A Study on Digital Leadership Scale Adaptation

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ABSTRACT

In recent years, the speed of digitalisation in nearly all fields has led organizations to actively use digital tools, practice working methods that are compatible with daily requirements, and adjust themselves to the process compositionally. The concept of digital leadership can be defined as the result of this necessity. Digital leaders focus on basic dynamics of the present world, can achieve digital transformation, and equate learning culture and the structure of an organization with digital standards. In this respect, to measure digital leadership understanding in Turkey, the present study adapted the scale, developed by Zeike et al. (2019) to Turkish and analyzed its reliability and validity. In the study, the first test was conducted with 135 teachers working in Kars, while the second test was conducted with 334 academicians. The adaptation of the scale into Turkish was achieved in the research by making the analyses of normality, correlation, and exploratory factor analysis through the SPSS program and by making confirmatory factor analyses through the AMOS program. The reliability and validity of the scale obtained were achieved by gathering it under a single dimension.

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In terms of organizations, having access to information, sharing, and using it has become necessary due to fast and radical changes in globalization and information technologies (Oberer & Erkollar, 2018). Those changes have led the leaders' styles of influencing their members, enabling motivation, communication, and inspiring confidence to be affected as well as leading classical leadership practices to become ineffective and inadequate under changing environmental conditions. The success of the leader, who can be defined as the one directing an organization towards certain aims and ideals and managing the change, is in direct proportion to his ability to read and analyze changing conditions and to benefit from managerial practices which are appropriate to them (Kırmaz, 2010). In this respect, in the digitalizing world, it has

become apparent that leaders need to have new qualifications and equipment and develop certain behavioral patterns(Karippur & Balaramachandran, 2022).

The rapid development in information technologies and digital transformation has brought about obtaining significant information touching every aspect of life. In terms of utilizing the information obtained, the existence of leaders who could manage the information has become an obligation in the present world (El Sawy et al., 2016). According to the classical understanding of manager and leader, in this transformation requiring much more than the qualifications attributed to these roles, the new leader type has been named the digital leader and has positioned these leaders with the qualifications mentioned as an organizational necessity.

The study carried out by (Zeike et al., 2019) as dealt with by many researchers in terms of the literature (Cahyadi & Magda, 2021; Claassen et al., 2021; Culasso et al., 2023; Efimov et al., 2022; Henderikx & Stoffers, 2022; Jafari-Sadeghi et al., 2023; Jović et al., 2022; Karippur & Balaramachandran, 2022; Lindert et al., 2022; Marino & Capone, 2021; Mutsuddi & Sinha, 2022; Tigre et al., 2022; Trenerry et al., 2021; Wang & Yang, 2022; Wendtlandt & Wicker, 2021; Zammitti et al., 2022). In this respect, the use of the scale was limited. However, there are also studies that utilized the scale. In the study conducted by Dewi and Sjabadhymi (2021), upon the scale, it was realized that the scale was used as a two-dimensional one, but the reliability and validity values of the scale were not shared. In the study conducted by Matsunaga (2022), the reliability values of the scale were shared with McDonald's omega (ω), and the value was determined to be 0.82. on the other hand, in the study by Zhu et al. (2022), the scale was used in the structural equation model in a one-dimensional structure. The reliability coefficient of the scale was found to be Cronbach Alpha .85. It was observed that the scale was the subject of three different studies and that these studies were not language adaptation studies. As well as the studies measuring the impact and structural equality, it is realized that there are studies utilizing the scale to create the agility scale (Pfaff et al., 2022). When the literature is taken into consideration, it was determined that the scale developed by Zeike et al. (2019) was mainly used in the development of the literature, especially as a reference tool for transformative leadership and digital transformation. It is thought that the scale has turned into an idle state with this feature and will draw more attention when adapted to other languages.

From this point of view, a framework was created for information technologies and digital transformation processes in the present study. Following that, the organizational reflections of this process were focused upon, and descriptive information was given about the concept of digital leadership, which is quite new. So as to create an alternative to the limited number of digital leadership scales in Turkish literature in the context of digital leadership, Turkish validity and reliability study of the digital leadership scale developed by Zeike et al. (2019) was performed. The first study was conducted with a group of 135 teachers working in Kars, and the second was conducted with a group of 334 academicians. In the study, the scale was translated into Turkish by performing normality, correlation, and exploratory factor analysis using the SPSS program and confirmatory factor and invariance analyses via the AMOS program. It was determined that the scale obtained met the validity and reliability conditions when gathered under one dimension.

