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Developing the Digital Literacy Barriers (DILBAR) Scale: A Validity and Reliability Study

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Abstract

This research aims to develop a digital literacy barriers (DILBAR) scale. The survey method was used to collect the data required to develop the scale. A total of 278 participants, including 177 students and 101 faculty members from Akdeniz University, Bartın University and Bayburt University in Turkey, were included in the study. According to the factor analysis results KMO value of DILBAR scale is 0.905 and the value of Barlett's test is 1023.211 (Df= 55, p=0.000). The DILBAR scale can be used in single and multidimensional forms. The scale explains 60.113% of the total variance. In the analysis results for DILBAR scale, it is seen that the factor loads vary between 0.453-0.819 and the item-total correlations vary between 0.523-0.752. The correlation coefficient between the two halves of the scale was 0.769. The Cronbach's Alpha Coefficient of DILBAR scale is 0.859. The scale consists of 11 items. Confirmatory factor analysis of the DILBAR scale was performed with the AMOS program (Chi-square = 59.882, Df = 40, GFI = 0.965, CFI = 0.980, RMSEA = 0.042). CFA results and reliability analysis showed that the scale is valid and reliable. DILBAR scale can be applied to university students and faculty members.

Keywords: Digital literacy barriers, validity, reliability, scale development.

Dijital Okuryazarlık Engelleri Ölçeğinin Geliştirilmesi: Geçerlik ve Güvenirlik Çalışması

Öz

Araştırmanın amacı, Dijital Okuryazarlık Engelleri (DILBAR) ölçeğinin geliştirilmesidir. Araştırmanın yöntemi tarama modeli şeklindedir. Uygulamada Türkiye'de Akdeniz Üniversitesi, Bartın Üniversitesi ve Bayburt Üniversitesi'nde bulunan 177 öğrenci ve 101 öğretim üyesi olmak üzere toplam 278 katılımcıyla çalışılmıştır. Faktör analizi sonuçlarına göre, DILBAR ölçeğinin KMO değeri 0.905, Bartlett testi değeri 1023.211'dir (Sd= 55, p=0.000). DILBAR ölçeği tek ve çok boyutlu olarak kullanılabilir. Ölçek, varyansın % 60.113'ünü karşılamaktadır. DILBAR ölçeği için yapılan analiz sonuçlarında, faktör yüklerinin 0.453-0.819 arasında ve madde toplam korelasyonlarının 0.523-0.752 arasında değiştiği görülmektedir. Ölçeğin iki yarı puanları arasındaki korelasyon katsayısı 0.769 bulunmuştur. DILBAR ölçeğinin Cronbach Alpha katsayısı 0.859'dur. Ölçek, 11 maddeden oluşmuştur. DILBAR ölçeğinin AMOS programı ile doğrulayıcı faktör analizi yapılmıştır (Kay kare=59.882, Sd=40, GFI=0.965, CFI=0.980, RMSEA=0.042). DFA sonuçları ve güvenirlik analizleri ölçeğin geçerli ve güvenilir olduğunu göstermiştir. DILBAR ölçeği üniversite öğrencilerine ve öğretim üyelerine uygulanabilir.

Anahtar kelimeler: Dijital okuryazarlık engelleri, geçerlik, güvenirlik, ölçek geliştirme.

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1 | Introduction

Today, stunning developments are experienced in science and technology and adaptation to these developments is difficult. The only way to adapt to the 21st century is to acquire the skills required by this century. According to Partnership for 21st Century Skills (2009), it is stated that one of the 21st century skills is digital literacy. True and false information spreads very quickly with the support of technology. Çubukçu and Bayzan (2013) state that the biggest factor in the formation of internet risks is the sharing of inaccurate and misleading information. In this case, digital literacy skills of individuals come to the fore (Ainley, Schulz, & Fraillon, 2016; Mohammadyari & Singh, 2015).

Digital literacy can be defined as "the ability to understand and use information in multiple formats" with an emphasis on critical thinking (Gilster, 1997). The indicator of an individual being digitally literate is adaptation to new or emerging technologies (Ng, 2012). On the other hand, according to Eshhet-Alkali and Amichai-Hamburger (2004), digital literacy includes technological, social and cognitive skills in the digital environment. Digital literacy is having the necessary skills to select, evaluate and reuse the information we encounter on the internet (Van Dijk, 2005).

