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DEVELOPMENT OF THE 21ST CENTURY TECHNOLOGY LITERACY SKILLS SCALE, VALIDITY AND RELIABILITY STUDY

Rüstem Kalaycı[1i],
Necmi Eşgi[2]
[1]Expert Teacher,
Tokat Cumhuriyet Vocational and Technical Anatolian High School,
Turkey
[2]Prof. Dr.,
Faculty of Education,
Department of Computer and Instructional Technologies Education,
Turkey

Abstract:
This study aimed to develop a valid and reliable scale to determine the opinions of high school students and teachers about 21st century technology literacy skills. During the scale development phase, an item pool of 36 items that provided content validity was created, after expert opinion, the number of items was reduced to 32 items in total, and the scale was applied to a total of 794 people for the first application of the scale development phase. The data obtained as a result of the first application were subjected to exploratory factor analysis (EFA) and reliability studies. As a result of the analysis, a three-factor scale ("Ability to Comprehend Technology", "Ability to Use Technology" and "Paying Attention") consisting of a total of 18 items, whose validity and reliability were ensured, was obtained. To test the suitability of the factor structure of the scale, confirmatory factor analysis (CFA) was performed by applying the scale to a total of 418 people. As a result of the analysis, the factor structure (fit index values) of the scale was found to be within the desired reference ranges. In line with the sub-objectives of the study, significant differences were observed according to the gender variable of students and teachers. No significant difference emerged according to the variables of teachers' seniority years. It was observed that there was a significant difference between students and teachers in favor of teachers in all dimensions. As a result of all analysis studies of the scale, a scale consisting of 14 items in total, whose validity and reliability have been sufficiently proven, has been developed and can be applied to high school students.

Keywords: 21st-century skill, technology literacy, scale development

[i] Correspondence: email kalaycirustem@gmail.com, necmiesgi@gmail.com

1. Introduction

Today, we can say that one of the most important environments where qualified individuals grow is the education environment. Determining students' individual differences and individual characteristics is one of the most important issues when designing an educational environment (Callison & Lamb, 2004). First of all, the teacher should know the student very well and plan teaching within the framework of his/her individual characteristics (Melvin, 2011). From this perspective, the teacher; Must be an instructor and trainer who has cultural, pedagogical, and professional field knowledge, can redesign the teaching environment according to individual differences, and has contemporary knowledge and methods.

In the 21st century, the most important expectation from teachers is to raise students as qualified individuals who can not only consume information and technology but also produce, differentiate, design, and control. It is important to ensure that they have skills appropriate for this age. These skills that enable students to become qualified individuals are often called "21st century skills". Various definitions have been made for these skills, such as “deep learning skills”, “essential skills”, “survival skills”, “employment skills”. Among the most frequently used ones are "creativity", "communication", "problem solving", "collaboration", "critical thinking", "decision making", "information literacy", "media literacy", "technology literacy", "productivity". There are skills such as "responsibility", "flexibility and adaptation", "leadership" and "entrepreneurship" (Ekici, Abide, Canbolat & Öztürk, 2017).

Considering the need for technology use today, it can be said that technological literacy is one of the most important types of literacy among the 21st century skills. Technology is a concept that includes not only machines but also their operation, learning processes, and all learning stages. We should not limit technology only to machines; because machines are a part of technology. Technology is part of a broader solution-oriented approach. Technology can be defined in different ways and can generally be understood as the process of combining and developing machines, tools, and materials to provide solutions to problems faced by individuals and societies (Kaya, 2006). With the rapid change and development in our age, the development of technology has also increased rapidly. So much so that this situation has triggered each other and enabled the rapid emergence of new technologies in technology. For this reason, the individual must constantly renew himself and update himself with the necessary knowledge and equipment in order to keep up with fast and new technology (Şenel & Gençoğlu, 2003). It can be said that individuals and societies who want to constantly keep themselves up to date on technology should be conscious of technological literacy. Because technology literacy is very important for individuals to understand each other personally and socially (Bacanak, Karamustafaoğlu & Köse, 2003).

The International Technology Education Association (ITEA, 1996) defines technology literacy as follows: technology includes three main capabilities; the ability to understand technology, the ability to use technology, and the ability to manage

technology. The ability to understand technology includes being aware of real and accurate information as well as blending information with new ideas. The ability to use technology is the effective use of current and new technological systems. The ability to manage technology means adapting all technological structures to the system in the most efficient way and determining the most appropriate one. Technology literacy includes four basic competencies:

1) To be able to adapt to technology that undergoes continuous and rapid development and to overcome this development,
2) Producing innovative and original solutions to technological problems encountered throughout life,
3) To put technological knowledge into practice by making it efficient and effective,
4) It is to intelligently analysis and evaluate all the relationships of technology with people's lives, individually and socially (Bölükbaşı, 2012).

In its studies, the International Technology Education Board (ITEA) gathered the characteristics that technologically literate individuals should have under five main headings (ITEA, 2000):

1) Understanding the structure of technology,
2) Technology and society,
3) Design process of technology,
4) Talent for technology,
5) The designed world of technology.