Digital Leadership

When the history of humanity is considered, some significant changes, such as the use of the wheel, the invention of the printing press and the steam-powered machine, as well as the discovery of electricity, have created such effects that they can be expressed as a turning point for humanity. One of those turning points is the development experienced in information technologies (Kaygin et al., 2019). Digitalization, defined as the greatest reflection of the last industrial revolution, which is known as Industry 4.0, and information technologies that have developed in parallel with Industry 4.0, have become observable in each aspect of life, such as education, transportation, health (Mihardjo et al., 2019a), etc. One of the domains of digital transformation is businesses. The harmonization of business processes with digital technology made by businesses is named "digital transformation in businesses". Following the digital transformation, new business processes, structures, and management approaches have emerged in businesses (Benitez et al., 2022).

New business structures and management approaches have created a scenario in which most of our business and daily lives are equipped with internet-based information and communication mechanisms (Zulu & Khosrowshahi, 2021). Developments in information and communication technologies are felt heavily in working life and social interactions (UN Economic and Social Council, 2018). These changes have turned the new definition of leadership into a necessity, specifically in certain sectors. With the introduction of the concept of digital leadership in recent years, it is realized that there has been a great interest in this concept in the literature (Sow & Aborbie, 2018).

Whereas leadership in the digital age is an inclusive approach involving all fields, irrespective of any sector, digital leadership refers to the understanding of leadership which is required by the main sectors of the information society (i.e., information-processing, multimedia, technology, etc.) (Westerman et al., 2014). Digital leadership is described as leaders' skill to create a clear and meaningful vision for the digitalization process and to perform strategies to realize it (Larjovuori et al., 2016). At the same time, digital leadership refers to making the right strategic decisions to achieve digitalization and development in businesses (El Sawy et al., 2016).

In the most general sense, digital leadership, which could be stated as performing the leadership process via digital channels, can be described as a skill that is shaped around issues such as having an internet connection, which is the bridge of the digital world, anytime, anywhere and uninterruptedly, making use of open source technologies effectively and personalizing mobile applications, devices, and technologies in accordance with organizational goals (Gronow, 2007). According to definition made by Sheninger (2019, p. 3), on the other hand, a digital leader is defined as "a leader who leads the organizational structure, affects the members, can have access to the information by using digital channels, pioneers sustainable change, and can anticipate the changes which will form the basis for the success aimed to be achieved in the future and therefore can establish relationships". According to another definition, however, digital leadership is described as "the type of leadership that exists in the digital world by combining actions such as managing, organizing and strategic thinking with skills like knowing, using and disseminating digital age tools in an effective way (Şahin et al., 2020). In accordance with all these definitions, it will be to the point to define digital leaders as leaders who have new and creative ideas in the digital arena, can draw the attention of

stakeholders to the digital environment in the context of organizational processes and activities, motivate them, maintain organizational continuity by keeping in touch with members in the digital area, and develop digital strategies which could provide a competitive advantage for the organization (Balci et al., 2022).

The basic quality distinguishing the digital leader approach from classical leader approaches is not skills, expertise, professionalism, or technological superiority but their knowledge of how and in which standard technology should be used while managing the business and organization (Dery et al., 2017). Digital leadership is defined by (Zhu, 2015) as a combination of five different leadership understandings involving creative, opinion, wise, global-visionary, and curious leadership.

Digital leadership is affected by many theories and models as well as many leadership understandings. It is stated by Wang et al. (2022) that the digital leadership logic is fed greatly by RBV. Resource-Based View (RBV), developed by Barney (2001), refers to sustainable competitive advantage and how it is practiced for businesses. In the study carried out by Borah et al. (2022), it was found that social media and innovation associated with RBV correlated highly with digital leadership. It was remarked by Mihardjo et al. (2019b) that digital leadership was related to the Upper Echelon Theory (Hambrick & Mason, 1984). Additionally, Wang et al. (2022) indicate that upper echelon theory and social information processing theory (Walther, 1992) also affect digital leadership. Topçuoğlu et al. (2022) tried to explain digital leadership through Technology Acceptance Model (Davis, 1989), and a moderate effect was found. It was found by Peter et al. (2020) that digital leadership was related to the Strategic Action Field Theory (Fligstein & McAdam, 2011). There are also studies associating digital leadership with transformational leadership and showing that it is fed from the same source (Karippur & Balaramachandran, 2022).

