

# Digital literacy self-efficacy scale: A scale development study<sup>#</sup>

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## ABSTRACT

This study aims to develop a scale in order to determine the digital literacy self-efficacy level of primary school students. In line with this purpose, firstly, open-ended questions, which were created and asked for opinions on digital literacy, were directed to field experts and primary school teachers. The draft scale form was created as a result of the responses to open-ended questions and the literature review was presented to the field experts and the items in the draft scale were finalized in the line with the feedback. The draft scale form was applied to a total of 175 4<sup>th</sup> grade students studying in the central district of Afyonkarahisar in the 2019-2020 academic year determined by purposeful methods. The data were analyzed by Exploratory Factor Analysis (EFA) and it resulted in a structure with 21 items and four subdimensions named 'Collaboration in Digital Environments', 'Emotion Management in Digital Environments', 'Information Management in Digital Environments' and 'Awareness in Digital Environments'. It was confirmed that the subscales constituted a model by the first level and second level Confirmatory Factor Analysis (CFA). The Cronbach's alpha value for the scale was found to be .944.

**Keywords:** Digital literacy, scale development, self-efficacy, primary school students.

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## INTRODUCTION

The concept of literacy has different meanings according to the changes that societies have shown over time. Literacy, previously defined as 'reading and writing' skills, has started to be used in the sense of 'ability to understand the information presented' as a requirement of both social and technological developments (Lanham, 1995). In order to keep up with the continuous development in digital technology, today's individual needs to use many technical, cognitive and affective skills together in order to solve problems and perform a task in digital environments. For this reason, many types of literacy have been proposed regarding our digital world, and the use and content of the concept of literacy have changed with digital developments.

Due to these developments and changes, literacy, which first emerged in the 1960s and is still in use, includes computer literacy which has been used as being aware of how to use computer and application software for practical purposes (Martin and Grudziecki, 2006).

Computer literacy has gone through an evolutionary process including three stages such as specialization period, application period and reflection skills, and the meaning attributed to the concept of computer literacy has changed, accordingly. While computer literacy was first used to meet the ability to use computers, it has begun to be used instead to refer to the ability to use various skills and information technology in different areas in the reflection period (Martin, 2003). Technological developments have led to different skills and expectations from the people of the age. Especially in the 1970s, the concept of Technology Literacy, which means that technological tools can be used to improve learning, productivity and performance, emerged with the understanding that technology has a power that can harm nature and human beings (Waks, 2006). This literacy level is defined by ITEA (1996) as the ability to benefit from technology by understanding how technological systems work, to manage technology by ensuring the

suitability and competence of all technological activities, and to benefit from technology in synthesizing information. Another type of literacy introduced in the digital field in the 1980s is Information Literacy, which has been defined as the ability to find resources, analyze and synthesize the material, evaluate the reliability of the source, use ethical and legal means to quote, focus on the issues and create research questions accurately, effectively and efficiently (Eisenberg, 2008). The society of each age has revealed different skills in creating the ideal human type for its development, and these skill definitions have been directly influenced by technological advances.

Literacy types that are put forward in line with these technological developments and are directly related to the digital world have also emerged. These literacy types can be listed as follows: Media Literacy, which includes the ability to access, analyze, evaluate and communicate information in a variety of forms, including unprinted and non-written messages; Visual Literacy, which means the ability to read, interpret and understand the information presented as pictures or graphics, translate information into graphics, and interpret the symbols that exist around (Stokes, 2002) and Communication Literacy, which is used to mean the ability to communicate effectively and to collaborate using various telecommunication tools (Winnepeg School Division, 2010).

In today's information age during which technology has reached an unprecedented level, individuals are expected to have versatile skills. The skills required by all sub-literacies have brought the definition of literacy to a different dimension and a concept that includes all of these skills has arisen. For this reason, the concept of Digital Literacy, which was coined by Gilster (1997), was introduced as an umbrella concept instead of all the mentioned literacy used in relation to the digital world (Calvani et al., 2008). This type of literacy, which some researchers claim to be "New Literacy", is a concept that emerged with the features of online social networks, knowledge of using mobile devices and recent technological applications (Lankshear and Knobel, 2008; Coiro et al., 2008). This new concept, beyond just using computer software and hardware, is defined in a way that includes the ability to use all digital devices in a social context (Bawden, 2001), the need for individuals to be aware of their own needs and skills (Jones and Hafner, 2012), and the special and technical language related to digital tools (Gee, 2012).

