International Journal of Assessment Tools in Education
2022, Vol. 9, Special Issue, 126–145

https://doi.org/10.21449/ijate.1125823

Published at https://ijate.net/ https://dergipark.org.tr/en/pub/ijate *Research Article*

The development of an online learning readiness scale for high school students

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ARTICLE HISTORY

Received: Jun. 6, 2022

Revised: Sep. 21, 2022

Accepted: Oct. 6, 2022

Keywords:

Online learning readiness,
Computer self-efficacy,
Internet self-efficacy,
Self-learning,
High school students.

Abstract: Assessing students' online learning readiness is important since numerous countries have started online learning at all education levels during the Covid-19 pandemic in the 21st century. By taking students' online learning readiness level into account, it will be easier to establish on-target online learning environments. Although there are a number of online learning readiness scales available aiming at higher-education students in the Turkish setting, there is no scale available specifically for high-school students. This study, therefore, aims to develop a valid and reliable scale to identify the levels of online learning readiness for high school students in Türkiye. In order to develop an Online Learning Readiness Scale for high school students, a mixed-method exploratory sequential design was employed in this study. The first sample consisted of 916 students and the second sample consisted of 323 students who had previously experienced an online learning environment. The data were analyzed through exploratory factor analysis and confirmatory factor analysis. Validity and reliability evidences were also provided. The final version of the scale consisted of a total of 16 items in three dimensions; namely, computer self-efficacy, internet self-efficacy, and self-learning and explained 65.76% of the variance. The results of the study indicate that the Online Learning Readiness Scale (OLRS) developed in this particular study is a reliable and valid measurement tool in the assessment of online learning readiness levels of high school students in Türkiye and is expected to guide researchers and practitioners who focus on assessing high school students' online learning readiness levels.

1. INTRODUCTION

Developments in information and communication technologies have affected the fields of education and training. The introduction of the Internet into education and training worldwide has led to the creation of computer-assisted digital environments for learning-teaching activities (Richardson & Swan, 2003). Intelligent tutoring systems, interactive multimedia learning environments, computers as cognitive tools, simulations, microworlds, computer supported

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e-ISSN: 2148-7456 /© **IJATE** 2022

collaborative learning, pedagogical agent-based environments, virtual reality environments, and online learning environmenst are the terms describing the use of technology in education as computer assisted digital envirenments (Lajoie & Naismith, 2012). Among these terms, online learning has a special importance because of its ability to supply communication and interaction between learners and teachers in a digital environment (Katz, 2000).

Online education offers a number of beneftis to teachers and students as it allows students to work collaboratively with their teachers and classmates (Katz, 2002), gives opportunuties to students to learn without place and time boundaries (Hill, 2000; Vrasidas & McIsaac, 2000), and also provides convenience and flexibility (Chizmar & Walbert, 1999; Poole, 2000). Through online learning students get quick feedback on their performance (Khan, 1997) and access information from different sources (Lin & Hsieh, 2001). Therefore, online learning is defined as a learning model in which students learn remotely by interacting with their teachers and peers, using the Internet and computer technologies. The effectiveness of online learning processes can be linked to such student characteristics as attitudes towards online learning environment (Sivo et al., 2007), attitudes towards computers (Pillay et al., 2007), perceptions on the usefulness of online learning environments, and flexibility that is obtained by taking courses online (Arbaugh, 2000). Oliver (2001) stated that sustaining online learning relies on teacher expertise, student readiness, technology infrastructure, and reusable learning objects. Given that various student characteristics influence the effectiveness of online learning processes and student readiness is a part of creating online learning, this study focuses on developing a scale that measures online learning readiness of high school students in Türkiye.

1.1. Online Learning Readiness

Online learning readiness is defined differently in various studies due to the differences in the dimensions of the online learning readiness measured and such dimensions measured can be listed as follows:

I. Watkins et al. (2004) developed online learner readiness self-assessment instrument on U.S. Coast Guard personnel and defined online learning readiness as a construct that includes the dimensions of technology access, technology skills, online relationship, motivation, online readings, online video/audio, discussion boards, online groups, and importance to your success.

II. Hung et al. (2010) developed an online learning readiness scale on college students and defined online learning readiness as a construct that includes the dimensions of self-directed learning, motivation for learning, computer/internet self-efficacy, learner control, and online communication self-efficacy.

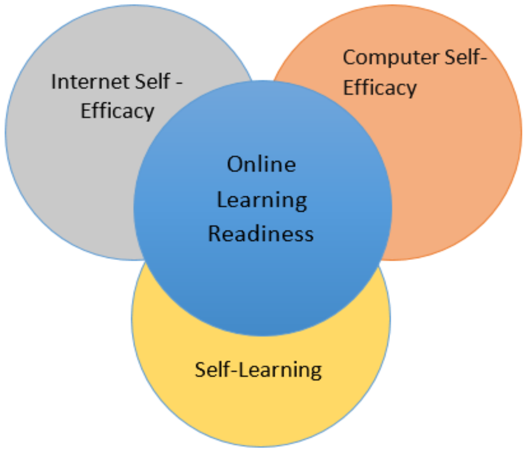
III. Pillay et al. (2007) developed a diagnostic tool for assessing tertiary level students' readiness for online learning on a sample of university students ranging from first year undergraduates to postgraduates and defined online learning readiness as a construct that includes the dimensions of technical skills, computer self-efficacy, learner preferences, and attitudes towards computers.

IV. Smith et al. (2003) adapted McVay readiness for an online learning questionnaire (McVay, 2000) on undergraduate students and defined online learning readiness as a construct that includes the dimensions of comfort with e-learning and self-management of learning.

V. Yurdugül and Demir (2017) developed a readiness for e-learning scale on undergraduate students and defined online learning readiness as a construct that includes the dimensions of autonomous learning and technology usage self-efficacy.