Digital leaders, who should focus on organizational transformation and development process, should have the knowledge, equipment, determination, and competence to cope with all the possible problems, obstacles, and incompatibility which are likely to be experienced in this process (Erhan et al., 2022; Karatepe & Arman, 2019; Sadi & Karatepe, 2021). With the new methods, plans and programs which are necessary for the transition process, the existing system should be adapted to the system to be created, and the members of the organization should be made ready throughout all this process (Mihardjo et al., 2019b). Those necessities require a digital leader to be persuasive, visionary, solution-oriented, sharing and transparent, open to innovations, and can adapt and learn fast (Özmen et al., 2020). These roles expected from the digital leader are often confused as they possess similar roles with the leadership approach stated as "transformational leadership" in the literature. Digital leadership can be described as a combination of transformational leadership understanding and digital technology competence, which is a more comprehensive form (De Waal et al., 2016).

The digital skills that leaders should have been divided into three groups basic, intermediate and advanced skills. According to this classification of skills, basic skills involve using information-communication devices like computers, interactive devices, and simple digital applications encountered frequently in daily life. Intermediate skills refer to the ability to use digital devices effectively, to produce content, and to use them within the scope of their goals, and lastly, advanced skills refer to the ability to have digital competence requiring certain

expertise which is not possessed by ordinary people, to use digital tools in a qualified manner and to shape them in accordance with demands (Öz, 2020).

The Aim and Significance of the Study

There are many initiatives devoted to digitalization in the world. Especially, the increase in profitability and error-free production opportunities, as a result of digitalization, trigger businesses in this regard. Following the understanding of Industry 4.0, digitalization has moved out of the production structure and has taken on a structure covering the whole enterprise. This development has brought about the necessity of digital leadership. It is seen this concept is dealt with in different dimensions in the scale studies emerging in the related literature on digital leadership.

In the digital leadership scale developed by Meier et al. (2017), the concept consists of four sub-dimensions: "cooperation, moderation and social structure", "inspiration and being open to communication", "developing organizational resilience," and "possessing digital meta-competences". In the present study, a two-dimensional digital leadership scale developed by Zeike et al. (2019) was utilized. The digital leadership scale developed by Zeike et al. (2019) consists of six items with two sub-dimensions involving "digital skills" and "managing digital transformation". When the scales used within the scope of digital leadership in Turkiye are considered, it is realized that the measurement is performed through Information Leadership (Ulutaş & Arslan, 2018).

Moreover, the scale developed by Büyükbeşe et al. (2022) is utilized as well. However, it is inevitable to state that these studies are limited, and alternatives should be formed for them to be conducted by creating new scales for researchers. In this respect, the Turkish validity and reliability of the digital leadership scale developed by Zeike et al. (2019) will be made to contribute to Turkish literature by carrying out a detailed examination. Ethical approval was obtained for the present study, as the research with number 45, within the approval decision of the Scientific Research and Publication Ethics Committee of Kafkas University, dated 04 June 2022, and numbered 33.

Method

Population and Sampling

The present study was designed in two stages population and sampling. In the first stage, the study was practiced on a group of at least 100 people to be pre-tested, consisting of teachers, and in the second stage, it was practiced on a second group consisting of academicians to represent the sample. The primary aim of choosing two different groups is to test the general applicability of the scale by reaching many different groups throughout the adaptation stage of the scale. Additionally, developing educators' digital skills and maintaining their education processes via digital methods during the Covid-19 pandemic were determinants for selecting educators as the population in the present research (AlAjmi, 2022; Fernández-Prados et al., 2021).

When the ability of the sample to represent the population of the research was taken into account, it was expressed that a group of at least 100 people would be adequate for the pre-test (Carpenter, 2018). In this regard, it is possible to state that the sample has the ability to represent the population for the pre-test. In the second analysis, 334 academicians were reached. Within

the scope of the research which was carried out at a public university in Kars, the total number of academicians in the research population was 925, and at least 272 people should have been reached (Hair et al., 2014). In this respect, it is also possible to say that the number of participants with whom the survey was conducted in the study could represent the sample.

Data Collection

To collect data Digital Leadership Scale developed by Zeike et al. (2019), in which six-questions with seven demographic variables were applied to the participants. The questionnaire was applied online with two different groups in a 5-point Likert format.

The Research Model

Within the scope of the research, permission was obtained from Zeike et al. (2019), who developed the scale through e-mail. The data obtained as a result of the research were analyzed by means of SPSS and AMOS programs. Furthermore, the scale adaptation methodology which was determined by Carpenter (2018), was utilized for the research. In this regard:

The necessary permissions will be obtained for the adaptation of the scales.