There are certain skills that an individual should have in order to be defined as digitally literate. These skills are described as (1) Instrumental Skills, (2) Cognitive Intellectual Skills, (3) Social Communication Skills, (4) Axiological Skills, and (5) Emotional Skills by Area and Pessoa (2012); (1) Knowledge Skills, (2) Communication Skills, (3) Cooperation Skills, and (4) Social Participation Skills by Monereo (2005) (as cited in Rodríguez de Dios, 2018); and (1) Visual Skill, (2) Reproduction Skill, (3)

Grouping Skill, (4) Knowledge Skill, and (5) Social Skill by Eshet (2004). As stated in the literature, the skills that a digitally literate individual is expected to have included not only the technical knowledge and skills of the individual but also the use of this knowledge and skill in the social context in digital environments. For this reason, assessing only technical knowledge and skills in evaluating the digital literacy levels of individuals will cause lower literacy levels to be evaluated. As the internet has become an indispensable part of our world, many students start to use it at a very early age for many activities such as searching for something new, making friends or playing. It has been indicated that the digital literacy level also affects academic achievement (Malkoç, 2018) and performance (Mohammadyari and Singh, 2015) in a positive way. Especially during the pandemic situation, there were attempts to pursue education on digital platforms. Therefore, it has become compulsory for students to learn digital literacy skills (Stripling, 2010). Acquiring this skill at an early age will help students to be more successful in their academic and future lives. Thus, it is essential to determine the digital literacy level of the students at an early age as it will help to take action in developing such skills.

When studies conducted with digital literacy and digital skills in the literature were examined, it was concluded that they were generally about teacher candidates (Kozan and Bulut Özek, 2019; Ocak and Karakuş, 2018; Üstündağ et al., 2017; Çetin, 2016), textbooks (Direkçi et al., 2019; Duran and Özen, 2018), school administrators (Sönmez and Gül, 2014), parents (Acar and Şimsek, 2015) and teachers (Arcagök, 2020; Tatlı, 2018). As stated in the literature about digital literacy, this skill is of the utmost importance in this age. For this reason, assessing this competence starting in lower levels in schools can contribute to both determining the level of achievement to the competence stipulated by the curriculum and understanding the importance of digital literacy skills. In this context, this study aims to develop a scale for determining the digital literacy self-efficacy of primary school students.

## METHOD

The general survey model has been employed in this study which aims to develop a scale that can be used to determine the digital literacy self-efficacy level of primary school students.

### Sample of the study

The sample of the study consists of 175 4th grade students, 98 girls (56%) and 77 (44%) boys, who are studying at the primary school in the Central District of Afyonkarahisar during the 2019-2020 academic year. In

scale development studies, Kline (1994) suggested that a group of 100 people would be sufficient for the study (Pearson and Mundform, 2010). Therefore, the size of the sample has been decided as sufficient.

## Scale development process

### *Creating an item pool for the draft scale*

Before creating the item pool, the studies conducted in the relevant field have been reviewed. As a result of this process, the keywords of digital literacy have been determined. At this stage, knowledge, skills, communication and collaboration have been determined as key concepts for digital literacy self-efficacy. After this stage, a teacher who is teaching coding for primary school students in a state school and has a Master's degree in Curriculum and Instruction and is currently continuing his doctorate education in the same field and twelve randomly selected classroom teachers working in Afyonkarahisar were asked the following question:

1) *One of the skills that are aimed to be acquired by students in the Social Studies curriculum is digital literacy. What kind of behavior/behaviors is a 4th grade student with digital literacy skills expected to exhibit? Please explain with examples.*

In addition, the following questions have been asked of 28 students who were educated with the same curricula a year ago and studied in the 5th grade in the 2019-2020 academic year:

- 1) *What does digital literacy mean to you? Please explain in detail.*
- 2) *How should an individual with digital literacy skills behave? Please explain with examples.*