Online learning readiness can be redefined by using these dimensions. Watkins et al. (2004) and Hung et al. (2010) mainly discuss internet usage by using such dimensions as online relationship, online readings, online groups, online video/audio, discussion boards, and online communication self-efficacy. Instead of using various online terms, internet self-efficacy is selected for the first dimension of the study. Watkins et al. (2004), Hung et al. (2010), Pillay et al. (2007), and Yurdugül and Demir (2017) use different terms for the technological readiness of learners; namely, technology skills, computer self-efficacy, technical skills, and technology usage self-efficacy. However, instead of these terms, computer self-efficacy can be used as the other dimension of online learning readiness. All these researchers also point out learners' characteristics. Motivation, importance to your success, self-directed learning, learner control, learner preferences, self-management of e-learning, and autonomous learning are the terms used for self-learning in the relevant literature. In consideration with the common dimensions that are considered as a part of online learning readiness in the related literature, dimensions as to online learning readiness can be listed as internet self-efficacy, computer-self efficacy, and self-learning as can be seen in Figure 1.

Figure 1. *Dimensions of online learning readiness.*



Online learning readiness scales described to date are intended for assessing online learning readiness levels of university students or adults. National literature review does not reveal any scales that assess high school students' readiness for online learning in Türkiye. Assessing high school students' online learning readiness is also important as seen during the Covid-19 pandemic. In Türkiye, although all students are likely to have opportunities to access online learning, some of them cannot access it due to their own lack of readiness.

While learning a new subject or solving a problem related to the subject, students perform activities based on their existing knowledge (Senemoğlu, 2011). While readiness has been accepted as an important factor in classroom learning in the 21st century, its importance has become more understandable with the technological developments experienced to date (Demir-Kaymak & Horzum, 2013). As a matter of fact, in the report published by the International Society for Technology in Education (ISTE) (2016), students are expected to be ready in the ever-evolving technology environments in order to empower students and provide a student-oriented learning process. In this context, determining the readiness levels of students for online learning will also help them learn in online classes. Therefore, students who use digital environments for learning purposes should be ready for online learning in order to enrich their classroom learning.

Having such a tool would help researchers to reveal the readiness levels of high school students in online learning. In addition, demonstrating whether high school students are ready for online learning would help educators to establish more effective online learning environments. Developing an online learning readiness scale for high school students will therefore fill the gap in the literature and allow further research in this context.

1.2. Dimensions of Online Learning Readiness Scale

The intended dimensions of the online learning readiness scale are computer self-efficacy, internet self-efficacy, and self-learning. Self-efficacy is defined as individuals' self-judgments about their capacity to organize and implement the activities necessary to demonstrate their desired performance (Bandura, 1997). The increase in individuals' perceived self-efficacy is associated with increased performance (Bandura et al., 1977). In this context, computer self-efficacy can be defined as "a judgment of one's capability to use a computer" (Compeau & Higgins, 1995, p. 192). Prior research reveals that individuals' high computer self-efficacy levels are important in terms of being successful in online learning environments (Simmering et al., 2009). Chang and Tung (2008) concluded that one of the factors positively affecting the behavioral intention to use online learning course websites is computer self-efficacy. Lim (2001) examined adult learners' satisfaction with a web-based distance education course and their intention to attend a similar course again and concluded that the computer self-efficacy factor was the only statistically significant predictor variable. In their study, Achukwu et al. (2015) investigated 129 first-year undergraduate students' computer self-efficacy and their online learning readiness and reported that computer self-efficacy was significantly correlated with online readiness.

In addition to computer self-efficacy, internet self-efficacy in students is a second concept that needs to be investigated and is defined as the ability of individuals to communicate with their friends in online learning environments, the ability to use the environments on the Internet easily, and the ability to access the information they seek and to separate the information reached (Kim & Glassman, 2013). According to Kuo et al. (2014), it is the ability of individuals to evaluate themselves regarding their ability to organize and conduct activities that need to be done on the Internet.

In a study examining the effect of internet self-efficacy on online learning, the relationship between internet self-efficacy, and students' information-seeking strategies, it was concluded that online learning environments facilitate students' information-seeking strategies (Tsai & Tsai, 2003). In different studies, it has been stated that internet self-efficacy affects students' motivation (Liang & Wu, 2010), their academic achievement, and also their information-seeking behavior (DeTure, 2004) in online learning environments. On the other hand, it was stated that students with low internet self-efficacy levels were worried about participating in online learning environments (Livingstone & Helsper, 2010).

Finally, online learning readiness includes students' self-learning skills and is defined as the ability of students to manage their own work in online environments, to set their goals, and to evaluate themselves (Oladoke, 2006). In online learning environments, students are provided with the opportunity to work independently of time and place, to access information, and to choose and to learn individually (Lin & Hsieh, 2001). Self-learning is when students direct their own learning processes and experiences. In other words, learning can be expressed as a controlled process (Shyu & Brown, 1992). When the importance of self-learning is examined, it is stated that students should have the ability to manage their self-learning habits as well as their motivation due to the independence of online learning (Daniels & Moore, 2000).