- The method suggested by Silva et al. (2022) will be used to adapt the scale to Turkish. Therefore, the scale items were first translated from English to Turkish. Then the translation process of the scale into Turkish will be completed by translating it again from Turkish to English to control the semantic shift and change in the scale. The adaption made is presented in Appendix A.
- The sample will be determined.
- A pre-test will be applied.
- Normality analysis will be performed on the data obtained through a pre-test.
- A correlation test will be performed to determine the relationship between the items.
- Cronbach-Alpha test will be practiced for reliability.
- Exploratory factor analysis to determine the factor structure,
- AVE and CR values will be calculated according to factor loading values,
- The parallel analysis will be made to test the factor structure determined,
- Confirmatory factor analysis will be performed to test the accuracy of the scale.
- The calculation of AVE and CR values will be made according to factor loading values.

As a result of observing the pre-test results applied to the teachers at the desired level, the research will continue with the academicians. The analysis mentioned above will be applied again to the data obtained from academicians. Furthermore, invariance analysis will be performed to test the compatibility of the data obtained from teachers and academicians with each other and test the general validity of the scale.

Findings
Findings Related to the Research on Teachers

The online questionnaire forms were sent to the teachers working at schools in the city center of Kars, and the information regarding demographic variables obtained is presented in Table 1. Among the teachers, 71 (52.60%) are female, and 64 (47.40%) are male, and the participation rate of female teachers is higher than men. A great majority of the participants (72.60%) are

married. When the ages are considered, it is realized that the participants between 31-40 are dominant. Regarding education level, it was found that the majority of them had a bachelor's degree. According to the duration of experience, it is possible to state that it is mostly six years or more. It is also possible to state that the income level is mostly between 6,000-10,000 TL, but the income varies depending on the additional class fees and being a substitute teacher.

Table 1

Demographic Information about Teachers

Demographic	Group	n	%
Gender	Female	71	52.60
	Male	64	47.40
Marital Status	Married	98	72.60
	Single	37	27.40
Age	Between 20-30	31	23.00
	Between 31-40	78	57.70
	Between 41-50	21	15.60
	51 and Above	5	3.70
Education Level	Bachelor	102	75.60
	Postgraduate	33	24.40
Experience	5 years and below	24	17.80
	Between 6-10 years	37	27.40
	Between 11-15 years	45	33.30
	Between 16-20 years	15	11.10
	21 Years and Above	14	10.40
Income	Between 4.000-6.000 ₺	7	5.20
	Between 6.001-8.000 ₺	55	40.70
	Between 8.001-10.000 ₺	50	37.00
	Between 10.001-12.000 ₺	17	12.60
	Between 12.001 ₺ and Above	6	4.50
Type of School	Pre-school	4	3.00
	Primary School	45	33.30
	Secondary School	52	38.50
	High School	34	25.20

First, the sample should have a normal distribution to analyze the data collected. The results of the analysis made in this context are presented in Table 2. When the table related to the scale was paid attention to, it was found that the sample showed a normal distribution because the values of Skewness and Kurtosis were between +1.96 and -1.96 (Hair et al., 2014).

Table 2

Normality Analysis of Teachers

The Scale and sub-Dimensions	Kolmogorov-Smirnov			Measures of Central Tendency			
	Statistic	df	*p*	*M*	Median	Skewness	Kurtosis
Digital Leadership	.05	135	.20	3.23	3.16	-.16	-.11

The item mean, median, and standard deviation values of the answers given by the teachers to the questions are presented in Table 3. When the answers given by the participants are considered, it is realized that the mean of the answers is above 3. It is possible to remark that the fact that teachers had to use digital technologies more frequently, especially during the pandemic, affected the high response rate.

Table 3

Item Means of Teachers

Items (Digital Leadership)		N	*M*	Median	*SD*
Question 1	"I think using digital tools is fun"	135	4.07	4	0.86
Question 2	"I would say I am a digital expert"	135	3.01	3	1.05
Question 3	"When it comes to digital knowledge, I am always up to date"	135	3.42	4	0.96
Question 4	"I am driving the digital transformation forward proactively in our unit"	135	2.58	2	1.13
Question 5	"I can make others enthusiastic about the digital transformation"	135	3.16	4	1.15
Question 6	"I have a clear idea of the structures and processes that are needed for the digital transformation"	135	3.16	3	1.02
	Mean		3.23	3.33	1.03

It is expected that there will be a relationship between the scale items, and this relationship will be significant. Thus, correlation analysis should be made to determine the items that are incompatible and have a weak relationship with the scale. The results of the analysis are displayed in Table 4. It is expected that the values obtained through correlation analysis should be significant, and the relationship between items should be at least ≥ 0.30. In this regard, it was observed that no items needed to be excluded from the scale as shown in Table 4.