A draft scale form consisting of 35 items was created based on the answers to the questions asked to the teachers and students and the key concepts determined as a result of the review of the studies conducted in the relevant field. The draft scale form was presented to two faculty members working in the Department of Computer and Instructional Technologies, who have studies on digital literacy, to check the content validity. Upon expert opinion, the five items in the draft scale were removed as they can be measured with other items. The draft scale with the remaining 30 items was sent to the twelve classroom teachers whose opinions were taken for the creation of the item pool, and to the teacher conducting the coding lessons to check the suitability of the items to the grade level. At this stage, feedback was obtained from five of the twelve class teachers and the coding teacher. In line with the feedback, the most used search engines' names are given as examples in parentheses

after the search engine expressions in each item as the teachers said the items 'Search Engine' would not be understood by students.

After these corrections, the draft scale prepared in five-point Likert type was applied as a preliminary to forty-two fourth-grade students selected by the simple random method in the fall semester of the 2019-2020 academic year to check the response of the participants to the items. The expression 'Is there an expression that you have difficulty with, do not understand or seem unfamiliar to you while answering the items in the scale? Please specify your answer' has been added to the end of each item. During this phase, all of the students stated that they had no difficulty in answering the scale items. After the corrections made as a result of all the feedback, the draft scale containing thirty items was applied to 175 4th grade students in the fall semester of the 2019-2020 academic year in state schools in Afyonkarahisar province, Turkey.

## FINDINGS

### Exploratory factor analysis

In the exploratory factor analysis, the suitability of the data for factor analysis is examined with the Kaiser Mayer Olkin (KMO) coefficient and the Bartlett Sphericity Test (Büyükoztürk, 2014). As a result of the tests conducted to find out whether data are suitable for the exploratory factor analysis, it has been concluded that the data have the necessary features to conduct the analysis (KMO = .894; Bartlett Sphericity Test = .000).

Maximum likelihood has been employed as the factorization technique as it is an iterative process that determines the direction and magnitude of the change in coefficients starting with the random coefficient values for the predictor set and maximizing the probability of obtaining the observed frequencies (Tabachnik and Fidell, 2013). Factor loading is a coefficient explaining the relation between items and factors. While there is a consensus that the factor loading of the scale should be .30 and above, it is generally preferable to have a factor loading of .40 or above (Tekindal, 2015). In this study, the minimum value has been accepted as .40. There are two available techniques in deciding the factors in an exploratory factor analysis as eigenvalue (Büyükoztürk, 2014) and scree plot (Çokluk et al., 2014). In this study, the first was used to determine the factors.

As a result of the exploratory factor analysis, 9 items were excluded and a scale consisting of 21 items and 4 sub-dimensions named "Cooperation in Digital Environments, Emotion Management in Digital Environments, Information Management in Digital Environments and Awareness in Digital Environments" were created.

As seen in Table 1, four factors explain 51.281% of the

**Table 1.** The explained total variance of the digital literacy scale.

	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Variance %	Cumulative%	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
Cooperation in digital environments	7.809	37.186	37.186	7.809	37.186	37.186	3.404	16.209	16.209
Emotion management in digital environments	1.919	9.137	46.323	1.919	9.137	46.323	2.517	11.986	28.195
Information management in digital environments	1.678	7.989	54.312	1.678	7.989	54.312	2.436	11.602	39.797
Awareness in digital environments	1.238	5.897	60.209	1.238	5.897	60.209	2.412	11.485	51.281

total variance. The values are accepted as an indicator of the applicability of factor analysis.

As seen in Table 2, it has been found out that seven items are under the 1<sup>st</sup> factor, five items are under the 2<sup>nd</sup> factor, five items under 3<sup>rd</sup> factor and four items are under the 4<sup>th</sup> factor. The factor loadings of the items are between .448 and .750. The factors and their features are given below:

**1<sup>st</sup> Factor: Collaboration in the digital environment:** The first factor of the scale includes seven items. The items in the first factor of the digital literacy self-efficacy scale are about sharing and communicating with other individuals in a digital environment. Based on this feature of the items collected under this factor, it has been named Collaboration in Digital Environment. The maximum score is 35 and the minimum is 7.