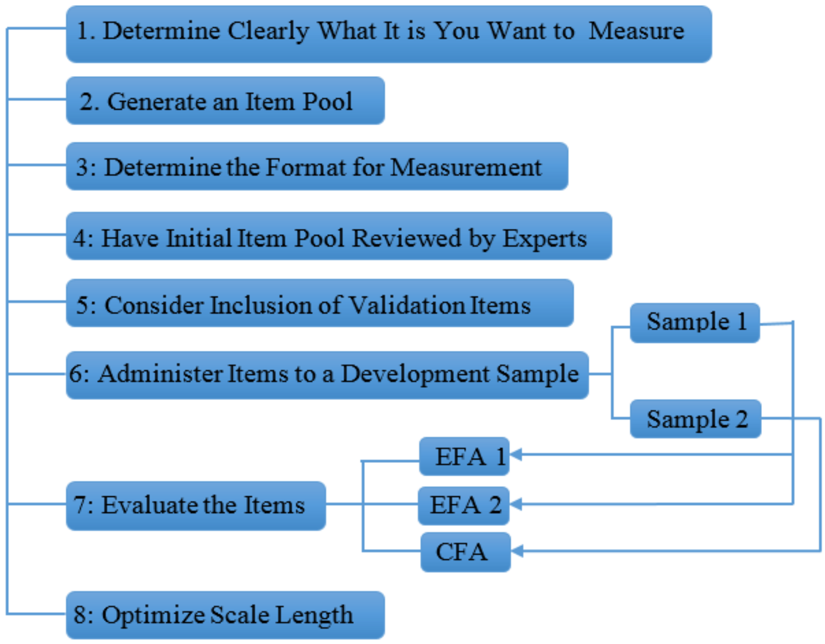
In this study, high school students' readiness for online learning is discussed in the sub-dimensions of computer self-efficacy, internet self-efficacy, and self-learning as the scale was also developed accordingly.

2. METHOD

2.1. Research Design

To develop the Online Learning Readiness Scale (OLRS) for high school students, a mixed-method exploratory sequential design was employed. Qualitative and quantitative data collection and analyses were carried out following a sequence (Creswell, 2012). Its development and validation phases (Creswell & Plano Clark, 2006) were conducted sequentially. In its development phase, the scale development process proposed by DeVellis (2017) was administered to develop OLRS for high school students. In the validation phase, two Exploratory Factor Analyses (EFA) were performed using data obtained from Sample 1 and Confirmatory Factor Analysis (CFA) was performed using data obtained from Sample 2 to test the validity and the reliability characteristics of the scores obtained from OLRS. All of these steps are summarized in Figure 2.

Figure 2. *Online learning readiness scale development steps.*



2.2. Development of the OLRS for High School Students

2.2.1. *Step 1: Determine clearly what it is you want to measure*

This study aims to develop a scale to measure high school students' online learning readiness. OLRS was constructed in three dimensions: computer self-efficacy, internet self-efficacy, and self-learning. Computer self-efficacy, a judgment of computer usability, is important to be successful in online learning (Hung, 2016). The higher the computer self-efficacy level is, the higher the success on online learning is likely to be. Internet self-efficacy, the ability to use the web services on the Internet easily, allows individuals to organize and conduct the activities which they need to do (Bernard, 2014). Those students who have low internet self-efficacy may worry about participating in online learning activities (Livingstone & Helsper, 2010). Self-learning, the ability of students to manage their own work, represents the opportunity to work independently of time and place (Lin & Hsieh, 2001). Those students who can control their own learning processes are also able to behave and make decisions along with their own needs. With the measurement of these dimensions in OLRS, the online learning readiness of high school students can be determined.

2.2.2. *Step 2: Generate an item pool*

Each item to be used in the scale should be specifically designed for high school students and correspond to one of the readiness sub-dimensions (DeVeilles, 2017). For this reason, these two situations were investigated in the relevant literature while creating the item pool. However, a previously created scale for high school students was not found. An item pool was created based on the items in the relevant sub-dimensions in the studies measuring the online learning readiness of university students (Durak, 2017; Gökçearslan et al., 2017; Horzum et al., 2019; İlhan & Çetin, 2013; Yurdugül & Alsancak Sırakaya, 2013; Yurdugül & Demir, 2017). These items were revised and presented to expert opinions. The related tudies used to make up the item pool and the number of items in the initial item pool are presented in Appendix 1.

The 26 items obtained at the end of the literature review and shown in the initial item pool were written by the researchers in a way that high school students could understand. During the arrangement made by the researchers, the item that contained more than one judgment or situation (Item 1) was separated and a new item was created. Some items designed only for university students were rewritten in a more general form (Item 3, Item 4, Item 5, Item 6, and Item 7). The language of some items was also simplified so that students could understand them more easily (Item 2, Item 8, Item 9). In this way, 10 items were written under the computer self-efficacy dimension.

Some items were combined because their content was close to each other (Item 10 and Item 11). Some items were rewritten with minor adjustments (Item 12, Item 13, Item 14, Item 15, Item 16, and Item 17). A total of 7 items were obtained in the internet self-efficacy sub-dimension. Since the content of some items and the situation to be asked could be easily understood from other items, some items were removed (Item 9, Item 16, Item 22, Item 23, Item 24, Item 26). Some items were rewritten with minor changes (Item 18, Item 19, Item 20, Item 21, Item 25). By reaching a total of 6 items in the self-learning sub-dimension, 23 items were created in the entire scale.

2.2.3. *Step 3: Determine the format for measurement*

Likert-type measurement is a widely used and effective form of measurement in obtaining attitudes, beliefs or opinions (DeVellis, 2017). Thorndike (2005) also pointed out that as the number of options in the scale increases, the reliability of the scores also increases. Responses to OLRS were obtained through a 5-point Likert-type scale. Options were "*Strongly Disagree*", "*Disagree*", "*Neither Disagree nor Agree*", "*Agree*", and "*Strongly Agree*".

2.2.4. *Step 4: Have initial item pool reviewed by experts*

Two different sets of expert opinions were obtained in order to examine the appropriateness of the questions and response options of the OLRS. The first set of opinions recruited as a pilot were obtained from 8 high school students who were registered at different grade levels (one female and one male student from each of the grade levels from 9th through 12th grades). The second set of opinions were obtained from 7 academics experts in the field of measurement and evaluation in education and instructional technologies in education. Appropriate, not appropriate, and explanation statements were written next to each item in the 23-item scale. All of the opinions were obtained during school hours via a face-to-face interview with each person.