We can say that one of the most important competencies expected from teachers today is to raise students with 21st century technology literacy. It can be said that it will be very difficult for teachers who do not have 21st century technology literacy skills to raise students with these skills. Therefore, the main problem of this study is; The aim is to determine to what extent teachers have 21st Century technology literacy skills and to what extent there is a difference between these skill levels and the students they teach.

When the literature is examined, it is seen that there are a limited number of 21st century technology skill scales (Adıgüzel, 2011). It has been observed that the scales available in the literature are studied separately for teachers and students. For this reason, there is no identical technology literacy scale in the literature to be applied to both teachers and students at the high education level. In this research, a new type of scale will be introduced to the literature by developing a technology literacy scale with proven validity and reliability at the point of solving the main problem ("It can be said that it will be very difficult for teachers who do not have 21st century technology literacy skills to raise students with these skills").

2. Methods

2.1 Research Design

This research is a quantitative study conducted in the survey model, aiming to develop a scale that can be used to determine the opinions of high school students and teachers

about 21st century technology literacy skills. Survey type studies are studies that aim to describe the characteristics and opinions of large participating audiences by taking a picture of the current situation. Information is collected from the masses using the answer options prepared or determined by the researcher for these studies that he aims to describe. (Fraenkel & Wallen, 2006; Wellington, 2006). This information collected from the participants is used to understand how the participants' "media", "talent", "skills", "interest or attitudes" regarding an event or issue are distributed (Büyüköztürk, Çakmak, Kılıç, Akgün, Karadeniz & Demirel 2008).

2.2 Research Group

The study group of the research consists of students (9th, 10th, 11th, and 12th grades) studying at Tokat Cumhuriyet Vocational and Technical Anatolian High School, Tokat Gaziosmanpaşa High School, and Tokat Private Dynamic Vocational and Technical Anatolian High School located in the central district of Tokat province between 2020 and 2023. It consists of teachers in different branches working in high education institutions in the central district of Tokat province. In accordance with the purpose of the study, typical case sampling, one of the non-random purposive sampling methods, was used for students, and convenient case sampling, one of the non-random purposive sampling methods, was used for teachers (Büyüköztürk, Çakmak Kılıç, Akgün, Karadeniz & Demirel, 2008).

In Table 1 and Table 2, the statistical information of the students participating in the research according to their gender and the teachers' gender and seniority variables are given. While determining the seniority range of the teachers participating in the research, the period (10 years) determined by the Ministry of National Education for the Specialist Teaching and Head Teaching criteria was taken into account (Ministry of National Education [MEB], 2022).

Table 1: Statistical Information of the First Group Participating in The Research

Participant Profile	**Categories**	**Subcategories**		**N**	**%**
Student	Female			246	48.01
	Male			256	50.99
Teacher	Female	Seniority year	1 - 10	34	36.96
			11 - 20	40	43.48
			21 above	18	19.56
	Male	Seniority year	1 - 10	68	34.00
			11 - 20	93	46.50
			21 above	39	19.50
Total				**794**	**100**

Table 2: Statistical Information of the Second Group Participating in The Research

Participant Profile	Categories	Subcategories		N	%
Student	Female			107	50.71
	Male			104	49.29
Teacher	Female	Seniority year	1 - 10	32	32.32
			11 - 20	40	40.40
			21 above	27	27.28
	Male	Seniority year	1 - 10	31	28.70
			11 - 20	44	40.74
			21 above	33	30.56
Total				**418**	**100**

2.3 Research Instruments and Processes

In the process of preparing the items required for the scale, firstly the scale items used and developed in the national and international literature were examined. A total of 36 items were created to ensure content validity and were presented to expert opinion. As a result of expert opinion and linguistic and scientific control, the number of items was reduced to 32 and it was decided to use the scale in a 5-point Likert type.

In order to apply the scale, which was ready for application, permission was first obtained from the University Ethics Committee Unit. Later, permission was obtained from Tokat Provincial Directorate of National Education for the students in the schools where the application would be carried out. The data collected in the application was obtained between 2020 and 2023. The data was obtained using an online form (Google Form) because the application to student and teacher groups was economical and the analysis was quick and errors were minimized.

2.3.1 First Research Instrument

The scale, consisting of a total of 32 items, was applied to a total of 502 students from three high schools in the central district of Tokat participated in the application. The application was then applied to a total of 292 teachers in different branches working in high school institutions in the central district of Tokat. In the first application phase, a total of 794 people were treated.

2.3.1 Second Research Instrument

As a result of the analyzes made after the first application, the scale turned into a structure with 14 items and two sub-factors and was applied to a total of 418 people, including 211 students and 207 teachers, within the same sample group.

2.4 Data Analysis

The scale finalized by the researcher was applied to the participants, and Microsoft Office 2016, SPSS 22.0, and AMOS 21.0 programs were used to analyze the validity and reliability of the data obtained as a result of the application. Before the validity and reliability analysis of the scale, the Kaiser-Meyer-Olkin (KMO) test was applied to determine whether the sample size of the data obtained from the 21st century technology

literacy skills scale was large enough. In addition, in order to determine the suitability of the collected data for factor analysis, the Bartlett Sphericity test was performed and the "T" code was defined for each item in technology literacy. For the reliability analysis of the scale, firstly, the internal consistency of the items and factors was calculated with the Cronbach Alpha coefficient. Then, the item-total correlation was examined to determine the correlation (positive relationship) between each item and the total score of each factor. Finally, to analyze the discrimination of the items from each other, it was checked whether there was a positive (significant) difference between the 27% lower and 27% upper groups.