**2<sup>nd</sup> Factor: Emotion management in digital environment:** The second factor of the scale consists of five items. Most of the items under this factor are about individuals' behavior and emotions in digital environments. Based on this feature of the items collected under this factor, it has been named Emotion Management in Digital Environment. The maximum score is 25 and the minimum is 5.

**3<sup>rd</sup> Factor: Information management in digital environment:** The third factor of the scale

consists of five items. All of the items under this factor are related to accessing and using the information in a digital environment. Based on this feature of the items collected under this factor, it has been named Information Management in Digital Environment. The maximum score is 25 and the minimum is 5.

**4<sup>th</sup> Factor: Awareness in digital environment:** The fourth factor of the scale consists of four items. All of the items under this factor are about the awareness of the digital environment. Based on this feature of the items under this factor, it has been named Awareness in Digital Environment. The maximum score is 20 and the minimum is 4.

**Assessing the total score of the scale:** The highest score that can be achieved from the digital literacy self-efficacy scale is 105 and the lowest score is 21. A high score from the scale indicates that digital literacy self-efficacy is high, while a low score from the scale is interpreted as low digital literacy self-efficacy.

The correlation analyses of the items in the scale are given in Table 3.

It has been concluded that all the items in the final scale have a significant correlation with the total score at the level of .01 as a result of the correlation analysis. A result of the independent t-test for the high group (27%) and low group (27%)

**Table 2.** Rotated component matrix of digital literacy scale.

Items	Components			
	1	2	3	4
Item 7	.750			
Item 5	.748			
Item 4	.681			
Item 6	.676			
Item 25	.573			
Item 26	.532			
Item 21	.507			
Item 28		.770		
Item 24		.716		
Item 23		.683		
Item 29		.454		
Item 31		.448		
Item 2			.673	
Item 1			.635	
Item 18			.620	
Item 19			.571	
Item 20			.520	
Item 10				.696
Item 17				.687
Item 11				.635
Item 22				.505

to determine the item discrimination index has revealed that each item has a statistically



**Table 3.** The correlation analyses of the items in the scale.

Items	Item total correlation	Item remaining correlation	t	p
Item 1	.693	.641	14.067	.000
Item 2	.693	.640	14.047	.000
Item 3	.598	.531	10.262	.000
Item 4	.671	.619	12.281	.000
Item 5	.564	.505	7.953	.000
Item 6	.642	.587	10.971	.000
Item 7	.698	.647	11.972	.000
Item 8	.621	.571	7.419	.000
Item 9	.628	.584	7.561	.000
Item 10	.580	.537	6.568	.000
Item 11	.386	.313	4.479	.000
Item 12	.572	.524	8.195	.000
Item 13	.555	.510	7.382	.000
Item 14	.611	.566	8.159	.000
Item 15	.647	.601	8.83	.000
Item 16	.586	.532	8.252	.000
Item 17	.583	.536	7.759	.000
Item 18	.551	.495	7.186	.000
Item 19	.593	.536	8.308	.000
Item 20	.652	.602	9.88	.000
Item 21	.587	.532	8.073	.000

meaningful discrimination index.

### Confirmatory factor analysis (CFA)

The purpose of this analysis is to verify the correlation between observed variables and latent variables and the intercorrelation among latent variables (Çokluk et al., 2014). A model has been structured by terming the digital literacy self-efficacy scale. It has been determined that the first factor of the scale measures collaboration, the second one measures emotion management, the third one measures information management, and the fourth one measures awareness and this model has been tested by CFA. The items under the first factor of the scale have been shown as a1-a2...-a7; the items under the second factor have been shown as a8-a9...-a12; the items under the information management have been shown as a13-a14...-a17 and the ones under the fourth factor have been shown as a18-a19...-a21. The reliability coefficients for the factors of this model have been calculated. The path diagram belonging to the 'Digital Literacy Self-Efficacy Scale' has been given in Figure 1.

As given in Figure 1, t values of the latent variables for explaining the observed variables are given on the arrows. It is stated that t value is accepted as significant at the level of .05 if it is over 1.96 and significant at the level of .01 if it is over 2.59 (Çokluk et al., 2014). It has been concluded that all the parameter estimations of the scale are significant at the level of .01.

