculated to examine the data's suitability for factor analysis. It is stated that the KMO value between 0.7-0.79 is considered as middling, while 0.8-0.89 meritorious and 0.9 and above is considered marvelous. In this case, it is stated that factor analysis can be performed if the KMO value is higher than 0.70 (Çokluk, Şekercioğlu, Büyüköztürk, 2018).

Table 2: Kaiser-Mayer-Olkin (KMO) and Bartlett's Test of Sphericity Results

Kaiser-Mayer-Olkin (KMO) Measure of Sampling Adequacy		**.917**
Barlett's Test of Sphericity	Approx. Chi-Square	2880.786
	df	210
	Sig.	.000
Cronbach's Alpha		.92

(p<.001)

The results of the Kaiser-Meyer-Olkin test are given in Table 2. As a result of the calculations, the KMO value was recorded as .92. The KMO value (.92) obtained in the study was determined as a value higher than the desired KMO value. From this value, it was concluded that the sample size was "mervelous" for factor analysis (Çokluk et al., 2018). In addition, the statistical result obtained from the Bartlett Sphericity test was found to be significant (x^2 = 2880,786, df: 210, p<.01). The significant results obtained from the Bartlett Sphericity test indicate that the data came from a multivariate normal distribution. It can be said that the data obtained from the scale are suitable for factor analysis.

Determining the Factor Pattern

In order to reveal the factor pattern of ATUSAS, principal component analysis (PCA) used as a factoring method, and Varimax, one of the vertical rotation methods, was chosen as the rotation method.

Scree plot graph, eigenvalue, and variance percentages were used to determine the number of factors that can reveal the relationship between items (Çokluk et al., 2018). The table regarding the eigenvalue and variance percentages and the scree plot chart are given below.

Table 3: Factor Structures of ATUSAS

Factor	**Eigenvalue**	**Variance Percentage**	**Total Variance Percentage**
Factor 1	8.445	40.213	40.213
Factor 2	2.417	11.509	51.722
Factor 3	1.407	6.700	58.422

As a result of EFA, it is observed that for 21 items, the eigenvalue is above 1 for three components. Also, it is seen that 40.213% of the total variance is explained by the first component, 11.509% by the second, and 6.700% by the third component. In addition, it was found that it contributed 58.422% to the total variance.

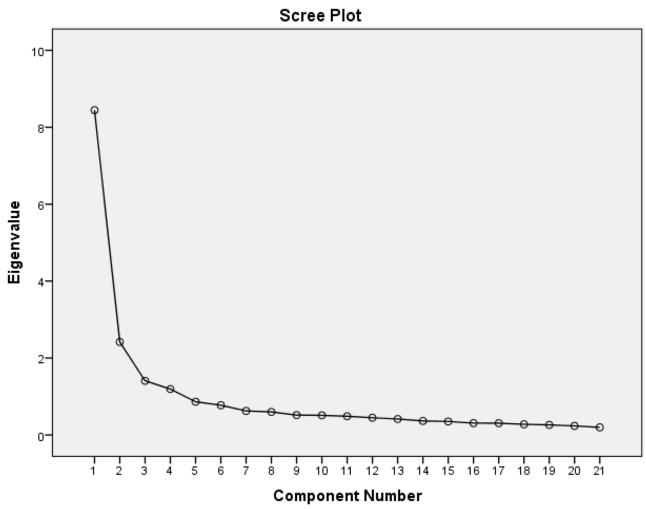

Figure 1: Scree Plot for the Exploratory Factor Analysis

When the scree plot chart with eigenvalues on the vertical axis and factors on the horizontal axis is examined, it is seen that the high acceleration decline decreases after the fifth point. A factor is identified by each interval between two points (Çokluk et al., 2018). In line with the data obtained from the eigenvalue and variance percentages and scree plot graph, it was decided to perform the analysis for three factors.

After determining the number of factors of the scale, the distribution of items to the factors was examined. In order to determine the items that have a strong correlation with which factor, the rotated component matrix was created (Table 4). Also, the matrix is used to investigate whether the items met the acceptance level of overlapping and factor load values. In order for an item to be overlapping, two conditions must occur. "i) The acceptance level of an item in more than one factor gives a high load value. ii) The difference between the load values of the item in two or more factors is less than .1" (Çokluk et al., 2018). In the exploratory factor analysis conducted in order to reveal the factor pattern of the ATUSAS, the factor load value was determined as .30.

Table 4: Rotated Component Matrix for ATUSAS

Items	Factor 1	Factor 2	Factor 3
s16	.759		
s18	.750		
s19	.749		
s17	.742		
s15	.741		
s14	.713		
s13	.680		
s21	.659		
s12	.567		
s20	.389	.383	
s7		.824	
s8		.819	
s9		.817	
s6		.738	
s10		.660	
s11		.584	
s1			.838
s5			.719
s3			.688
s4			.590
s2			.302

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

When item factor loads are examined; Items that do not load any items (below .30), overlapping items, and items loading multiple factors were excluded from the scale. Accordingly, when Table 4 is examined, it is seen that, except for item 2, the load acceptance level of all items (.56) is high, and only one item (20th item) is overlapping. It is observed that the 20th item gives a load value of .389 in the first factor and .383 in the second factor. The 20th item was excluded from the analysis since the difference between two load values (.389-.383 = .006) of this item is less than 0.1. Also, it shows that these items are overlapping and that this item does not measure a single property. The factor pattern obtained as a result of the analysis made by excluding the 20th item from the analysis, the factor load values, and the common variances of the items are given in Table 5.