Table 4

The Correlation between Items

	1	2	3	4	5	6
Question 1	1					
Question 2	.54**	1				
Question 3	.50**	.61**	1			
Question 4	.39**	.58**	.57**	1		
Question 5	.35**	.49**	.53**	.64**	1	
Question 6	.48**	.50**	.54**	.57**	.60**	1

So as to determine the factor structure of the scale, it is required to apply exploratory factor analysis to the research data. Parallel analysis should be made to determine whether the factor structure is random (Carpenter, 2018). Bartlett's test of sphericity, Kaiser-Meyer-Olkin (KMO) test and factor loading values will be evaluated via exploratory factor analysis. A Bartlett's chi-square value of .05 or lower, a KMO value of .60 or higher, and a factor load value of over .50 show that the analysis performed is significant (Büyüköztürk et al., 2012; Hair et al., 2014, 2017; İslamoğlu & Alnıaçık, 2019). In this respect, the results of the exploratory factor analysis and parallel analysis are illustrated in Table 5.

As presented in Table 5, the results of the analysis indicate that the two-dimensional scale was gathered under one dimension. The parallel analysis also confirmed this result. It was observed that the KMO value was at the desired level of .86. The analysis was significant because Bartlett's chi-square value was below .05. With respect to reliability, the Cronbach Alpha value of the scale was found to be .87. The Combined Reliability (CR) value was found to be .87. It is, therefore, possible to point out that the scale is reliable because the mentioned values are above .7. Moreover, it is realized that the scale is valid as the Average Explained Variance (AVE) value calculated for convergent validity is between .53 and above .5, (Cudeck & O'Dell, 1994; Hair et al., 2014; Luo et al., 2019).

Table 5

The Exploratory Factor Analysis and Parallel Analysis of Teachers

Statement		Factor Load Value (SPSS)	Cronbach Alfa (α) AVE CR	Parallel Analysis (Ncases: 135; Nvar: 6; Ndataset:100; Percent: 95; Brian Oc)		
				Eigen-value	M	Percentage
Digital Leadership						
% of Variance: 53.654						
Question 1	"I think using digital tools is fun"	.60		3.67	1.28	1.40
Question 2	"I would say I am a digital expert"	.74		0.73	1.14	1.20
Question 3	"When it comes to digital knowledge, I am always up to date"	.76		0.51	1.04	1.10
Question 4	"I am driving the digital transformation forward proactively in our unit"	.78	α = .87 AVE = .53	0.40	0.95	1.01
Question 5	"I can make others enthusiastic about the digital transformation"	.74	CR = .87	0.34	0.84	0.91
Question 6	"I have a clear idea of the structures and processes that are needed for the digital transformation"	.74		0.32	0.73	0.81
Extraction Method: Maximum Likelihood (ML)						
Rotation Method: Direct Oblimin						
KMO: .86						
Bartlett's sphericity test; ($\chi2$ = 361.64; df = 15; *p* = .000)						

With the aim of testing the factor structure created in a more detailed way, Confirmatory Factor Analysis (CFA) should be performed. AMOS program will be utilized for CFA. In this respect, the path diagram of the analysis made is presented in Figure 1.