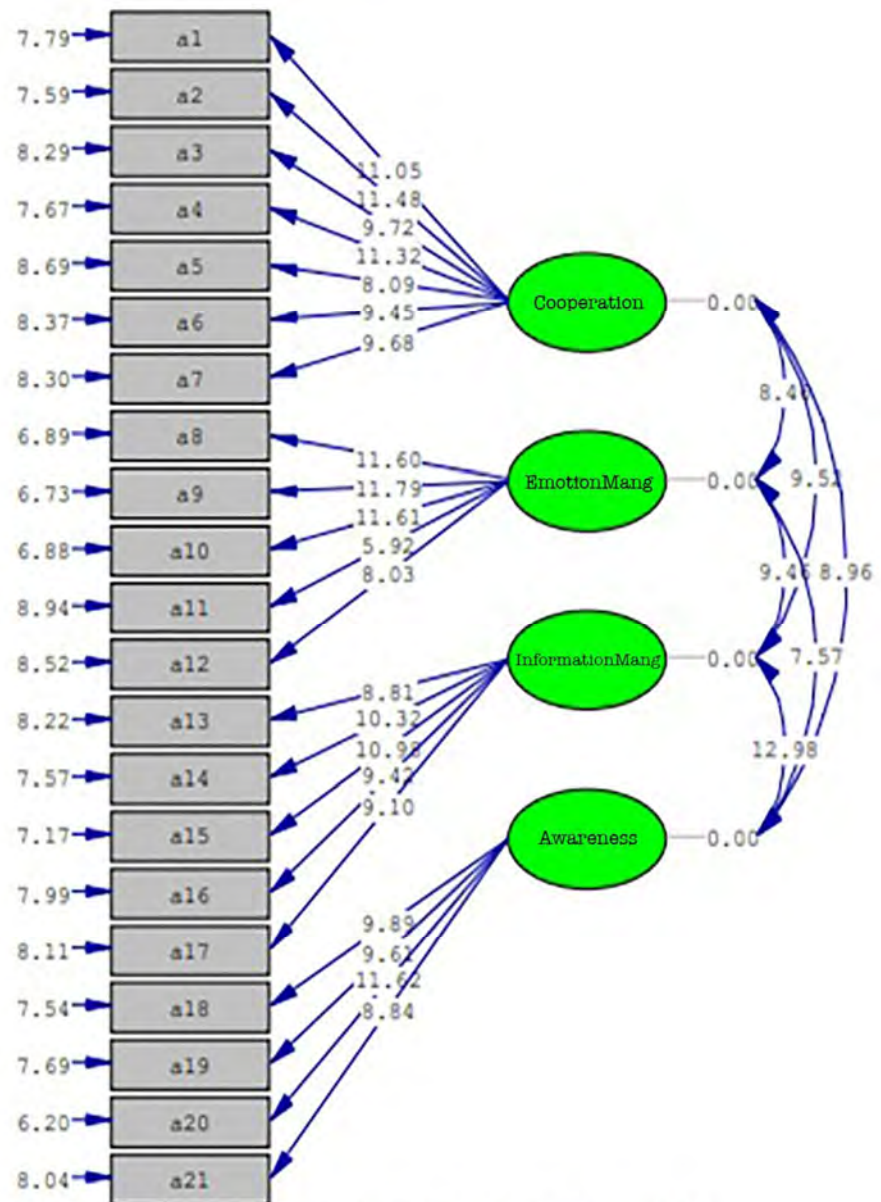
As seen in Figure 2, the items with the highest error

variance are a11, a12 and a15. As the t-values of all the items are at a highly significant level, it has been decided that all the items can be included in the model. The second order confirmatory analysis of the scale is given in Figure 3.

As shown in Table 4,  $\chi^2/df$  value is accepted to show good fitness when it is as low as 2.0 by Tabachnik and Fidell (2013), RMSEA value is accepted as .08 by Browne and Sugawara (1996), GFI value is accepted as .95 by Miles and Shevlin (2007) and GFI value is accepted as showing a good fitness when it equals to .95 by Miles and Shevlin (2007), however, it is ignored by Sharma et al. (2005) as it is affected by the population size. Hooper et al. (2008) accepted that CFI shows good fitness when it gets closer to 1; and NNFI can be accepted as low as .80. When the goodness of fit values of the Digital Literacy Self-Efficacy Scale structural model are examined, the values of the model are generally within the acceptable goodness of fit values ( $\chi^2/df = 1.24$ ; RMSEA = .03; CFI = .96; RMR = .05, GFI = .89; AGFI = .86 and NNFI = .95).