To test the construct validity of the scale, EFA (Exploratory Factor Analysis) and CFA (Confirmatory Factor Analysis) were used, respectively. To determine whether the 21st century technology literacy scale serves its purpose, its construct validity was first tested with EFA (Exploratory Factor Analysis). "Exploratory Factor Analysis: It is done to collect the items that measure the same structure in the measurement tool under factors, that is, to determine the implicit structure of the measurement tool." (Bursal, 2017). With Exploratory Factor Analysis, items with low item variance (< .30) and overlapping items were removed from the scale and the scale was ready for the second application (Tabachnick & Fidell, 2007). Then, it was tested with CFA (Confirmatory Factor Analysis) to test whether the Exploratory Factor Analysis categorized the factors correctly. Finally, in the light of the data obtained after the second application, various variables were analyzed in line with the sub-objectives of the study. Whether there was a difference according to (gender, years of seniority, etc.) was analyzed by independent t test and ANOVA test.

2.5 Ethic

The data collection processes carried out within the scope of this research were approved by the Tokat Gaziosmanpaşa University Social and Humanities Research Ethics Committee's document dated 02.04.2020 and numbered 33490967-044/19337.

3. Findings

Before starting the validity and reliability studies of the scale, item analyzes of the data were made, and skewness and kurtosis values, general mean and standard deviation values of the items were examined to determine whether they were normally distributed.

Table 3: Total Item Analysis of Participants Who Participated in the First Study

N	Average	Standard Deviation
794	3.88	1.12

When Table 3 is examined, the average value given to the items by a total of 794 people who participated in the first study was 3.88 and the standard deviation was 1.12. Accordingly, since the median value is 3.88 and the total score of the participants is

between 3.41 and 4.20, it is seen that they express "I agree" in terms of the average of all items.

Table 4: Normal Distribution Parameters of the First Application Scale

Normal Distribution Parameters	**Result**
Skewness	-0.67
Kurtosis	0.92

When Table 4 is examined, it is seen that the skewness value of the items is -.67 and the kurtosis value is .92. In order for the items to show a normal distribution, it is sufficient for these values to be between +1 and -1. In addition, the closer it is to 0, the more normal it is distributed (Büyüköztürk, 2008). Accordingly, it can be said that the items are in a normal distribution.

3.1 Findings Regarding Validity and Reliability

For the technology literacy skills scale, first the Kaiser-Meyer-Olkin (KMO) test was applied. In addition, Bartlett's Sphericity test was performed to determine the suitability of the collected data for factor analysis.

Table 5: Findings Regarding KMO and Bartlett Sphericity Test

KMO Coefficient		0.96
Bartlett Sphericity	**X^2**	9124.27
	Sd	496
	p	0

When Table 5 is examined, the Kaiser-Meyer-Olkin (KMO) test was found to be .96. A value of .90 or above is considered "excellent" in terms of sample size (Büyüköztürk, 2008). Additionally, Bartlett's Sphericity test was found to be significant as $X^2_{794} = 9124.27$ and $p < .005$. The findings show that exploratory factor analysis can be performed on the data obtained for technology literacy skills.

3.2 Findings of Exploratory Factor Analysis (EFA)

When Figure 1 is examined, it is seen that the accumulation graph starts to flatten from the fifth item. It is seen that the thirty items in the technology literacy skills of the scale are grouped under three factors with eigenvalues greater than 1. When the factors with eigenvalues greater than 1 and the slope-drain graph in Table 7 are examined, it is seen that the scale consists of five factors.

When Table 6 is examined, the eigenvalues and variance values explained by the three factors with eigenvalues above 1 are seen. The total variance ratio explained by the three factors with eigenvalues greater than 1 of the 32 analyzed items regarding technology literacy skills is 51.47%.