Confirmatory Factor Analysis

According to the results of ECA, the scale consisting of 20 items and three factors was tested with Confirmatory Factor Analysis. Also, the goodness of fit indexes of the model was examined as a result of this analyzes. It has been stated that the most frequently used statistics of model-data fit with CFA are Chi-square ($\chi 2$), $\chi 2$ / sd, RMSEA, RMR, GFI, and AGFI. The fact that the calculated $\chi 2$ / df ratio for the model is less than 3 is the perfect fit, and that it is less than 5 is an indicator of acceptable fit (Kline, 2005). Also, GFI and AGFI values higher than .90, and RMSEA values lower than .05 indicate model data compatibility (Marsh and Hocevar, 1988). However, if GFI is greater than .85, AGFI is greater than .80, RM,R, and RMSEA values are less than .10, it is accepted as acceptable lower limits for model data compliance (Anderson and Gerbing, 1984; Cole, 1987). According to the CFA studies results carried out for the research, GFI is .85, IFI is .89, NFI is .83. It is understood that the model has a good fit by calculating the RMSEA value as .075, CFI as .89, and AGFI as .80. Chi-square statistics are indicated as a lack of index fit (Stapleton, 1997). Doğan and Başokcu (2010) emphasized that the small test statistic is suitable for the observational structure. The sizeable statistical value indicates that the model does not fit the observational structure, that is, the model does not adequately explain the observed structure. Since chi-square statistics are aggregated statistics, the higher the number of variables, the higher the chi-square/degree of freedom is used (Doğan & Başokcu, 2010; Çokluk et al., 2018). If this value is less than 5, the model is considered to have the goodness of fit, and if it is less than 3, the model is considered to have a very good fit (Byrne, 1994 act. Doğan & Başokcu, 2010). It can be said that the model created in the study is suitable for the observed structure, based on the results of chi-square/degrees of freedom operation results (477,363 / 167 = 2,858) less than 5. The structure obtained for the model is presented in Figure 2.

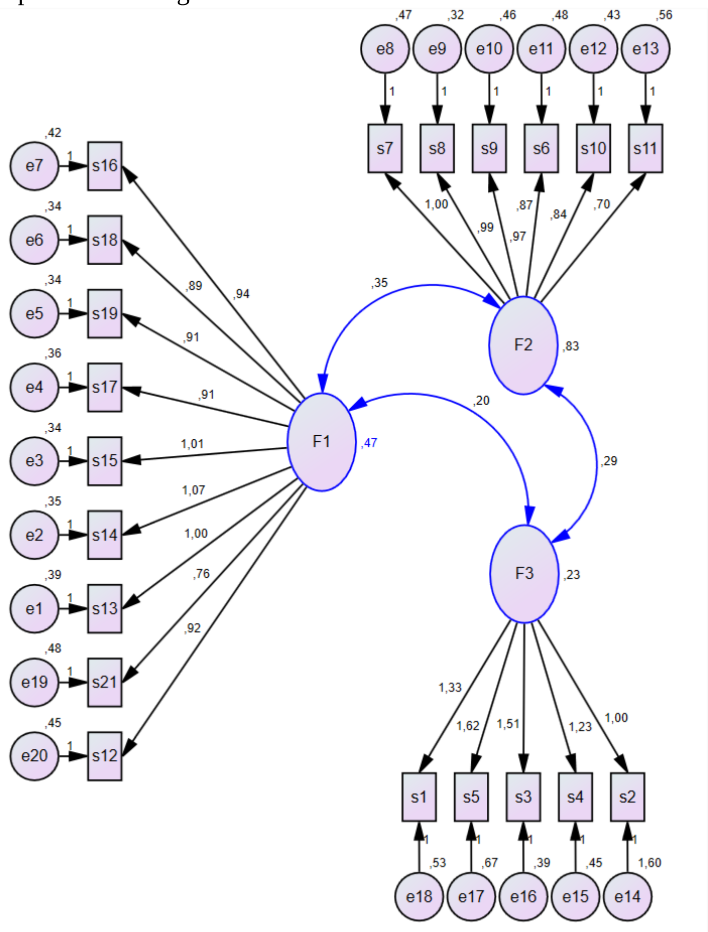

Figure 2: Path Diagram for ATUSAS

Naming Factors

As can be seen from Table 5, there are three factors in the ATUSAS. The first one is, "assistive technologies usage skills in the classroom" (S16, S18, S19, S17, S15, S14, S13, S21, and S12), the second one is, "Education material design and usage skills using assistive technologies" (S7, S8, S9, S6, S10 and S11), the third one is "assistive technologies usage skills" (S1, S5, S3, S4 and S2). Factor load values; It is observed that it varies between .77 and .58 for the first factor, .83 and .60 for the second factor, and .84 and .40 for the third factor. It is seen that the common factor variances of the items in the ATUSAS ranged from .84 (S1 item) to .40 (S2 item). This situation can be interpreted that there is homogeneity between the variables since the common factor variance is greater than .20 (Tabachnick & Fidel, 2001; Çokluk et al., 2018: 240-241).