### Reliability analysis of the scale

Cronbach's alpha value of the scale has been found as  $\alpha = .944$  ( $\alpha = .873$  for the 1st factor, 2nd factor  $\alpha = .796$  for the 2nd factor, 3rd factor  $\alpha = .822$  and 4th factor  $\alpha = .799$ ). If the reliability coefficient of a scale is .90, it can be said that 90% of the total variance in this scale scores is real (Tekindal, 2015).



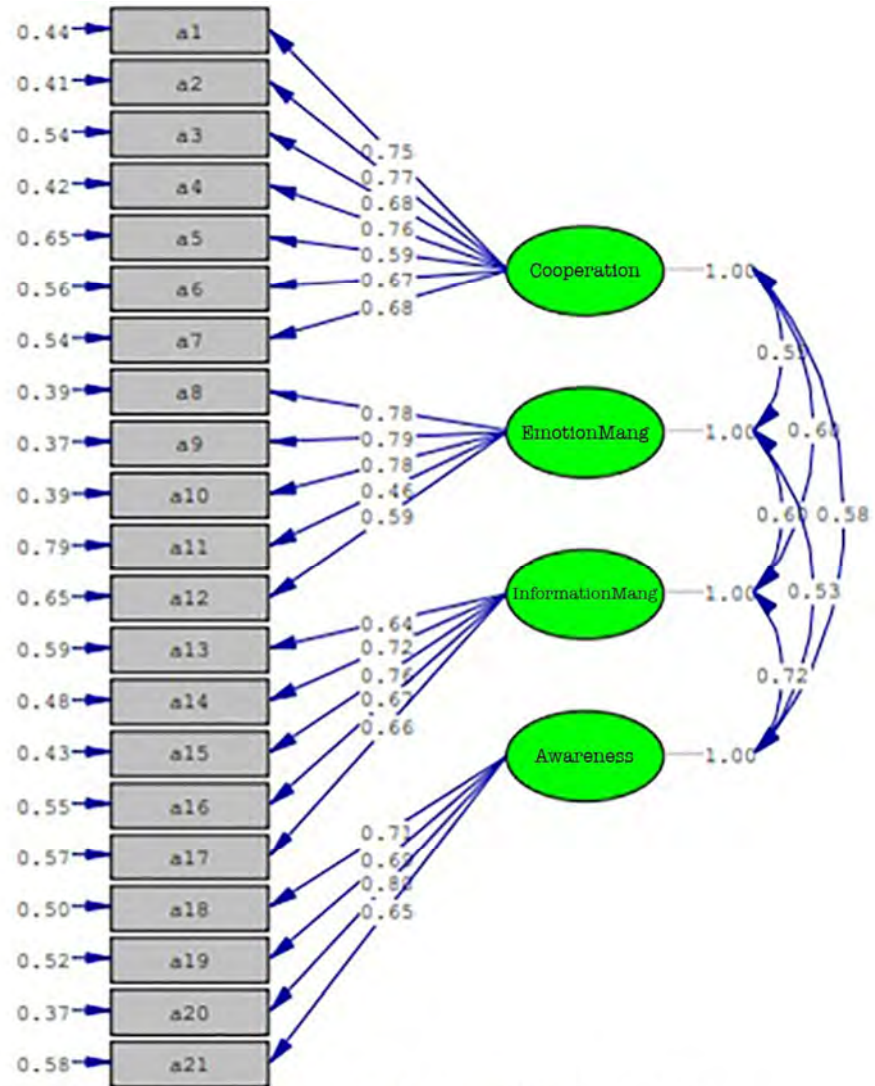
Chi-Square=228.55, df=183, P-value=0.01247, RMSEA=0.038

**Figure 1.** Significance levels of the explanation rate of the latent variables on the observed variables for the four-factors model of the digital literacy self-efficacy scale.