At the end of student interviews, we found that the students wanted us to add explanation texts such as writing, creating tables, and making presentations in parentheses to make the Office programs in Items 1, 2 and 3 clearer and to write "distance education system" in parentheses next to the expressions "online learning system". We also asked the students to specify which web sources or internet environments they used in addition to those web sources given in Items 11, 12, and 16.

At the end of the interviews with expert academics, it was stated that the definition of online learning should have been at the beginning of the scale. The yes/no question in item 4 was rearranged and transformed into a Likert form. Item 16, Item 23, and Item 9 were to be removed from the scale because Item 9 had various meanings and did not express a specific situation and Item 16 and Item 23 included expressions close to Item 17. In addition, the place of Item 11 and Item 12 was changed.

2.2.5. *Step 5: Consider the inclusion of validation items (preparation of the data for analysis)*

To keep the ORLS simple and short, no validation item was included. Respondents who answered the OLRS carelessly or without sufficient effort in their response were determined via an investigation of response patterns after data collection phases. Both the longest length of consecutive identical responses and the average length of consecutive identical responses were investigated. Answers that were obtained from individuals who had identical responses throughout the OLRS or who had an average length of more than 5 consecutive identical responses were excluded. Meade and Craig (2012) found that average length of 3.64 to 4.15 consecutive identical responses was found in a real data that were obtained from careless respondents. When individuals met either criterion listed above, it was assumed that these individuals responded to the items by neglecting the content of the items. 1017 students in the first sample and 397 students in the second sample responded to the ORLS initially. 101 of the responses in the first sample and 74 of the responses in the second sample were excluded due to careless or insufficient efforts in responding. Rather than including validation items, the investigation of response patterns and preparation of the data for analysis allowed us to validate the response process to some extent.

2.2.6. *Step 6: Administer items to a development sample*

Evidence based on response processes can be used as validity evidence. Specifically, internal structure of the responses was investigated to obtain valid evidence of the OLRS. Since this method relies on response processes, items were administered to two development samples. Responses from the first sample were used to explore the internal structure of responses via Exploratory Factor Analysis procedures. Responses from the second sample were used to confirm the internal structure of the responses via Confirmatory Factor Analysis. A total of 14 high schools in Siirt Province, Türkiye were selected to participate in the development and validation of OLRS via convenience sampling. All of the students registered in those schools received the OLRS form and responded voluntarily. After excluding careless or insufficient efforts on the part of respondents, the first sample consisted of 916 students and the second sample consisted of 323 responses. The descriptive characteristics of both samples are summarized in Table 1.

Table 1. *Descriptive characteristics of the development samples.*

	1st. Sample (*N*=916)		2nd. Sample (*N*=323)	
	f	%	*f*	%
Gender				
Male	303	33.08	171	52.94
Female	613	66.92	152	47.06
Grade Level				
9th. Grade	404	44.10	131	40.56
10th. Grade	203	22.16	84	26.01
11th. Grade	215	23.47	44	13.62
12th. Grade	94	10.26	64	19.81

Note: f stands for frequency, % stands for percentage.

There are various suggestions regarding appropriate sample size to estimate parameters in factor analysis. Commonly used rule of thumb suggested by Comrey and Lee (1992) and Tabachnick and Fidell (2013) is 50 as very poor, 100 as poor, 200 as fair, 300 as good, 500 as very good, and 1000 as excellent. Nunnally and Bernstein (1967) also suggested having at least 10 cases per question; hence, sample size of 200 would be sufficient for OLRS. Similar to this criterion, Bentler and Chou (1987) suggested that the sample size should be at least 5 times more than the number of estimated parameters. Forero et al. (2009) suggested that factor analysis of ordinal data with sample size of 200 and small factor loadings (<.40) may provide biased estimates, while a sample size of 500+ or models with moderate or high factor loadings (>.40) may provide adequate estimates. Overall, we may conclude that the sample size for the first sample meets very good criteria and sample size for the second sample meets good sample criteria in our specific study.

2.2.7. *Step 7: Evaluate the items*

To understand the validity and reliability properties of the scores obtained using OLRS, a three-step approach was administered. The first step involved Exploratory Factor Analysis (EFA) to understand the internal structure of the data obtained from the first sample. The number of dimensions in the data and items that are highly related to each dimension is determined. To determine the number of dimensions, three rules were used additively. Firstly, Kaiser (1960) and Guttman (1954) criterion was used to determine the maximum number of dimensions. Dimensions that had an eigenvalue of 1.00 or more were taken into consideration. Secondly, Cattell's scree plot rule (1966) was considered. Furthermore, the eigenvalue difference among consequent dimensions was investigated. We assumed that no new dimension emerged when the slope of the scree plot became close to flat. Finally, only those dimensions that met our theoretical expectancies were considered. After the number of dimensions was determined, we investigated the relationship between dimensions and items through the evaluation of factor loadings. As Matsugna (2010) suggested, a standardized factor loading of .40 or more in the absolute value is a common cut-off in social sciences to indicate an important relationship between the dimension and the item.

After this first EFA, we ran a second EFA using data obtained from the first sample again. The main reason to run a second EFA was to see if the structure of the responses was still the same when items that did not work as expected were excluded. The second EFA consisted of dimensions that were emergent at the first EFA and items that were found to be related to the dimension that the item was supposed to be related to. This second EFA allowed us to remove items that were unrelated to the dimension that item was supposed to be loaded theoretically. In addition, reliability evidence of the scores obtained in each dimension was obtained through Cronbach's α statistic (Cronbach, 1951). Cronbach's α statistic of .70 or greater reflects acceptable reliability, .80 or greater reflects good reliability, and .90 or greater reflects excellent reliability.