Table 5: ATUSAS's Transformed Factor Loads

Items	Assistive technologies usage skills in the classroom	Educational material design and usage skills using Assistive technologies	Assistive technologies usage skills	Common Factor Variance
s16	.766			.625
s15	.752			.599
s18	.750			.604
s19	.749			.600
s17	.748			.593
s14	.725			.622
s13	.692			.589

s21	.633			.433
s12	.576			.573
s8		.827		.753
s7		.826		.727
s9		.809		.712
s6		.735		.663
s10		.653		.633
s11		.603		.573
s1			.839	.753
s5			.721	.667
s3			.672	.610
s4			.574	.496
s2			.400	.209

After the 20th item is excluded from the analysis, the contribution of the factors to the total variance is given in Table 6.

Table 6: Factor Structures of ATUSAS After Excluded Items

Factor	Eigenvalue	Variance Percentage	Total Variance Percentage
Assistive technologies usage skills in the classroom	8.229	41.143	41.143
Educational material design and usage skills using assistive technologies	2.417	12.083	53.225
Assistive technology usage skills	1.390	6.948	60.173

As seen in Table 6, the contribution of factors to total variance is 41.143% for the first factor, 12.083 for the second factor, and 6.948 for the third factor. It is seen that the total contribution of these factors to variance is 60.173%. It can be considered sufficient in multi-factor patterns that the explained variance is between 40% and 60% (Çokluk et al., 2018).

Reliability Analysis

The result of the reliability analyzes regarding the factors of the scale and whole scale, which was finalized with 20 items, are given in Table 7. In order to reveal the reliability of the scale, Cronbach's alpha internal consistency coefficient was examined. Cronbach's alpha was calculated separately for the factors and overall scale.

Table 7: Reliability Statistics

Factors	Cronbach's Alpha
Factor 1	.904
Factor 2	.894
Factor 3	.732
Total	**.919**

As seen in Table 7, .90 values for Factor 1, .89 for Factor 2, .73 for Factor 3 and .92 for the whole scale (20 items) were calculated. The acceptable range of Cronbach's alpha is 0.7 or higher for reliability (Yaratan 2017). These indicate that the reliability of the factors and the whole of the scale is in the acceptable range.

DISCUSSION AND CONCLUSION

In this study, Assistive Technologies Usage Skills Assessment Scale was developed. The study sample consisted of a total of 510 teacher candidates studying at the Faculty of Education. To develop Assistive Technologies Usage Skills Assessment Scale, the literature on the subject was reviewed, and a scale was set up, including 21 items. In line with expert opinions, expressions that were not suitable for content and that were ambiguous were corrected. The scale prepared in this way is rated in 5-point Likert Type.

Then, item-total correlations were examined in item analysis studies from the data obtained from the scale's application. In order to determine the validity of ATUSAS, its content validity and construct validity were examined. Expert opinions were consulted for content validity. EFA and CFA were used for construct validity. SPSS 24 package program was used for EFA. IBM SPSS Amos 26 package program was used for CFA.

As a result of EFA, a construct consisting of 20 items and three factors, which explains 60.17% of the total variance, was obtained. In line with expert opinions and the literature; the first factor was named as "Information technologies usage skills in the classroom", the second factor was "Education material design and usage skills using information technologies", and the third factor was "Information technology usage skills". The accuracy of the construct obtained for ATUSAS was tested with CFA. By examining the fit index values obtained from CFA, it was seen that the data were compatible with the model at an acceptable level. In summary, the scale consisting of three dimensions was valid, and the CFA result showed that the model was compatible.

In order to reveal the reliability of the scale, Cronbach's alpha internal consistency coefficient was examined. Cronbach's alpha reliability coefficient was calculated separately for the factors and the whole scale. The results showed that the scale was reliable (the whole scale $\alpha = .919$; 1st factor $\alpha = .904$; 2nd factor $\alpha = .894$; 3rd factor $\alpha =. 732$) as it meets the $\alpha = .70$ or higher criteria required for reliability (Nunnally, 1978; Şencan, 2005). EFA was carried out in order to contribute to the construct obtained with CFA. The results obtained showed that the resulting construct was acceptable.

Most people generally think assistive technology compels purchasing expensive hardware or software specially designed to meet a particular student's precise needs, and that requires extensive training to use them (Koch, 2017). However, there are assistive technology components built into the operating systems of various mobile devices, Microsoft and Mac/Apple computers that do not require additional software or hardware other than what comes installed in them (Apple, 2020; Microsoft, 2020; Android, 2020).

The developed scale is an effective data collection tool in revealing teacher candidates' assistive technologies usage skills. Within the Turkish literature framework, it is anticipated that the scale studies on assistive technologies are not sufficient in number, and this developed scale will constitute an essential reference for the studies to be conducted.

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