Figure 1

Confirmatory Factor Analysis of Teachers

CMIN=17,682; DF=8; CMIN/DF=2,210; RMSEA=,095; CFI=,973; GFI=,959
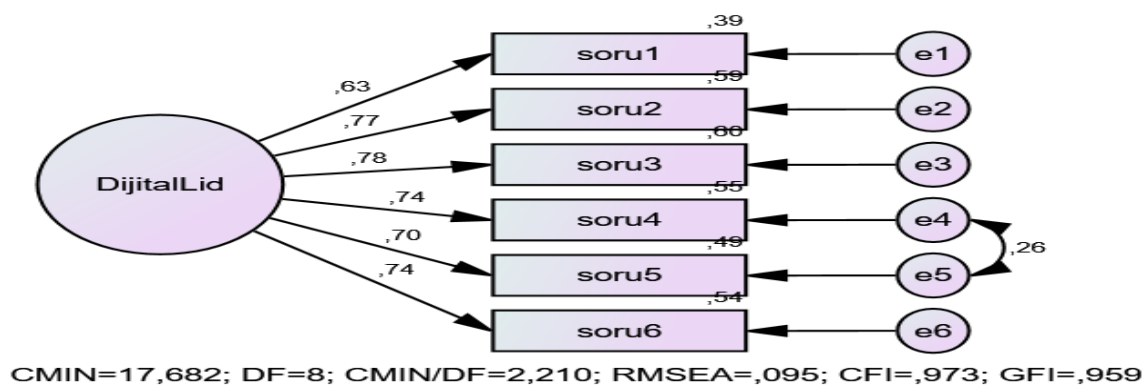
The analysis results show that the X2 (df) value should be below 5, the p-value below the significant level of .05, the RMSEA value below .10, the CFI value above .90, the GFI value above .90, the SRMR value below .08, the AVE value above 0.50, and the CR value should be above .70 (Schermelleh-Engel et al., 2003; Yaşlıoğlu, 2017). Goodness-of-fit values for the analysis are displayed in Table 6.

Table 6

CFA Goodness-of-Fit Values for Teachers

X2(df)	*p*	RMSEA	CFI	GFI	SRMR	AVE	CR
2.21	.000	.09	.97	.95	.03	.52	.87

The results from the CFA goodness-of-fit values indicate that the values are within the desired limits. Additionally, the item load values are above the desired .5 load value; the data related to the measurement model are presented in Table 7.

Table 7

CFA Measurement Model Values for Teachers

			β1	β2	*SD*	*t*	*p*
Measurement Model							
Question 1	<---	Digital Leadership	.62	1.00			
Question 2	<---	Digital Leadership	.76	1.50	.21	7.00	< .001
Question 3	<---	Digital Leadership	.77	1.39	.19	7.07	< .001
Question 4	<---	Digital Leadership	.74	1.56	.23	6.83	< .001
Question 5	<---	Digital Leadership	.69	1.49	.23	6.48	< .001
Question 6	<---	Digital Leadership	.73	1.40	.20	6.82	< .001

The Findings Regarding the Study Conducted with Academicians

Online survey forms were sent to academicians working at a public university in Kars, and information regarding demographic variables is displayed in Table 8. Among the participant academicians, 152 (45.50%) are female, and 182 (54.50%) are male, and the participation rate of male academicians is higher than female ones. A great majority of the participants (76%) are married. When the ages of the academicians are taken into consideration, it is realized that the participants who are between 31-40 years of age are dominant. With respect to education level, it is observed that the majority of them had Ph.D degrees. In terms of the duration of experience, it is possible to state that the majority of the participants have 11 years of experience or more. It is also possible to say that the dominant level of income is over 12.000 ₺, but the income is realized to vary depending on the additional class fees and the academic title.

Table 8

Demographic Variables of the Academicians

Demographic	Group	n	%
Gender	Female	152	45.50
	Male	182	54.50
Marital Status	Married	254	76.00
	Single	80	24.00
Age	Between 20-30	64	19.20
	Between 31-40	160	47.90
	Between 41-50	66	19.80
	51 and Above	44	13.10
Education Level	Bachelor	68	20.40
	MA	113	33.80
	Ph.D	153	45.80
Experience	5 Years and below	52	15.60
	Between 6-10 Years	53	15.90
	Between 11-15 Years	68	20.40
	Between 16-20 Years	73	21.90
	21 Years and Above	88	26.20
Income	Between 8.000-10.000 ₺	29	8.70
	Between 10.001-12.000 ₺	42	12.60
	Between 12.001-14.000 ₺	103	30.80
	Between 14.001-16.000 ₺	53	15.90
	16.001 ₺ and Above	107	32.00
Title	Research Assistant	95	28.40
	Lecturer	92	27.50
	Assistant Professor	67	20.10
	Associate Professor	48	14.40
	Professor	32	9.60

In order to analyze the collected data, firstly, the sample should have a normal distribution. The results of the analysis are illustrated in Table 9. When the table related to the scale is considered, it is observed that the sample showed a normal distribution because the values of Skewness and Kurtosis were between +1.96 and -1.96 (Hair et al., 2014).

Table 9

Normality Analysis of The Academicians

Scale and Sub-Dimensions	Kolmogorov-Smirnov			Measures of Central Tendency			
	Statistic	df	*p*	*M*	Median	Skewness	Kurtosis
Digital Leadership	.05	334	.00	3.27	3.33	-.06	-.22

The item mean, median (median), and standard deviation values of the answers which were given by the academicians to the questions are displayed in Table 10. The averages of the answers given by the teachers and academicians are realized to be very close to each other.