To confirm the internal structure that was reflected through the second EFA results, we collected additional data but the items that were included in OLRS were determined by the second EFA results only. Confirmatory Factor Analysis (CFA) was conducted using data obtained from the second sample to secure further validation evidence. In addition, we also calculated Raykov'sρ reliability statistic (1997) based on CFA results for further reliability evidence. Raykov'sρ was preferred here because unlike Cronbach's α, each item contributes to the composite score reliability with respect to the magnitude of its factor loading.

Model-data fit in both EFAs and in CFA was evaluated through model X2 Statistic Root Mean Square Error of Approximation (RMSEA) (Byrne, 1998), Bentler Comparative Fit Index (CFI) (Byrne, 1998), Tucker – Lewis Index (TLI) (Tucker & Lewis, 1973), and Standardized Root Mean Square Residual (SRMR) (Kline, 2011). Browne and Cudeck (1993) suggested that RMSEA value that exceeds .10 reflects a serious problem about the model. RMSEA values in between .08 and .10 reflect an acceptable level of model fit and RMSEA values that are smaller than .08 reflect a good model fit (MacCallum et al., 1996). Hu and Bentler (1999) suggested that CFI and TLI values that are smaller than .90 reflect bad fit, values that are between .90 and .95 reflect acceptable fit, and values that are greater than .95 reflect good fit. Again, Hu and Bentler (1999) suggested that SRMR values that are smaller than .08 reflect an acceptable fit.

Both EFAs and CFA were performed in Mplus version 8.6 (Muthen & Muthen, 1998-2017). In consideration of the ordinal nature of the responses, Weighted Least Squares – Mean and Variance Adjusted (WLSMV) estimator was used because Li (2016) concluded that the WLSMV estimator provides unbiased estimates when the sample size is greater than 200 with non-normal data.

Results of item evaluation based on two EFAs and one CFA, as well as reliability, are presented in the Results section in detail.

2.2.8. *Step 8: Optimize scale length*

The scale length was optimized based on two EFAs and one CFA results as presented in the Results section.

3. RESULTS

In order to evaluate items and obtain validity evidence regarding OLRS scores, two EFAs were run to determine the factor structure of the OLRS with the first sample and one CFA was run to confirm the factor structure of the OLRS with the second sample. Reliability evidence regarding OLRS scores was obtained through estimation of Cronbach's α with the first sample and Raykov'sρ with the second sample. Model fit statistics of both EFAs and CFA are summarized in Table 2; followed by results of the EFA 1, EFA 2, and CFA, respectively.

Table 2. *Model fit statistics summary.*

	χ^2	*df*	RMSEA	CFI	TLI	SRMR
EFA 1	1356.114	133	0.100	0.929	0.899	0.047
EFA 2	629.368	75	0.090	0.962	0.936	0.034
CFA	272.195	101	0.072	0.963	0.956	0.052
Acceptable fit			≤ 0.08	≥ 0.90	≥ 0.90	≤ 0.08

Note: df is the degree of freedom.

3.1. EFA 1 with Sample 1

EFA 1 included 20 items and all solutions up to the 5-factor solution were obtained. The eigenvalue of the first factor was 7.481, the eigenvalue of the second factor was 2.881, the eigenvalue of the third factor was 1.753, the eigenvalue of the fourth factor was 1.094, and the eigenvalue of the fifth factor was 0.878. According to the Kaiser-Guttman rule, it can be said that the data set is represented by the most complex 4-factor structure. However, when the scree plot was drawn, it was determined that the curve of the eigenvalues flattened after the third factor; therefore, different factors did not emerge. In addition, for this scale, which is theoretically planned to have three factors only, the 3-factor solution was primarily evaluated. The 3-dimensional structure explains 60.58% of the variance of the answers given to the indicator items. When the model-data fit statistics in Table 2 are examined, the RMSEA value of 0.100 estimated for the 3-factor structure can be seen to be at the limit indicating that the model can be developed seriously according to the RMSEA criterion. However, the CFI value of 0.929 indicates acceptable fit, the TLI value of 0.899 indicates borderline poor fit, and the SRMR statistic of 0.047 indicates a good fit. In general, it can be said that the model-data fit is borderline acceptable.

Table 3. *Results of explanatory factor analysis – factor loadings.*

		First Exploratory Factor Analysis			Second Exploratory Factor Analysis		
No	Item	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
1	I am confident in using Microsoft Office-MS Word program (a writing program).	**0.905**	0.002	-0.044	**0.907**	0.001	-0.039
2	I am confident in using Microsoft Office-MS Excel (a table creation program).	**0.802**	-0.047	0.061	**0.807**	-0.053	0.060
3	I am confident in using Microsoft Office-MS PowerPoint (a presentation program).	**0.714**	0.122	-0.028	**0.727**	0.103	-0.024
4	I know how to log in to my courses using the online learning software (distance education system).	-0.024	**0.602**	0.177			
5	I know how to log in to my courses using the online learning software (distance education system) using a computer.	0.059	**0.637**	0.101			
6	I can progress in my courses by using online learning software (distance education system) on a computer.	0.010	0.284	**0.400**			
7	I feel confident in using the operating system on a computer.	**0.571**	0.249	0.026	**0.578**	0.22	0.024
8	I can use files saved in audio, music, text, etc. formats on a computer	**0.383**	0.493	0.026			
9	I am confident in setting up programs (i.e., installing new software) on a computer.	**0.563**	0.133	0.011	**0.549**	0.146	0.018
10	I can use web browsers (Internet Explorer, Google Chrome, Safari, Mozilla, Opera, etc.) to access the Internet easily.	0.177	**0.727**	-0.032	0.187	**0.731**	-0.009
11	I am confident in using search engines such as Google-Yahoo, Bing, and Yandex on the Internet.	0.181	**0.737**	-0.017	0.198	**0.740**	0.002
12	I am able to find the information I seek on the Internet easily.	-0.016	**0.737**	0.093	-0.012	**0.759**	0.098
13	I can use social networks easily.	0.070	**0.789**	0.000	0.087	**0.796**	0.003
14	I can send e-mails using internet tools.	0.343	**0.461**	-0.021	0.351	**0.476**	-0.017
15	I can use instant messaging software (Skype, WhatsApp, etc.) to communicate with people.	-0.040	**0.734**	0.072	-0.02	**0.724**	0.073
16	I implement my own study plan in online learning (distance learning).	0.003	0.134	**0.698**	0.005	0.129	**0.702**
17	I manage time well in online learning (distance education).	-0.013	-0.042	**0.801**	-0.011	-0.04	**0.795**
18	I set my learning goals in online learning (distance education).	-0.008	0.014	**0.806**	-0.011	0.018	**0.810**
19	I can direct my own learning process in online learning (distance education).	0.014	-0.002	**0.805**	0.013	-0.004	**0.808**
20	I take a high degree of responsibility during online learning (distance learning).	0.081	0.001	**0.601**	0.079	0.002	**0.602**