In this context, there are many scale studies developed or adapted regarding digital literacy in the literature (Hamutoğlu et al., 2017; Hargittai, 2005; Ng, 2012; Ocak & Karakuş, 2018; Rodríguez-de-Dios, Igartua & González -Vázquez, 2016; Sulak, 2019; Toker, Akgün, Cömert & Edip, 2021; Üstündağ, Güneş & Bahçıvan, 2017). The sub-factors of these scales focused on issues related to attitude, technique, technology, information and communication, cognitive, social, digital resource use and digital material production.

It is a fact that a considerable number of people are not digitally literate. There are some factors that prevent people from being digitally literate. These factors are called digital literacy barriers. Regarding digital literacy barriers, Hew and Brush (2007) listed lack of resources and information, lack of vision in the institution, and the negative attitudes and beliefs of teachers as main barriers. In addition, Miranda and Russell (2011) emphasized access to technology resources and technical support as major problems. Ertmer (1999) categorized digital literacy barriers as first degree or second-degree barriers. First-degree barriers are related to technology integration in an enterprise sense. Second-degree barriers are personal barriers and include beliefs and attitudes about technology.

When the related literature is reviewed, it is observed that some studies were carried out on barriers to digital literacy. In Hosseini's (2018) study titled "Digital Literature in Early Elementary School: Barriers and Support Systems in the Era of the Common Core", teachers identified the high student to teacher ratio, lack of time to plan and teach technology lessons, and students' limited self-management and independence skills as major impediments to digital literacy instruction in the early elementary grades. In the study titled "Barriers to Digital Literacy: Learning to Program" conducted by Cartile (2020), the digital literacy barriers of engineering students were investigated. This thesis discusses digital literacy barriers to acquiring the digital literacy needed to learn end-user programming, or programming as a tool to support activities in a non-computer science domain.

Digital literacy barriers were examined in five categories: They can be classified as attitude, educational-cognitive, technical, social-economic and physical (Eshhet-Alkali & Amichai-Hamburger, 2004; Hargittai, 2005; Ng, 2012; Rodríguez-de-Dios, Igartua & González -Vázquez, 2016). The keywords such as adoption, reluctance, prejudice, burnout, dislike of technology, lack of vision, staying away from new technologies, weak belief in technology, fear of technology and lack of curiosity about technology can be listed under the category of attitude. The keywords such as dictatorial education, traditional education, teacher-centred education, learning disability, inability to receive education or inaccessibility, and ignorance about technology can be placed under the education-cognitive category. Inadequacy of technological infrastructure, lack of technical knowledge, inability to access the internet, lack of technical skills, inability to cooperate over the internet, inability to use technology, the absence of people using technology in the environment, the use of too many foreign words, adherence to the philosophy of perennialism and essentialism, inability to find time

to learn technology and inability to integrate digital technology into education can be grouped under the technical category. Under the category of social-economic, the keywords such as low budget, economic difficulties, poor social life, expensive technology and technology poverty can be included. The keywords such as physical defects, old age, parental inhibition and digital bullying can be included under the physical category.

One way of acquiring and gaining digital literacy skills is to identify digital literacy barriers and remove these barriers through teaching programs. Unless these barriers are identified, teaching digital literacy skills would take more time and a positive result cannot be guaranteed. In order to prepare the curriculum, first of all, it is necessary to develop a measurement tool to measure the digital literacy barriers. That's why this study was carried out.

Purpose of the Research

Based on this situation, the purpose of the research is to develop the digital literacy barriers (DILBAR) scale. Validity and reliability studies were conducted to develop the scale in the study.

2 | Method

Survey method was used in this research. With survey method, events and objects are described (Büyüköztürk vd., 2009, 16-17; Kaptan, 1998, 59; Karasar, 1995, 77; Sönmez ve Alacapınar, 2011, 46). The digital literacy barriers (DILBAR) scale was developed in this study.

Data Collection Process

The study group was selected from the universities in the top, middle and lower levels in the general satisfaction ranking of university students in Turkey and in the ranking of "satisfaction with the richness of learning opportunities and resources" of universities (Karadağ & Yücel, 2020). The draft scale was applied to students and faculty members at Akdeniz University (Upper group), Bartın University (Middle group) and Bayburt University (Lower group) in Turkey in 2021. Table 1 shows the distribution of students and faculty members by universities.