Table 10

Item Means of the Academicians

Items (Digital Leadership)		N	*M*	Median	*SD*
Question 1	"I think using digital tools is fun"	334	4.05	4	0.86
Question 2	"I would say I am a digital expert"	334	3.07	3	1.05
Question 3	"When it comes to digital knowledge, I am always up to date"	334	3.46	4	1.00
Question 4	"I am driving the digital transformation forward proactively in our unit"	334	2.66	2	1.19
Question 5	"I can make others enthusiastic about the digital transformation"	334	3.17	3	1.16
Question 6	"I have a clear idea of the structures and processes that are needed for the digital transformation"	334	3.22	3	1.04
	Mean		3.27	3.1667	1.05

It is expected that there will be a relationship between items in the scale, and this relationship will be significant. Hence, correlation analysis should be made in order to determine the items that are incompatible among the items and possess a weak relationship with the scale. The results of the analysis are shown in Table 11. It was expected that the values obtained through correlation analysis should be significant, and the relationship between the items should be at least ≥ .30. In this regard, it was found that there were no items requiring to be removed from the scale items.

Table 11

The Correlation between Items

	1	2	3	4	5	6
Question 1	1					
Question 2	.36**	1				
Question 3	.38**	.63**	1			
Question 4	.28**	.61**	.60**	1		
Question 5	.25**	.51**	.53**	.66**	1	
Question 6	.30**	.55**	.57**	.60**	.59**	1

So as to determine the factor structure of the scale, it was required to perform exploratory factor analysis on the research data. Parallel analysis should have been made to determine whether the resulting factor structure was random. Bartlett's test of sphericity, Kaiser-Meyer-Olkin (KMO) test and factor loading values would be evaluated by means of exploratory factor analysis. A Bartlett's chi-square value of .05 or lower, a KMO value of .60 or higher, and a factor load value of over .50 show that the analysis performed is significant (Büyüköztürk et

al., 2012; Hair et al., 2017; İslamoğlu & Alnıaçık, 2019). In this respect, the results of the exploratory factor analysis and parallel analysis are displayed in Table 12.

The results of the analysis again show that the two-dimensional scale was gathered under one dimension. The parallel analysis also confirmed this result. It was found that the KMO value was at the desired level of .87. The analysis was significant because Bartlett's chi-square value was below .05. When the reliability is considered, it is realized that the Cronbach's Alpha value of the scale was .85. The Combined Reliability (CR) value was .87. It is possible to state that the scale is reliable due to the fact that the values are above .7. Additionally, it is observed that the scale is valid because the Average Explained Variance (AVE) value which was calculated for convergent validity is between .53 and .5 (Cudeck & O'Dell, 1994; Hair et al., 2014, 2017; Luo et al., 2019).

Table 12

Exploratory Factor Analysis and Parallel Analysis of the Academicians

Statement		Factor Load Value (SPSS)	Cronbach Alfa (α) AVE CR	Parallel Analysis (Ncases: 334; Nvar: 6; Ndataset:100; Percent: 95; Brian Oc)		
				Eigen-value	M	Percentage
Digital Leadership						
% of Variance: 51,896						
Question 1	"I think using digital tools is fun"	.51		3.55	1.18	1.25
Question 2	"I would say I am a digital expert"	.75		0.84	1.09	1.13
Question 3	"When it comes to digital knowledge, I am always up to date"	.76		0.50	1.03	1.06
Question 4	"I am driving the digital transformation forward proactively in our unit"	.81	α = .85 AVE = .53 CR = .87	0.42	0.97	1.00
Question 5	"I can make others enthusiastic about the digital transformation"	.74		0.36	0.89	0.94
Question 6	"I have a clear idea of the structures and processes that are needed for the digital transformation"	.75		0.31	0.82	0.87

Extraction Method: Maximum Likelihood (ML)
Rotation Method: Direct Oblimin
KMO: .87
Bartlett's sphericity test; ($\chi2$ = 863.83; df = 15; p = .000)

With the aim of testing the created factor structure in more detail, Confirmatory Factor Analysis (CFA) should be performed. AMOS program will be utilized for CFA. The path diagram of the analysis made is shown in Figure 2.