## CONCLUSION

In this study, a five-point Likert type scale named as 'Digital Literacy Self-Efficacy Scale (DLS)' was developed to determine the digital literacy self-efficacy levels of primary school students. The scale developed by conducting AFA and CFA consists of four factors and 21 items. The reliability coefficient of the scale has been calculated as .944. The highest score that can be achieved from the scale is 105 and the lowest score is 21. A high score from the scale indicates a high level of Digital Literacy Self-efficacy, while a low score indicates a

low level of Digital Literacy Self-efficacy. The factors of the scale have been named as 'Collaboration in Digital Environment', 'Emotion Management in Digital Environment', 'Information Management in Digital Environment', and 'Awareness in Digital Environment', respectively. As a result of the item total correlation, item remaining correlation, and item discrimination analysis, it has been concluded that the discrimination indices of each item included in the scale are statistically significant. First-level and second-level confirmatory factor analyzes have been conducted to determine whether the structure formed as a result of the exploratory factor analysis has



Chi-Square=228.55, df=183, P-value=0.01247, RMSEA=0.038

Figure 2. The error variance of the path diagram of the digital literacy scale.

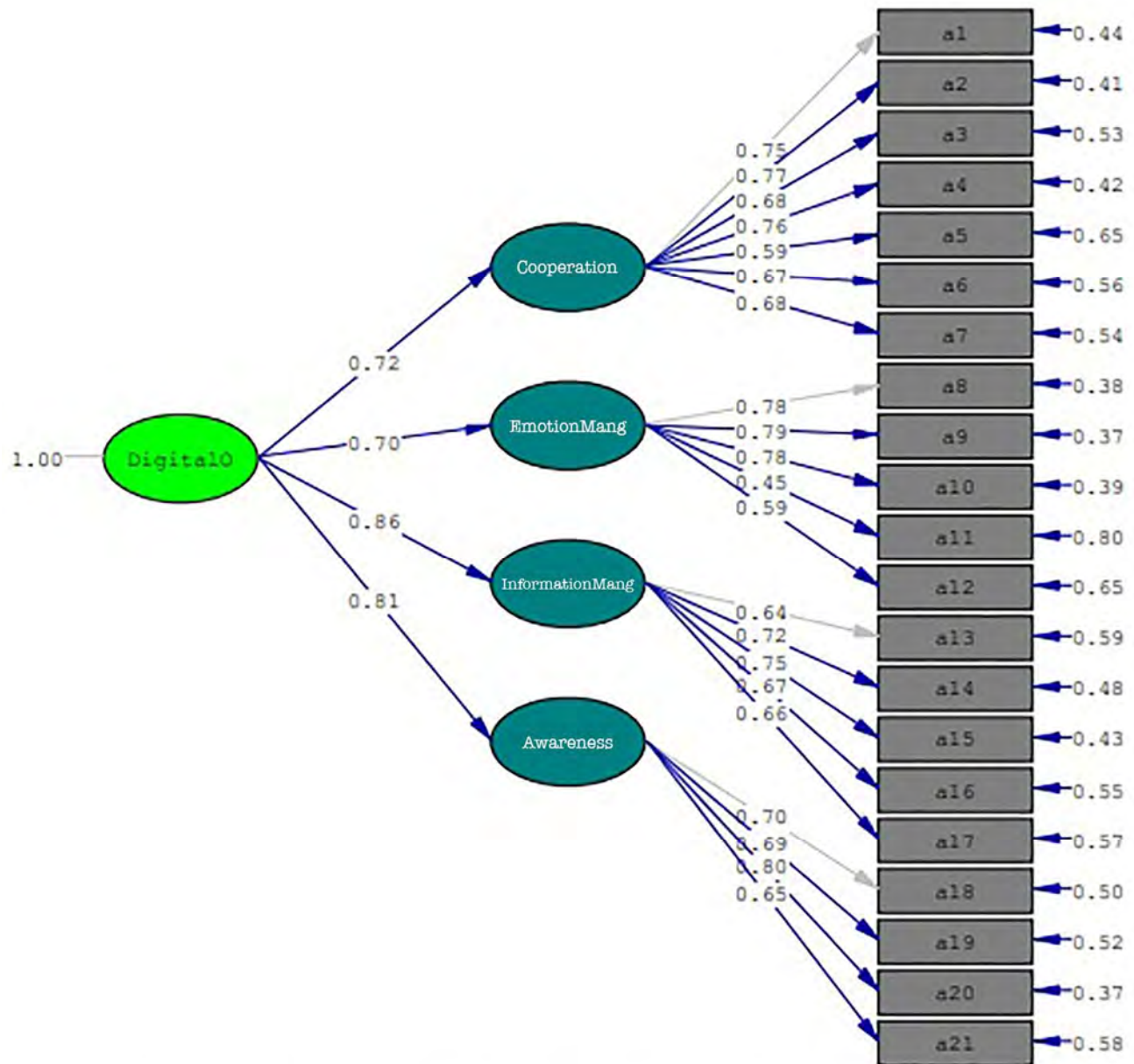
Table 4. The goodness of fit indices of digital literacy self-efficacy scale.