Table 1. Distribution of Study Group by Universities

Universities	Students	Teaching Staff
Akdeniz University	58	31
Bartin University	70	43
Bayburt University	49	27
Total	177	101

The draft scale was applied in Akdeniz University (58 students, 31 faculty members), Bartın University (70 students, 43 faculty members) and Bayburt University (49 students, 27 faculty members). The distribution of the study group by faculties is given in Table 2.

Table 2. Distribution of Study Group by Faculties

Faculty	Students	Teaching Staff
Letters	38	18
Education	51	27
Science	22	11
Islamic Science	15	8
Engineering	24	15
Sports Science	16	13
Medicine	21	9

Total	177	101

The draft scale was applied in the Faculty of Letters (38 students, 18 faculty members), Faculty of Education (51 students, 27 faculty members), Faculty of Science (22 students, 11 faculty members), Faculty of Islamic Studies (15 students, 8 faculty members), Faculty of Engineering (24 students, 15 faculty members), Faculty of Sports Sciences (16 students, 13 faculty members) and Faculty of Medicine (38 students, 18 faculty members).

Data Analysis and the Stages of Development of the Digital Literacy Barriers (DILBAR) Scale

A statistical package program was used for data analysis in the study. Data analysis was given during the development of the scale. The stages of development of the digital literacy barriers (DILBAR) scale are given below:

1. Literature review and formation of the item pool,
2. Getting expert views,
3. Factor analysis and identification of the themes (sub-dimensions) of the multidimensional scale,
4. Finding item-total correlations,
5. Finding correlations between factors,
6. Finding the correlation between two equivalent semi-scores,
7. Finding the internal consistency coefficient (Cronbach alpha),
8. Confirmatory factor analysis with AMOS.

3 | Findings

Developing a Digital Literacy Barriers (DILBAR) Scale

As a result of the examination of the related literature and the scales related to digital literacy, an item pool was formed. Then, the draft scale was formed consisting of 29 items, all of which were included in the item pool. The grading of the scale is as follows: "Totally agree (5), Mostly agree (4), Partially agree (3), Slightly agree (2), Totally disagree (1)".

The DILBAR scale was given to five (5) faculty members (2 Professors and 3 Assistant Professors) working in the field of Educational Sciences at a state university in order to get expert opinion. In addition, opinions of 5 graduate students were taken. In line with the opinions of experts and students, a consensus was reached on 15 out of 29 items. Corrections on expressions were made in some of the items, and it was concluded that the scale could measure the digital literacy barriers of students and faculty members. The draft scale consists of 15 items. These items which were identified in line with expert opinions, were applied to a total of 278 participants, 177 students and 101 faculty members in Akdeniz University, Bartın University and Bayburt University in Turkey.

Factor analysis was performed with the collected data. Factor analysis is a multivariate statistics that aims to find and discover fewer unrelated and conceptually meaningful new dimensions by bringing together p interrelated variables (Büyüköztürk, 2002, 117). Firstly, the Kaiser-Meyer-Olkin (KMO) value, which demonstrates the suitability of factor analysis, was calculated. In addition, the Bartlett's Test was conducted to test the hypothesis that "the correlation matrix is equal to the unit matrix" (UYTES, 1995, 4). In this sense, it can be seen that the distribution in the population is normal. Items with factor loads below 0.45 were not

included in the DILBAR scale. The factor loads of the scale are given in Table 3. The DILBAR scale has three factors: attitude, technique and cognitive.

According to the results of the factor analysis, the KMO value of the DILBAR scale was 0.905 and the Bartlett's test value was 1023.211 (Df=55, p=0.000). The DILBAR scale can be used in single and multidimensional forms. The scale accounts for 60.113% of the total variance. In the analysis results for the DILBAR scale, it is seen that factor loads vary between 0.453-0.819 and item-total correlations vary between 0.523-0.752.

Correlations between the factors were analyzed according to the answers given by the participants (N=278). There is a high correlation of 0.719 between "technical" and "cognitive". A moderate correlation was found between "attitude" and "cognitive" (r=0.516) and between "attitude" and "technique" (r=0.534). The correlations are positive and significant at 99% confidence interval.

On the other hand, two equivalent half-score correlations were calculated in the scale. The scale was applied once to a group of 278 students and faculty members, and it was divided into two halves with the approach of "odd and even numbered" items. The correlation between the scores of the students from both halves was found 0.769. In addition, the internal consistency coefficient of the scale was calculated. The Cronbach Alpha coefficient of the scale was 0.859. As a result, the scale consisted of a total of 11 items, all of which were positive according to the purpose. There are no items that need to be reverse scored (Appendix-1).