Note: Factor loadings that are greater than 0.400 in absolute value are bolded. Items 4, 5, 6 and 8 are excluded from the second Explatory Factor Analysis.

The 3-dimensional structure obtained in the exploratory factor analysis was summarized in Table 3 and the items loaded heavily by each dimension were examined, and the items that did not have a factor load of at least 0.400 in the absolute value were determined. Accordingly, although items 4, 5, 6, and 8 were written to determine the level of computer self-efficacy, the factor loads in the first dimension, on which the other theoretically related items were loaded, were found to be -0.024, 0.059, 0.010, and 0.383, respectively. In addition, factor loadings of items 4, 5, and 8 in the second dimension, which was predominantly loaded by the items written to determine the internet self-efficacy level, were found to be 0.602, 0.637, and 0.493, respectively. Finally, factor loading of item 6 in the third dimension, which was predominantly loaded by the items written with the aim of determining the self-learning level, was found to be 0.400. The exploratory factor analysis was renewed by removing items 4, 5, 6, and 8.

3.2. EFA 2 with Sample 1

In consideration with the results of EFA 1, 4 items with low factor loadings with the dimension it aims to measure were removed and EFA was performed again. There were 16 items in EFA 2, and all solutions up to 5-factor solution were obtained again. The eigenvalue of the first factor was 6.103, the eigenvalue of the second factor was 2.745, the eigenvalue of the third factor was 1.673, the eigenvalue of the fourth factor was 0.825, and the eigenvalue of the fifth factor was 0.609. According to the Kaiser-Guttman rule, it can be said that the data set is represented by the most complex 4-factor structure. However, when the scree plot was drawn, it was determined that the curve of the eigenvalues flattened after the third factor; therefore, different factors did not emerge again. In addition, for this scale, which is theoretically planned to have 3 factors, the 3-factor solution was primarily evaluated. The 3-dimensional structure explains 65.76% of the variance of the item responses. When the model-data fit statistics in Table 2 are examined, the RMSEA value of 0.090 estimated for the 3-factor structure indicates that the model is acceptable based on the RMSEA criterion. In addition, the CFI value of 0.962 indicates a very good fit, the TLI value of 0.936 indicates a good fit, and the SRMR value of 0.034 indicates a good fit. In general, it can be said that the model-data fit is good.

The 3-dimensional structure that corresponds to our theoretical expectations and was obtained in the second exploratory factor analysis is summarized in Table 3. Each factor loading was examined in terms of determining which item was loaded heavily by which factor. It was found that all of the items were loaded heavily by the theoretically intended factors with factor loadings of over 0.400. The factor loadings of items 1, 2, 3, 7, and 9 that were written to reveal the level of computer self-efficacy ranged between 0.549 and .907. The factor loadings of the items 10, 11, and 12, 13, 14, and 15 that were written to reveal the level of internet self-efficacy ranged between 0.476 to 0.796, and the factor loadings of items 16, 17, 18, 19, and 20 that were written to reveal the level of self-learning ranged between 0.602 and 0.810. Thus, the first dimension is called computer self-efficacy, the second dimension is called internet self-efficacy, and the third dimension is called self-learning. The Cronbach's alpha statistics calculated to determine the internal consistency of the scores for each dimension score were found to be 0.83, 0.82 and 0.84, respectively.

3.3. CFA with Sample 2

In order to confirm the 3-factor 16-item structure obtained in the EFA 2 results, data were collected again and confirmatory factor analysis was performed using the second data set. When the model-data fit statistics in Table 2 are examined, the RMSEA value of 0.72 was estimated for the 3-factor structure that indicates a good model-data fit. In addition, the CFI value of 0.963 and TLI value of 0.956 indicate a very good fit, and the SRMR value of 0.052 indicates a good fit. In general, the model-data fit can be said to be very good. Thus, the 3-factor and 16-item structure was confirmed in another sample.