Fit indices	Proposed value for the model	Criteria	Acceptable values
$\chi^2/df$	1.24	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$
RMSEA	.03	$0 \leq RMSEA \leq .05$	$.05 < RMSEA \leq .08$
Comparative Fit Index (CFI)	.96	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI < .95$
Standardized RMR	.05	$0 \leq SRMR \leq .05$	$.05 < SRMR \leq .10$
Goodness of Fit Index (GFI)	.89	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI < .95$
Adjusted Goodness of Fit Index (AGFI)	.86	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI < .90$
NNFI	.95	$.95 \leq NNFI \leq 1.00$	$.90 \leq NNFI < .95$

been verified. As a result of the first-level confirmatory factor analysis, it has been concluded that the t-values of the items are significant at the .01 level. As a result of the analysis made for the error variances of the items, it has

been concluded that Item11, Item12 and Item15 have the highest error variance. It has been decided that these three items should be included in the scale because both the t-values are significant at the level of .01 and the





Chi-Square=228.55, df=183, P-value=0.01247, RMSEA=0.038

**Figure 3.** Second level confirmatory factor analysis for digital literacy self-efficacy scale.

factors they are located in are suitable for the self-efficacy scope they want to measure. As a result of the confirmatory factor analysis, good fit indices of the scale have been found as:  $\chi^2/df = 1.24$ ; RMSEA = .03; CFI .96; RMR = .05, GFI = .89, NNFI = .95 and AGFI = .86. Good fit indices of the scale indicate a high fit.

The ability to communicate and collaborate effectively with individuals is one of the outstanding features of digital literacy (Eshet, 2004; Monereo, 2005 cited in Rodríguez de Dios, 2018). Based on this fact, it is seen that all of the items in the sub-dimension "Collaboration in Digital Environments", which is the first sub-dimension of

the scale, consists of items for the ability to establish communication and collaboration between individuals in digital environments. It is seen that the items in the "Emotion Management in Digital Environments", which is the second sub-dimension of the scale, are related to the individuals' ability to control their emotions in digital environments. It has been concluded that the items in this sub-dimension are all related to emotional skills under the digital literacy competence specified by Area and Pessoa (2012). Digital Literacy is defined as the ability to access information existing in the digital environment and to analyze and synthesize this information individually



(Bawden, 2001; Martin, 2006). As a result of this study, it is seen that the items in "Information Management in Digital Environments", which is the third sub-dimension of the scale, cover this aspect of digital literacy skills. All of the items in this sub-dimension of the scale are about accessing and using the information in digital environments. Digital literacy is also defined as being aware of the needs and skills of individuals (Jones and Hafner, 2012) and understanding the information contained in a digital environment (Turculet and Tulbure, 2015). The items in the "Awareness in Digital Environment", which is the fourth sub-dimension of the scale, are related to the individual's ability to be aware of true and deceptive information in digital environments.

As a result of this study, it has been concluded that the "Digital Literacy Self-Efficacy Scale" is a valid and reliable measurement tool. This scale can be used to measure the digital literacy self-efficacy of students. Determining the digital literacy levels of the students will reveal to what extent the digital competencies foreseen to be developed in the curriculum have been gained and will allow the necessary improvements to be made.

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