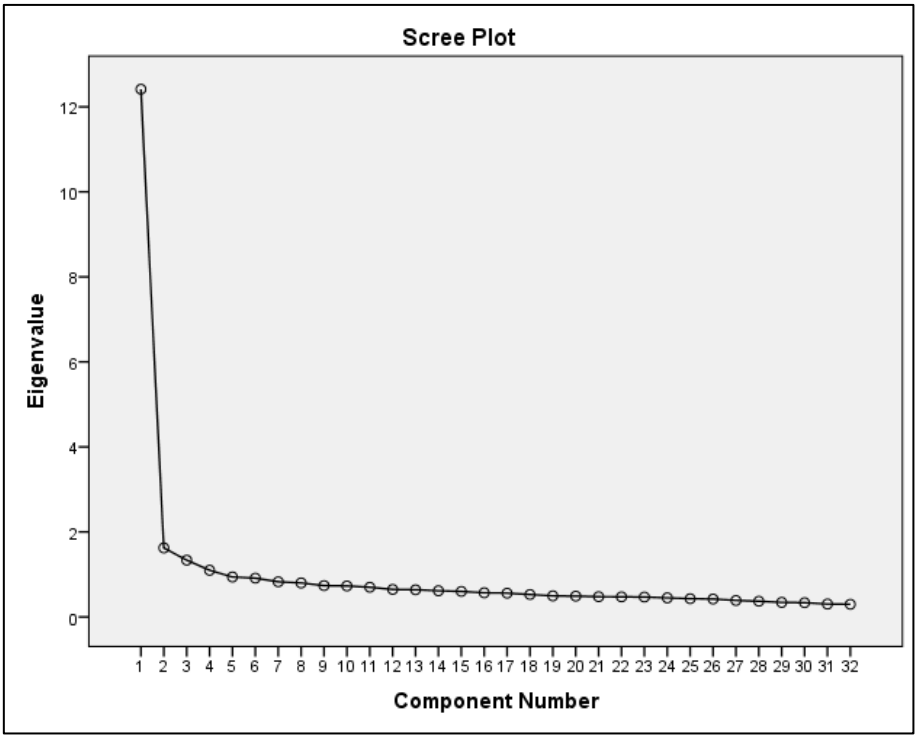

Figure 1: Technology Literacy Skills Scale Scree Plot Graph

Table 6: Explained Variance Values

Factor	Eigenvalues			Transformed Sum of Squares		
	Eigenvalue	Explained Variance (%)	Total Variance (%)	Eigenvalue	Explained Variance (%)	Total Variance (%)
1	12.41	38.79	38.79	12.41	38.79	38.79
2	1.62	5.07	43.87	1.62	5.07	43.87
3	1.34	4.18	48.04	1.34	4.18	48.04
4	1.09	3.43	51.47	1.09	3.43	51.47

Tabachnick and Fidell (2007) stated that the loading value of each item in the scale should be .30 and above. First of all, it was examined whether each item had a score of .30 or less and whether there were overlapping items. As a result of the examination, a total of 14 items, namely items 20, 26, 23, 2, 14, 8, 3, 22, 15, 9, 11, 12, and 6, were determined to be overlapping and were excluded from the analysis one by one. The overlapping status of the items indicates that the loading values between at least two factors are less than approximately .10 (Tümer & Gür, 2007; Yavuz, 2005).

As a result of the analysis, it was observed that a total of 14 items were eliminated and the remaining 18 items had a three-factor structure. When the analysis was repeated with 18 items, the variance rates and factor loadings obtained for each factor are shown in Table 7. As a result of the first analysis, it is seen that the scale, which consists of 4 factors according to the scree plot and eigenvalue data, consists of 3 factors in total with the final analysis result.

Table 7: Factor Loadings of Scale Items

Items	Factors			
	1	**2**	**3**	
T29	0.72			
T24	0.67			
T27	0.63			
T31	0.62			
T30	0.62			
T21	0.62			
T25	0.60			
T16	0.59			
T28		0.80		
T19		0.74		
T17		0.65		
T18		0.54		
T10		0.51		
T32		0.80		
T1		0.74		
T4			0.73	
T7			0.65	
T5			0.59	
Explained	7.06	1.28	1,09	**Total**
Variance (%)	39.2	7.12	6.04	**52.35**

The scale's explanation percentage of the total variance was 52.35. The variance explained in multi-factor scale designs is between 40% and 60%, which is considered sufficient for factor determination analysis (Çokluk *et al*., 2012). When the items collected in the factors were examined, the first factor was named "Ability to Comprehend Technology". The items are listed according to the factor loading, from higher to lower, as follows: items 29, 24, 27, 31, 30, 21, 25, 16 and 28.

The eigenvalue of the Technology Comprehension sub-dimension is 7.06 and the variance explanation percentage of the factor is 39.20. Additionally, it is seen that factor loadings vary between .59 and .72. The second factor of the scale is called "Ability to Use Technology". The items are listed in order of factor loading, from higher to lower, as follows: items 19, 17, 18, 10 and 32. The eigenvalue of the Ability to Use Technology sub-dimension is 1.28 and the variance explanation percentage of the factor is 7.12. Additionally, factor loadings appear to vary between .51 and .80. The third factor of the scale is called "Paying Attention". The items are listed as follows, from higher to lower factor loadings: items 1, 4, 5 and 7. The eigenvalue of the Paying Attention sub-dimension is 1.09 and the variance explanation percentage of the factor is 6.04. Additionally, factor loadings appear to vary between .58 and .73.

3.2.1 Findings of Reliability Analysis

After the factor analysis of the technology literacy scale, Cronbach's alpha (α) coefficients were analyzed for the reliability level. The findings obtained as a result of the analysis are presented in Table 8.

Table 8: Item Analysis of Scale Items

Factor	Item	Item Total Correlation	Cronbach Alfa
Ability to Comprehend Technology	T16	0.57	.86
	T21	0.57	
	T24	0.63	
	T25	0,62	
	T27	0.62	
	T29	0.63	
	T30	0.61	
	T31	0.58	
Ability to Use Technology	T10	0.44	.79
	T17	0.63	
	T18	0.62	
	T19	0.64	
	T28	0.44	
	T32	0.48	
Paying Attention	T1	0.45	.70
	T4	0.54	
	T5	0.50	
	T7	0.47	
Total			**.90**

When Table 8 is examined, the reliability coefficient for the first factor of the scale is 0.86 and the item-total correlation coefficients vary between 0.57 and .63, the reliability coefficient for the second factor of the scale is .79 and the item-total correlation coefficients vary between .44 and .63, and the reliability coefficient for the third factor of the scale varies between .44 and .63. It is seen that the coefficient is .70 and the item-total correlation coefficients vary between .45 and .54. According to Kalaycı (2006), it can be said that both the general and factor-related reliability (internal consistency) levels of the technology literacy skills scale are "fairly" reliable. In addition, it is seen that the item-total score coefficients are in sufficient relationship ($r \geq .30$) (Bursal, 2017).