Table 4. *Summary of confirmatory factor analysis results.*

No	Item	Factor Loading	Standard Error	*t*	*p*
Computer Self-Efficacy (*Raykov'sp* = 0.860)					
1	I am confident in using Microsoft Office- MS Word program (a writing program).	0.860	0.020	41.996	<.0001
2	I am confident in using Microsoft Office- MS Excel (a table creation program).	0.779	0.023	33.640	<.0001
3	I am confident in using Microsoft Office- MS PowerPoint (a presentation program).	0.782	0.028	27.922	<.0001
7	I feel confident in using the operating system on a computer.	0.739	0.031	23.916	<.0001
9	I am confident in setting up programs (i.e., installing new software) on a computer.	0.530	0.042	12.719	<.0001
Internet Self-Efficacy (*Raykov'sp* = 0.894)					
10	I can use web browsers (Internet Explorer, Google Chrome, safari, Mozilla, Opera etc.) to access the Internet easily.	0.807	0.024	34.230	<.0001
11	I am confident in using search engines such as Google-Yahoo, Bing and Yandex on the Internet.	0.837	0.023	37.116	<.0001
12	I can find the information I seek on the Internet easily.	0.673	0.038	17.546	<.0001
13	I can use social networks easily.	0.829	0.024	34.701	<.0001
14	I can send e-mails using internet tools	0.702	0.034	20.399	<.0001
15	I can use instant messaging software (Skype, WhatsApp, etc.) to communicate with people.	0.733	0.033	22.176	<.0001
Self-Learning (*Raykov'sp* = 0.853)					
16	I implement my own study plan in online learning (distance learning).	0.667	0.034	19.468	<.0001
17	I manage time well in online learning (distance education).	0.725	0.035	20.980	<.0001
18	I set my learning goals in online learning (distance education).	0.779	0.026	29.747	<.0001
19	I can direct my own learning process in online learning (distance education).	0.846	0.024	35.930	<.0001
20	I take a high degree of responsibility during online learning (distance learning).	0.638	0.036	17.648	<.0001
Correlations among dimensions					
Internet Self-Efficacy and Computer Self-Efficacy		0.687	0.033	20.093	<.0001
Computer Self-Efficacy and Self-Learning		0.246	0.056	4.364	<.0001
Internet Self-Efficacy and Self-Learning		0.254	0.057	4.447	<.0001

CFA results are summarized in Table 4. The factor loadings of items 1, 2, 3, 7, and 9 included with the intention of revealing computer self-efficacy ranged between 0.530 and .860. The factor loadings of the items 10, 11, 12, 13, 14, and 15 included with the intention of revealing internet self-efficacy varied between 0.673 and 0.837. Finally, the factor loadings of the items 16, 17, 18, 19, and 20 included with the intention of revealing self-learning ranged from 0.638 to 0.846. In addition, a positive/moderate-high correlation of 0.687 was estimated between computer self-efficacy and internet self-efficacy dimensions. Also, a positive/small correlation of 0.254 was estimated between internet self-efficacy and self-learning dimensions. Finally, a positive/small correlation of 0.246 was estimated between computer self-efficacy and self-learning dimensions. Raykov'sp reliability statistics for the computer self-efficacy dimension was 0.860, for the internet self-efficacy dimension it was 0.894, and for the self-learning dimension it was 0.853. In conclusion, the total scores in all three dimensions were found to be reliable.

4. DISCUSSION and CONCLUSION

To investigate the online learning readiness of high school students, an OLRS for High School Students was developed and validated in this specific study. A review of the national and international literature showed some online learning readiness scales prepared for university students (Hung et al., 2010; Lin et al., 2016; Pillay et al., 2007; Yurdugül & Demir, 2017). It was seen that these studies had common characteristics in the dimensions measured and there was no scale prepared for high school students. Since many countries started online learning in all education levels during the Covid-19 pandemic in the 21st Century, the development of such a scale would fill a gap in the literature to assess the situations of high school students about online learning readiness.

Steps proposed by DeVellis (2017) on scale development were applied in a sequence as can be seen in Figure 2. While preparing the initial item pool in Appendix 1, the items in these scales, which were prepared for university students and mentioned above, were used. Then the researchers rewrote the items to make them easily understandable by high school students. The first version of OLRS was implemented to 8 high school students in a high school in Siirt, Türkiye. Additionally, expert opinion was obtained from 7 academics. After the analysis of students' and experts' opinions, the implementation form of the OLRS was obtained. For statistical analysis of OLRS, 916 high school students in sample 1 and 323 students in sample 2 participated in the study. The data taken from sample 1 were used for EFA and the data taken from sample 2 were used for CFA. The final version of OLRS is displayed in Table 4. In addition, the original Turkish version is also reported in Appendix 2. This final version includes 16 items in three dimensions: computer self-efficacy, internet self-efficacy, and self-learning.

In the studies performed with university students about online learning readiness, the number of dimensions and the content of them differs. In the present study, computer self-efficacy dimension corresponds to technology use (Watkins et al., 2004), ability to use technological tools (computer) (Hung et al., 2010), and technical interaction (Barker, 2002). Internet self-efficacy corresponds to communication (Watkins et al., 2004), willingness to interact, ability to communicate, (Bernard et al., 2004), ability to use technological tools (internet) (Hung et al., 2010), using internet sources (Choucri et al., 2003), and communication skills (Barker, 2002). Finally, self-learning corresponds to self-directed learning (Watkins et al., 2004), self-learning ability and belief, (Bernard et al., 2004), management and responsibility of self-learning (Hung et al., 2010), managing time (Pillay et al., 2007), mental and physical readiness (Borotis & Poulymenakou, 2004), and intrinsic motivation (Smith et al., 2003). Therefore, the present study corresponds to many dimensions mentioned in the related literature, while literacy and access to technology dimensions in Watkins et al. (2004) and using asynchronous and synchronous tools in Pillay et al. (2007) were not included in the study.

5. RECOMMENDATIONS for RESEARCH

As a consequence of the Online Learning Readiness Scale application, there are some recommendations for future research. Correlation between the results of OLRS and newly developed similar scales can be compared to analyze concurrent validity. Furthermore, if OLRS were applied for different levels like elementary and primary students, it would also be necessary to repeat validity and reliability analyses for the data taken from these groups. Such individual differences as gender, education level, age, and familiarity can also be searched in future studies. Additionally, new studies can be performed to adapt OLRS to new cultures through reliability and validity analyses.

Acknowledgments

The authors would like to thank the assistance of Siirt Provincial Directorate of National Education personnel and high school principals who helped researchers to get in touch with high school students. The authors received no financial support for the research.

Declaration of Conflicting Interests and Ethics

The study followed all protocols required to research in an ethical manner. The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. Ethics Committee Number: Siirt University Directorate of Ethics Committee (11/11/2020-86).