Table 2. Factor Loadings of the Scale and Item-Total Correlations

Draft Scale Item Number	Scale Item Number	Items	Factor loadings	Item-total correlation
Attitude Factor				
1	1	I have negative bias towards new technologies.	0.786	0.536**
2	2	I have no interest in digital technologies	0.761	0.583**
20	3	Instructors' pedagogical attitudes about technology are negative.	0.453	0.556**
Technical Factor				
10	4	I have difficulty in integrating digital technologies into learning environments.	0.729	0.678**
16	5	I have difficulty in systematically integrating technology into lessons	0.752	0.742**
26	6	I do not have the technical skills required to develop digital teaching materials (videos, digital materials, presentations, blogs, wikis, etc.).	0.472	0.743**
28	7	I can not communicate over the Internet (Social network applications, forums, blogs, etc)	0.682	0.581**
Cognitive Factor				
15	8	My technical knowledge about technology is insufficient.	0.550	0.740**
24	9	I cannot learn new technologies easily.	0.490	0.752**
25	10	I am unaware of many of the new technologies.	0.516	0.702**
29	11	I can not use cloud computing technologies.	0.819	0.523**
Removed Items				
3	-	I am reluctant to use technologies.	-	-
4	-	I did not receive training on new technologies.	-	-
5	-	My managers do not guide me on technology.	-	-
6	-	The technological infrastructure of the classrooms is insufficient.	-	-
7	-	Instructors do not embrace technology.	-	-
8	-	I have difficulty in using technology.	-	-
9	-	In-service training activities for technology by our institution are insufficient.	-	-
11	-	I am afraid of digital bullying.	-	-
12	-	The institution does not have a vision for new technologies.	-	-
13	-	Instructors stay away from new technologies.	-	-
14	-	Instructors' beliefs about technology are weak.	-	-
17	-	Digital technology equipment is lacking in schools.	-	-

18	-	Vocational training for digital technology is insufficient.	-	-
19	-	Instructors' pedagogical beliefs about technology are weak.	-	-
21	-	The trainings I receive for digital technologies are not student-centered.	-	-
22	-	Those who adopt traditional approaches have a low tendency to use digital technologies.	-	-
23	-	I am afraid of new technologies.	-	-
27	-	I do not feel confident in collecting and evaluating information from the Internet.	-	-

Confirmatory factor analysis was performed with the AMOS program on the DILBAR scale (Figure 1). Confirmatory Factor Analysis is used in validity analysis in scale development (Bollen, 2007, 40-51; Sümer, 2000, 49-52). With this analysis, it is tested or verified how the factor analytic structure of the research data fits the hypothesized model (Bayram, 2010, 42). In the studies using structural equation models (SEM), the reliability and validity of parameter estimations for the population and the appropriateness of model evaluation criteria depend on the size of the sample size (Tezcan, 2008, 30). In this regard, it is considered sufficient to collect data from 278 people in the study.

Confirmatory factor analysis of the DILBAR scale was performed with the AMOS program. The results of the AMOS program are given in Figure 1. The chi-square value in the program output was found 59.882. Since chi-square ($\chi 2$) / degree of freedom is 59.882 / 40 < 2, it can be asserted that there is a very strong model fit. In addition, the fact that the goodness of fit index (GFI=0.965) of the model is close to 1 and the mean square root of the approximate errors (RMSEA=0.042) value is less than 0.05 supports this fit.