In order to analyze the discrimination power of the items in the technology literacy skills scale, the score averages of the groups comprising the lower 27% (n=214) and upper 27% (n=214) of the participants in the research were compared with independent (in unrelated samples) t-test and obtained. The findings are presented in Table 9.

Table 9: Item Distinctive Findings

Factor	Upper Group (27%)		Lower Group (27%)			
	$\overline{X}$	Ss	$\overline{X}$	Ss	t	P
Factor 1	39.07	1.03	24.27	4.31	48.90	.000
Factor 2	28.57	1.20	16.19	3.06	55.07	.000
Factor 3	19.45	0.66	11.61	2.35	46.91	.000
Total	**85.18**	**3.21**	**54.55**	**8.28**	**55.53**	**.000**

When Table 9 is examined, it is seen that there is a significant difference as a result of the independent groups t test for the technology literacy scale and its sub-factors ($p < .001$). Accordingly, it can be said that each item and factor in the scale is distinctive enough to measure the feature it is intended to measure.

3.3 Findings of Confirmatory Factor Analysis (CFA)

As a result of the 21st century technology literacy scale Exploratory Factor Analysis, the scale was completed with a 2-factor structure. Confirmatory Factor Analysis (CFA) was conducted to verify the appropriateness of the subfactors. CFA is a very useful analysis method in terms of confirming the accuracy of the model, which has a theoretical basis, testing the suitability of the factor structure determined as a result of the model, developing it, and re-establishing the factor structure by editing it if necessary (Büyüköztürk, 2008; Gürbüz, 2019). As a result of confirmatory factor analysis of the data, for the relationship between the model and the model to be perfect, it should be close to 0 and the p-value (significance) should not be significant (Hoyle, 1995).

The goodness of fit indexes of the model must be able to be interpreted in its entirety and the values for the fit of the model must be among the parameters specified in Table 10 (Brown, 2006; Çokluk *et al.*, 2014; Kline, 2015; Schumacker & Lomax, 2010; Sümer, 2000; Şencan, 2005; Şimşek 2007).

Table 10: Confirmatory Factor Analysis Fit Index Parameter Value Ranges

Fit Index	Excellent Value (Excellent Fit)	Normal Value (Good Fit)	Acceptable Value (Fit)
Ki-square/sd	>0.00 - <2.00	>2.00 - <3.00	>3.00 - <5.00
AGFI	>0.95 - <1.00	>0.90 - <0.95	>0.85 - <0.90
CFI	>0.97 - <1.00	>0.95 - <0.97	>0.90 - <0.95
GFI	>0.95 - <1.00	>0.90 - <0.95	>0.85 - <0.90
NFI	>0.97 - <1.00	>0.95 - <0.97	>0.90 - <0.95
IFI	>0.97 - <1.00	>0.95 - <0.97	>0.90 - <0.95
RMR	>0.00 - <0.05	>0.05 - <0.08	>0.08 - <1.00
RMSEA	>0.00 - <0.05	>0.05 - <0.08	>0.08 - <1.00

As a result of the confirmatory factor analysis for technology literacy skills, t values were examined and it was found that all 18 items were significant at the .01 level. However, since the CFA fit index values were not within the desired reference ranges, the 3rd, 11th, 13th and 14th items, which affected the factor structure the most, were removed

respectively and the necessary modifications were made between the error references (e2-e4, e6-e8, e7-e8, e9-e12). The path diagram has been redrawn.