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APPENDIX

Appendix 1. The Initial Item Pool That is Reviewed by Experts

	Number of Items: 26	Reference
	Computer Self-efficacy	
1	I am confident in using the basic functions of Microsoft Office programs (MS Word, MS Excel, and MS PowerPoint).	İlhan, M. & Çetin, B. (2013)
2	I trust my knowledge and skill in how to manage online learning software.	İlhan, M. & Çetin, B. (2013)
3	I am confident in using the basic functions of mobile learning systems.	Gökçearslan, Ş., Solmaz, E. & Kukul, V. (2017)
4	I trust my knowledge and skills about mobile learning systems.	Gökçearslan, Ş., Solmaz, E. & Kukul, V. (2017)
5	I am confident in knowing how mobile learning systems work.	Gökçearslan, Ş., Solmaz, E. & Kukul, V. (2017)
6	I can use online note-taking technologies (Color note) to take notes or access my notes.	Durak, H. Y. (2017)
7	I can easily use Windows operating systems.	Yurdugül, H. & Demir, Ö. (2017)
8	I can view the contents of an electronic file (sound, music, text, etc.) on a computer.	Yurdugül, H. & Demir, Ö. (2017)
9	I can solve problems I encounter while using a computer.	Yurdugül, H. & Demir, Ö. (2017)
Internet Self-efficacy		
10	I can download files from the Internet.	Durak, H. Y. (2017)
11	I feel confident when using the Internet (Google, Yahoo) to obtain or collect information for mobile learning.	Gökçearslan, Ş., Solmaz, E. & Kukul, V. (2017)
12	I can easily use web browsers (Internet Explorer, Google Chrome etc.).	Yurdugül, H. & Demir, Ö. (2017)
13	I can easily find the information I am looking for on the Internet.	Yurdugül, H. & Demir, Ö. (2017)
14	I can easily ask questions in online discussion environments.	Yurdugül, H. & Demir, Ö. (2017)
15	I can ask for help by using internet tools (discussion sites, social networks, e-mail, etc.)	Yurdugül, H. & Demir, Ö. (2017)
16	I can easily communicate with voice or video on the Internet (Skype, Google hangout, Google talk, etc.).	Yurdugül, H. & Demir, Ö. (2017)
17	I can use instant messaging software (Skype, WhatsApp etc.) to communicate with people.	Durak, H. Y. (2017)
Self-learning		
18	I implement my own study plan.	Yurdugül, H. & Alsancak Sırakaya, D. (2013)
19	I manage time well.	Yurdugül, H. & Alsancak Sırakaya, D. (2013)
20	I set my learning goals.	Yurdugül, H. & Alsancak Sırakaya, D. (2013)
21	I can direct my own learning process.	İlhan, M. & Çetin, B. (2013)
22	I can direct my own learning process online.	Yurdugül, H. & Alsancak Sırakaya, D. (2013)
23	I set goals in my work and take a high degree of responsibility.	Gökçearslan, Ş., Solmaz, E. & Kukul, V. (2017)
24	In a subject that requires special field expertise, I support the student in determining the right field experts to support his/her own learning.	Horzum, M., Bektaş, M., Ayvaz Can, A., Güngören, Y. & Sellüm, F. (2019)
25	During the online education process, other online activities (chatting, surfing the Internet) do not distract me.	İlhan, M. & Çetin, B. (2013)
26	I prepare my own work plan and put it into practice.	Durak, H. Y. (2017)

Appendix 2. OLRS Final Turkish Version

LİSE ÖĞRENCİLERİ İÇİN ÇEVRİMİÇİ ÖĞRENME HAZIRBULUNUŞLUK ÖLÇEĞİ		Kesinlikle Katılmıyorum	Katılmıyorum	Ne Katılıyorum Ne Katılıyorum	Katılıyorum	Kesinlikle Katılıyorum
Bilgisayar Öz Yeterliliği						
1.	Microsoft Office- MS Word programını (yazı yazma programı) kullanma konusunda kendime güvenirim.					
2.	Microsoft Office- MS Excel (tablo oluşturma programı) programını kullanma konusunda kendime güvenirim.					
3.	Microsoft Office- MS PowerPoint (sunum yapma programı) programını kullanma konusunda kendime güvenirim.					
7.	Bilgisayardaki işletim sistemini kullanma konusunda kendime güvenirim.					
9.	Bilgisayara program (yeni yazılım kurma) kurma konusunda kendime güveniyorum.					
İnternet Öz Yeterliliği						
10.	İnternete kolay erişim için web tarayıcılarını (İnternet Explorer, Google Chrome, safari, mozilla, opera v.b.) rahatlıkla kullanabilirim.					
11.	İnternette Google-Yahoo, bing ve yandex gibi arama motorlarını kullanabilme konusunda kendime güvenirim.					
12.	İnternette aradığım bilgiye rahatlıkla ulaşabilirim					
13.	Sosyal ağları rahatlıkla kullanabilirim.					
14.	İnternet araçlarını kullanarak mail gönderebilirim					
15.	İnsanlarla iletişim kurmak için anlık mesajlaşma yazılımlarını (Skype, WhatsApp vb.) kullanabilirim.					
Kendi kendine öğrenme						
16.	Çevrimiçi öğrenmede (uzaktan eğitim sürecinde) kendi çalışma planımı uygularım.					
17.	Çevrimiçi öğrenmede (uzaktan eğitim sürecinde) zamanı iyi yönetirim.					
18.	Çevrimiçi öğrenmede öğrenme (uzaktan eğitim sürecinde) hedeflerimi belirlerim.					
19.	Çevrimiçi öğrenmede (uzaktan eğitim sürecinde) kendi öğrenme sürecime yön verebilirim.					
20.	Çevrimiçi öğrenme (uzaktan eğitim sürecinde) sırasında yüksek derecede sorumluluk alırım.					