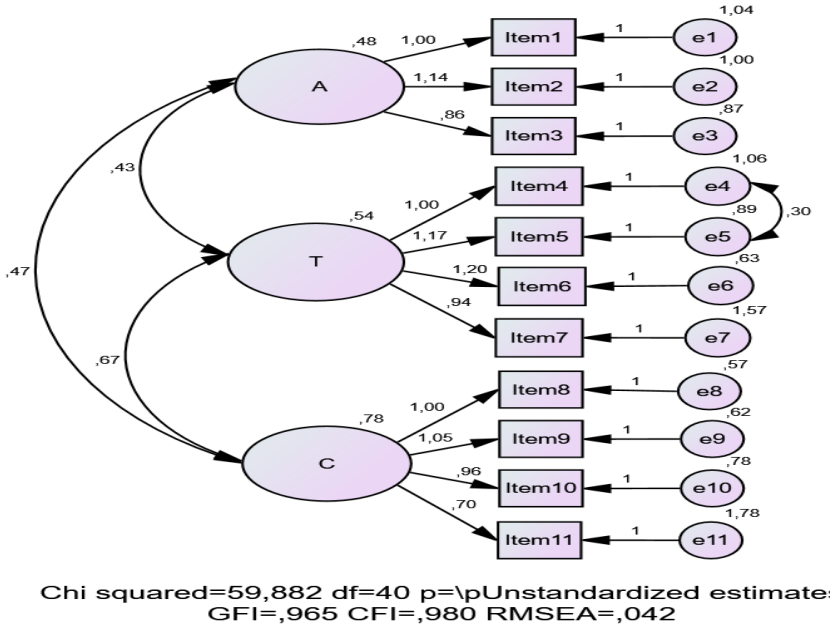

Figure 1. *The Results of Confirmatory Factor Analysis of DILBAR Scale (A:Attitude, T:Technical, C:Cognitive)*

Figure 1 shows the results of confirmatory factor analysis of the DILBAR scale. The observed variables between item 1 and item 11 and digital literacy barriers are latent variables. In the figure, e1 to e11 are the measurement error of each observed variable. In the modification measurement errors, it was concluded that there was a higher level of correlation between the item 4 and item 5 variables (e4-e5) than the model predicted, and their errors were highly correlated. In this case, the covariance was added to the model and the model was re-estimated. One-way arrows in the figure are the regression coefficients from the latent variable to the observed variables.

Table 4. Confirmatory Factor Analysis Results of the Scale

Model Fit Indexes	Goodness of Fit Standart Measures	The DILBAR Scale	Decision
χ2/sd	0 ≤ χ2/sd ≤ 2	1,497	Well Compatible
RMSEA	0 ≤ RMSEA ≤ 0.05	0,042	Well Compatible
SRMR	0 ≤ SRMR ≤ 0.05	0,037	Well Compatible
GFI	0.95 ≤ GFI ≤ 1.00	0,965	Well Compatible
AGFI	0.90 ≤ AGFI ≤ 1.00	0,942	Well Compatible
CFI	0.97 ≤ CFI ≤ 1.00	0,980	Well Compatible
NFI	0.95 ≤ NFI ≤ 1.00	0,942	Acceptable

(Bayram, 2010; Bryne, 2016; Schumacker, & Lomax, 2004; Schermelleh-Engel, Moosbrugger & Müller, 2003)

In the estimated model, χ2/sd (CMIN/DF) value was found to be 1.497. This result is suitable according to the standard measures of good fit (0≤χ2 /sd ≤2). The root mean square error of approximation (RMSEA) was found to be 0.042. RMSEA values of 0.05 or less indicate good fit. In this study, the RMSEA value of 0.042 indicates a perfect fit and there is no difference between population and sample covariance.

According to the SRMR, GFI and AGFI fit indices, evaluation can be made as follows: The fact that the value of the standardized root mean square residual (SRMR) value is close to zero indicates a perfect fit (Bayram, 2010, 72). In the research, this situation is seen as a perfect fit (SRMR=0.037). The goodness of fit index (GFI) is calculated by calculating the covariance between the observed variables. The GFI result of the study was found to be 0.965, and it was among the standard measures of good fit. Adjusted goodness of fit index (AGFI) was calculated considering the degrees of freedom. The AGFI was found 0.942 and the result is suitable.

NFI and CFI were calculated from the fit indices based on the independent model. The normed fit index (NFI: Normed fit index) is given by the relative position of the current model between the saturated model and the independent model (Schermelleh-Engel, Moosbrugger & Müller, 2003). As a result of the research, NFI was found 0.942. Compliance with standard measures (0.95≤NFI≤ 1.00) seems acceptable. Comparative fit index (CFI: Comparative fit index) is found 0.980, which indicates that the model is in strong fit.