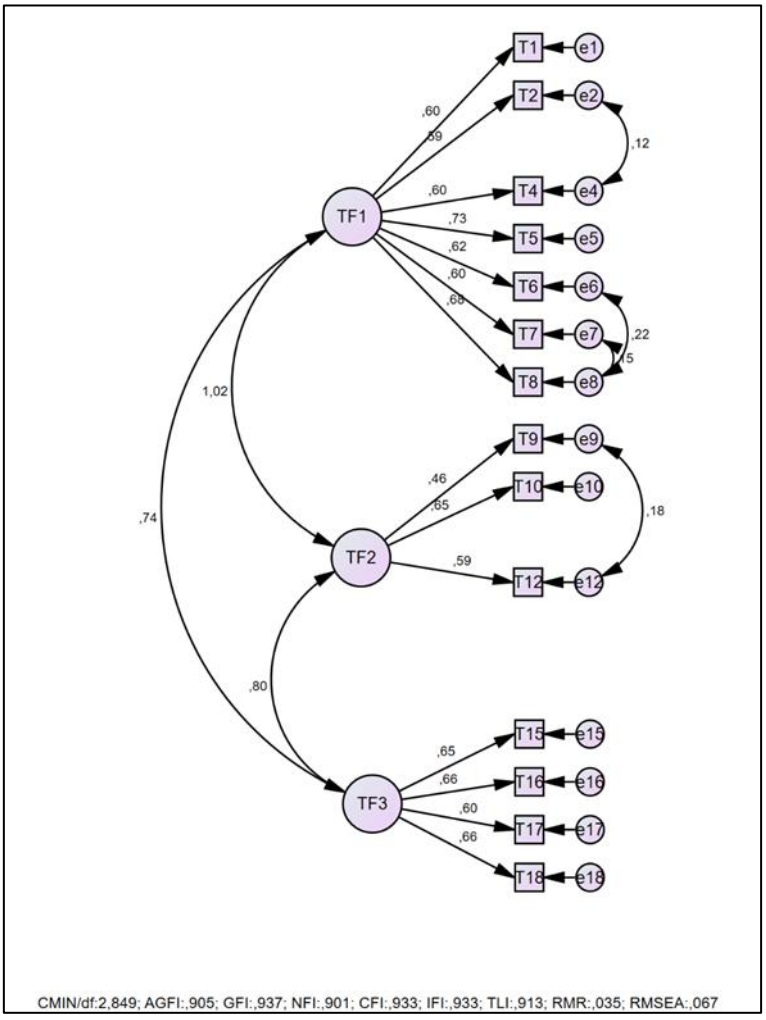

Figure 2: Technology literacy skills scale confirmatory factor analysis path diagram

Table 11: Confirmatory Factor Analysis Results of the Technology Literacy Skills Scale

Fit Index	Measurement Value	Fit
Ki-square/sd	2.84	Good Fit
AGFI	0.90	Fit
CFI	0.93	Fit
GFI	0.93	Good Fit
NFI	0.90	Fit
IFI	0.93	Fit
RMR	0.03	Excellent Fit
RMSEA	0.06	Good Fit

When Table 11 is examined, the RMR value is found to be .03. These values show that the model has a perfect fit. X2/df (chi-square/degrees of freedom) value was found to be 2.84, RMSEA value was .06 and GFI value was .93. These values show that it has a good fit with the model. The AGFI value was found to be .90, the CFI value was .93, the NFI value

was .90 and the IFI value was .93. These values show that there is an acceptable fit with the model. When the values obtained as a result of the analysis are compared with the desired reference values, it is seen that all of the values for technology literacy skills are within the desired values.

3.4 Examining the Total Scores of the 21st Century Technology Literacy Skills Scale by Students' Gender

Independent groups t test analysis was conducted to determine whether there was a significant difference in the 21st century technology literacy skills levels of high school students according to gender. The data obtained as a result of the analysis are shown in Table 12.

Table 12: Independent T-Test Results on the Difference in Technology Literacy Skill Levels of High School Students by Gender

Dimension	Gender	N	$\bar{X}$	SS	T	DF	P
Ability to Comprehend Technology	Male	104	3.82	0.88	- 3.89	160.74	**0.00**
	Female	107	4.21	0.49			
Ability to Use Technology	Male	104	3.72	0.82	- 2.44	172.37	**0.01**
	Female	107	3.95	0.51			
Paying Attention	Male	104	3.93	0.89	0.24	178.91	0.80
	Female	107	3.90	0.59			
Technology Literacy (Total)	Male	104	3.83	0.78	- 2.71	155.01	**0.00**
	Female	107	4.07	0.41			

When Table 12 is examined, the sub-factor values of Comprehension of Technology ([t= - 3.89 and p< .05]), the sub-factor values of Being able to Use Technology ([t= - 2.44 and p< .05]), the sub-factor values of Paying Attention ([t= .24 and p> .05]) and Technology Literacy values ([t= - 2.71 and p< .05]). These results show that high school students' Ability to Comprehend Technology and Use Technology sub-factors create a significant (p< .05) difference in favor of female students, and the Attention sub-factor does not create any difference according to the gender of the students. In addition, it is seen that the total skill level of Technology Literacy creates a significant (p < .05) difference in favor of female students.

3.5 Examination of Total Scores of the 21st Century Technology Literacy Skills Scale by Teachers' Gender

In order to determine whether the 21st Century Technology Literacy skill level average scores of teachers working at the high education level showed a significant difference according to their years of seniority, the homogeneity hypothesis was first examined. The homogeneity hypothesis situation was analyzed with Levene's test and the analysis results are given in Table 13.

Table 13: Independent T-Test Results on the Difference in High School Teachers' Technology Literacy Skill Levels According to Gender

Dimension	Gender	N	$\overline{X}$	SS	T	DF	P
Ability to Comprehend Technology	Male	108	4.37	0.38	2.46	205	**0.01**
	Female	99	4.23	0.41			
Ability to Use Technology	Male	108	4.43	0.44	3.48	205	**0.00**
	Female	99	4.19	0.56			
Paying Attention	Male	108	4.38	0.43	0.69	205	0.49
	Female	99	4.34	0.41			
Technology Literacy (Total)	Male	108	4.39	0.33	2.68	205	**0.00**
	Female	99	4.25	0.37			

When Table 13 is examined. the sub-factor values of Comprehension of Technology ([t= 2.46 and p< .05]). the sub-factor values of Being able to Use Technology ([t= 3.48 and p< .05]). the sub-factor values of Paying Attention ([t= .69). and p> .05]) and Technology Literacy values ([t= 2.68 and p< .05]). These results show that teachers' skill levels for the Paying Attention sub-factor do not make a significant (p> .05) difference according to the gender variable. In addition. these results show that the sub-factors of Understanding Technology and Using Technology and the total skill levels of Technology Literacy create a significant (p < .05) difference in favor of male teachers and female teachers according to the gender variable of teachers.