4 | Discussion & conclusion

In the research, the digital literacy barriers (DILBAR) scale was developed. The scale was applied to 278 students and faculty members. In practice, when the DILBAR scale was developed, 29 items were reduced to 15 according to expert opinions. Experts eliminated 14 items due to the large number of items measuring the same behavior. These 15 items were processed in factor analysis. According to Tavşancıl (2002, 31), in order to increase the reliability of the scale, it is necessary to increase the number of items. However, while increasing the number of items in order to increase reliability, if more items measuring the same behavior are included in the scale, reliability will still be damaged. On the other hand, a large number of items may not be read by the student and lecturer. For this reason, a sufficient number of items were included in the DILBAR scale.

The measuring power of the scales is debatable. Scales are indirect measurements. Therefore, it is not possible to replace direct measurements with the scales. Therefore, care should be taken when interpreting measurements obtained with the DILBAR scale. For example, a measurement from the first item should be interpreted as follows. "I have a negative bias towards new technologies." Considering that a student gives a score of 1 out of 5 in the item, it should not be ignored that although this student has a prejudice against new technologies, s/he may want to reflect it in that way. For this reason, a description to be made should be checked from different angles.

The points supporting the usability of the scale are as follows: In the analysis results for the DILBAR scale, it is seen that factor loads vary between 0.453 and 0.819 and item-total correlations vary between 0.523 and

0.752. The Cronbach Alpha coefficient of the DILBAR scale is 0.859. On the other hand, the fit index values obtained as a result of the confirmatory factor analysis with the AMOS program show that the scale has a valid structure. The fact that the Chi-square value divided by the degree of freedom (χ2/df) of these values is less than 3 indicates that the factor structure is compatible (Kline, 1998; Segars and Grover, 1993).

Digital literacy barriers are related to digital divide. The digital divide is basically the difference between those who use information and communication technologies (ICT) and those who do not (Hargittai, 2003; OECD, 2001; Salinas, 2003). In other words, it refers to the differences between individuals or communities in owning and benefiting from information and communication technologies.

Societies do not have equal opportunities to use ICT due to reasons such as lack of equipment or infrastructure, lack of technical knowledge and skills (OECD, 2001). The technical factor of the DILBAR scale is partly linked to the digital divide. In the technical dimension of the scale, there are technical information deficiencies and items related to usage. For example, one of the items is as follows: "I do not have the technical skills required to develop digital teaching materials (videos, digital materials, presentations, blogs, wikis, etc.)".

As a result of the research, the following suggestions can be made: The DILBAR scale can be applied to university students and faculty members. In addition, digital literacy barriers scales can be developed for teachers, administrators, parents and primary and secondary school students.

Research Ethics

Bartin University Social and Human Sciences Ethics Committee issued an ethics committee approval certificate for the "Digital literacy barriers scale" with the decision no. 5 on 07 April 2021 (2021-SBB-0111).

Researchers' Contribution Rate

The first author collected data and contributed to article revisions. The second author contributed with data analysis and reported the results. All authors contributed to the literature review, read and approved the final article.

Conflict of Interest

The authors of this article declare that there is not conflict of interest.

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APPENDIX 1. DIJITAL OKURYAZARLIK ENGELLERI (DILBAR) ÖLÇEĞI (A SCALE DEVELOPED IN TURKISH)

1- Hiç katılmıyorum 2- Çok az katılıyorum 3- Kısmen katılıyorum
4- Çoğunlukla katılıyorum 5- Tamamen katılıyorum

	Rakam Değeri
1. Yeni teknolojilere karşı olumsuz bir önyargım var	[ ]
2. Dijital teknolojilere karşı merakım olmadı.	[ ]
3. Öğreticilerin teknoloji hakkındaki pedagojik tutumları olumsuzdur.	[ ]
4. Dijital teknolojileri öğrenme ortamlarına entegre etmekte zorlanıyorum.	[ ]
5. Teknolojiyi sistemli bir şekilde derslerle bütünleştirmede zorluk yaşıyorum.	[ ]
6. Dijital öğretim materyallerini (videolar, dijital materyaller, sunumlar, bloglar, wikiler vb.) geliştirmek için gereken teknik becerilere sahip değilim.	[ ]
7. İnternet üzerinden (Sosyal ağ uygulamaları, forumlar, bloglar vb.) yardımlaşamıyorum.	[ ]
8. Teknolojiyle ilgili teknik bilgim yetersizdir.	[ ]
9. Yeni teknolojileri kolay öğrenemiyorum.	[ ]
10. Yeni teknolojilerin birçoğundan habersizim.	[ ]
11. Bulut bilişim teknolojilerini kullanamıyorum.	[ ]

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