3.6 Examination of the Total Scores of the 21st Century Technology Literacy Skills Scale by Teachers' Years of Experience

In order to determine whether the 21st Century Technology Literacy skill level average scores of teachers working at the high education level showed a significant difference according to their years of seniority, the homogeneity hypothesis was first examined. The homogeneity hypothesis situation was analyzed with Levene's test and the analysis results are given in Table 14.

Table 14: Homogeneity Analysis Results of Sub-Factors

Dimension	Levene's	Df1	Df2	P
Ability to Comprehend Technology	1.02	2	204	0.36
Ability to Use Technology	2.25	2	204	0.10
Paying Attention	1.04	2	204	0.35
Technology Literacy (Total)	1.02	2	204	0.36

According to the analysis results. Ability to Comprehend Technology ([LF= 1.02 and p> .05]). Use Technology ([LF= 2.25 and p> .05]). Pay Attention ([LF= 1.04 and p> .05]) and Technology Literacy. ([LF= 1.02 and p> .05]) dimensions were found to be homogeneous. For this reason, one-way analysis of variance (ANOVA) was performed and the analysis results are given in Table 15.

Table 15: ANOVA Test Results of High School Teachers According to Their Seniority Years

Dimension	Variance Sources	Squares Total	Freedom Degree	Average Squared	F	P
Ability to Comprehend Technology	Intergroup	0.45	2	0.22	1.39	0.25
	In-group	33.09	204	0.16		
	Total	33.54	206			
Ability to Use Technology	Intergroup	0.28	2	0.14	0.51	0.59
	In-group	55.90	204	0.27		
	Total	56.82	206			
Paying Attention	Intergroup	0.20	2	0.10	0.57	0.56
	In-group	36.51	204	0.17		
	Total	36.72	206			
Technology Literacy (Total)	Intergroup	0.19	2	0.09	0.74	0.47
	In-group	26.56	204	0.13		
	Total	26.75	206			

When Table 15 is examined. the sub-factor values of Comprehension of Technology ([F= 1.39 and p> .05]). the sub-factor values of Being able to Use Technology ([F= .51 and p> .05]). the sub-factor values of Paying Attention ([F= .57 and p> .05]). and Technology Literacy total values ([F= .74 and p> .05]). These results show that high school teachers' Technology Literacy skill levels do not create a significant (p> .05) difference between their years of seniority.

3.7 Examining the Total Scores of the 21st Century Technology Literacy Skills Scale by Category (Teacher-Student) Status

Independent groups t-test analysis was carried out to determine whether there was a significant difference between the 21st century technology literacy skills levels of teachers teaching at the high school level and students studying at the high school level. The data obtained as a result of the analysis are shown in Table 16.

Table 16: Independent T-Test Results on the Difference between Technology Literacy Skill Levels of High School Teachers and Students

Dimension	Gender	N	$\overline{X}$	SS	T	DF	P
Ability to Comprehend Technology	Student	211	4.02	0.73	- 4.87	326.80	**0.00**
	Teacher	207	4.30	0.40			
Ability to Use Technology	Student	211	3.84	0.69	- 7.93	390.51	**0.00**
	Teacher	207	4.32	0.52			
Paying Attention	Student	211	3.91	0.75	- 7.50	329.75	**0.00**
	Teacher	207	4.36	0.42			
Technology Literacy (Total)	Student	211	3.95	0.63	- 7.40	334.62	**0.00**
	Teacher	207	4.32	0.36			

When Table 16 is examined. the sub-factor values of Comprehension of Technology ([t= - 4.87 and p< .05]). the sub-factor values of Being able to Use Technology ([t= - 7.93 and p< .05]). the sub-factor values of Paying Attention ([t= -7.50 and p< .05]) and Technology

Literacy values ([t= - 7.40 and p< .05]). These results show that there is a significant (p < .05) difference in favor of the teachers between the sub-factors of Understanding Technology. Being Able to Use Technology. Paying Attention and the total skill levels of Technology Literacy among high school students and teachers.

4. Results and Discussion

It was observed that the 21st century technology literacy skill levels of the high school students participating in the research were at the "Agree" level (X=3.95). It is seen that the students' total skill levels of Comprehension of Technology sub-factor. Ability to Use Technology sub-factors and Technology Literacy do not create a significant difference according to gender. It is seen that only the Paying Attention sub-factor creates a significant difference in favor of female students. In his study. Duruk (2012) did not find a significant difference in all sub-dimensions of students' science and technology literacy skills according to the gender variable. We can say that this situation is due to variables such as the characteristics of the students participating in the research. the time when the research was conducted. the population and the sample.

It was observed that the 21st century technology literacy skill levels of teachers working in high school institutions were at the "I definitely agree" level (X=4.32). There was no significant difference in teachers' skill levels for the Paying Attention sub-factor according to the gender variable. It is seen that the sub-factors of Understanding Technology and Using Technology and the total skill levels of Technology Literacy create a significant difference in favor of male teachers according to the gender variable of the teachers. Adıgüzel (2010) in his study "Classroom teachers' views on their level of use of instructional technologies" and Aydemir (2011) in his "Research on the level of use of tools and equipment by social studies teachers working in public and private primary schools" found a significant difference according to the gender of the teachers. They couldn't find it. It is seen that the skill levels of teachers working in high school institutions in all dimensions do not differ significantly according to their years of seniority. Similarly. Kahyaoğlu (2011) in his research on "Primary School Teachers' Opinions on Using New Technologies in Science and Technology Courses" could not find a statistically significant difference according to the teachers' years of seniority. Again. we can say that this situation is due to variables such as the characteristics of the teachers participating in the research. the time when the research was conducted. the population and the sample.

It has been observed that there is a significant difference in favor of the teachers between the 21st century technology literacy skill levels of high school level teachers and secondary school students. The opinions of the teachers participating in the research regarding the 21st century technology literacy skill levels (X=4.32) are at the "I definitely agree" level. The students' views on 21st century technology literacy skill levels are at the "I agree" level (X=3.95). This result shows us that teachers have higher 21st t century technology literacy skill levels than students. There is no other study in the literature in

which the same technology literacy scale is applied to both teachers and students at the high school level. In addition. the scale developed in this study; Although it was developed for students studying at high school level. the fact that the technology literacy skill levels of students and teachers are at parallel levels shows that the application is applicable to both students and teachers during the scale development process. Thus. the scale developed in this study; It guided the main problem of the research. which is "to investigate to what extent teachers have these skills in teaching students' technology literacy skills".

In this research it was aimed to develop a scale to determine the 21st century technology literacy skill levels of high school students and teachers and to examine the scores obtained as a result of the application of the scale in terms of different variables (gender. years of seniority. category). The 32-item 21st Century Technology Literacy Skills Scale created for this purpose was applied to high school students and teachers working in high school institutions in Tokat. The first application was applied to a total of 794 people and Exploratory Factor Analysis was performed to determine the validity of the scale correlations between factors were calculated. Cronbach's alpha test was performed for reliability and upper-lower groups t-test was applied to determine item discrimination power. As a result of EFA the factor structure of all sub-factors of the scale was tested with Confirmatory Factor Analysis. For CFA (second application) the 18-item final scale was applied to different groups on the same sample as in the first application to a total of 418 people. As a result of CFA the 21st Century Technology Literacy Skills Scale consisting of two sub-factors and a total of 14 items took its final form.

According to all analysis results regarding the validity and reliability of the 21st Century Technology Literacy Skills Scale: The content validity of the scale was ensured based on an extensive literature review and expert opinions. KMO values above .90 indicate that the sample size is at an "excellent" level. According to the Cronbach Alpha values tested separately for all skills regarding the reliability of the scale. it can be said that both the general and factor-related reliability (internal consistency) levels of the scale are "quite" reliable. As a result of the independent groups t test of all factors of the scale. it can be said that each item and factor in the scale is "sufficiently" discriminative in measuring the feature that is intended to be measured. As a result of CFA applied to test the suitability of the factor structure. the fact that the fit index values of the factors are within the desired ranges shows that the scale is at a "sufficient" level in terms of construct validity.

5. Recommendations

Similar types of scales can be developed by researchers for students studying in primary school, High school, and high school. Since this study is a scale development study, the measurement results were associated with the gender variable for the students. Researchers can also examine students in terms of different variables according to their

grade level, school type, and family demographic status (parents' education, number of siblings, financial situation, ICT equipment ownership status, etc.).

Conflict of Interest Statement
The authors declare no conflicts of interest.

About the Author(s)
Necmi Eşgi works as a full-time professor at Tokat Gaziosmanpasa University, Turkey, in the field of computer and instructional technologies. He gives lectures on internet addiction, instructional technologies, instructional design, teacher training, curriculum and instruction.
Rüstem Kalaycı works as an expert information technology teacher at Tokat Vocational and Technical High School in Turkey. He has studies on topics such as virtual reality, augmented reality, coding, and teacher competencies.

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Appendix

21st Century Technology Literacy Skills Scale			I strongly disagree	I do not agree	I'm undecided	I Agree	Absolutely I agree
Dimension	**N**	**ITEMS**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Ability to Comprehend Technology	1	It increases file transfer (upload/download) between mobile devices using the Bluetooth feature.					
	2	I can use social media applications easily					
	3	I can easily use photo viewing and editing programs					
	4	I can upload content such as audio and video from computers and mobile phones.					
	5	I know the importance of technology and its use					
	6	I know what the role of society is in the development and use of technology.					
	7	I can classify technological tools according to their intended use.					
Ability to Use Technology	8	I attach importance to R&D activities in the development of technology.					
	9	I can easily use video and audio player programs.					
	10	I can easily use presentation preparation programs (such as Power point, Prezi).					
Paying Attention	11	I review the user manual of a technological device that I will use for the first time.					
	12	I pay attention to occupational health and safety when using technological tools.					
	13	I pay attention to the cost when purchasing the technology I need					
	14	I make sure that the technological tool I use is ergonomic.					