Figure 2

Exploratory Factor Analysis of The Academicians
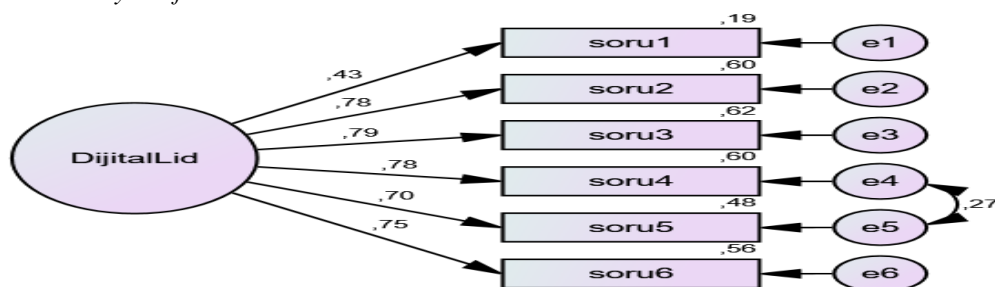
CMIN=18,789; DF=8; CMIN/DF=2,349; RMSEA=,064; CFI=,987; GFI=,980

The results of the analysis indicate that the X2(df) value should be below 5, the p-value below the significant level of .05, the RMSEA value below .10, the CFI value above .90, the GFI value above .90, the SRMR value below .08, the AVE value above .50, and the CR value above .70 (Schermelleh-Engel et al., 2003; Yaşlıoğlu, 2017). Goodness-of-fit values for the analysis are displayed in Table 13.

Table 13

DFA Goodness-of-Fit Values for the Academicians

X2(df)	*p*	RMSEA	CFI	GFI	SRMR	AVE	CR
2.349	.000	.06	.98	.98	.02	.51	.85

The CFA goodness-of-fit indices show that the values are within the desired limits. Furthermore, the item load values are above the desired .5 load value, and the data related to the measurement model are presented in Table 14.

Table 14

DFA Measurement Model Values of the Academicians

|			β1	β2	SD	t	p
Measurement Model							
Question 1	<---	Digital Leadership	.43	1.00			
Question 2	<---	Digital Leadership	.77	2.20	.29	7.47	< .001
Question 3	<---	Digital Leadership	.79	2.13	.28	7.52	< .001
Question 4	<---	Digital Leadership	.77	2.49	.33	7.46	< .001
Question 5	<---	Digital Leadership	.69	2.17	.30	7.17	< .001
Question 6	<---	Digital Leadership	.74	2.10	.28	7.39	< .001

Confirmatory factor analysis (CFA) is basically utilized for psychometric assessment of instruments and construct verification, but also it is used to determine the effects of the method and to evaluate factor invariance (Kääriäinen et al., 2011). In this regard, two analyzes will be exposed to invariance analysis through AMOS program. Findings regarding invariance analysis are presented in Table 15. With the aim of testing the compatibility of the data obtained from teachers and academicians and the general validity of the scale, invariance analysis was applied to the scale; the analysis results make it possible to state that the scale, which was adapted into Turkish, had invariance and was appropriate to be used by large masses due to the fact that the ΔCFI value was below .01 (Cheung & Rensvold, 2002) between both samples (Byrne, 2016). The path diagram regarding the invariance analysis is displayed in Figure 3.

Table 15

Invariance Analysis

Model	χ2	df	χ2/df	RMR	SRMR	CFI	RMSEA	Δχ2	Δdf	ΔCFI	p-value for Δχ2
Group1	17.68	8	2.21	.04	.03	.97	.09	-	-	-	
Group2	18.78	8	2.34	.03	.02	.98	.06	-	-	-	
Model 1: Configural	36.47	16	2.27	.03	.03	.98	.05	-	-	-	
Model 2: Weak (Metric)	42.07	21	2.00	.05	.05	.98	.04	5.60	5	.000	.34
Model 3: Scalar	42.12	22	1.91	.05	.05	.98	.04	0.04	1	.000	.82
Model 4: Strong	44.66	29	1.54	.05	.06	.98	.03	2.54	7	.004	.92
Model 5: Partial (Soru 2-a1)	40.27	17	2.36	.04	.04	.98	.05	4.38	12	.006	.97

Δχ2: χ2 change (|χ2n- χ2n-1|); Δdf: df change (|dfn-dfn-1|); Δχ2/df: χ2/df change (|χ2n/ dfn -| χ2n-1/ dfn-1); ΔCFI: CFI change (|CFIn-CFIn-1|); ΔCFI<0,01**; p-value for Δχ2: χ2 significance value of change (p<0.05*)

Figure 3
Invariance Analysis Path Diagram
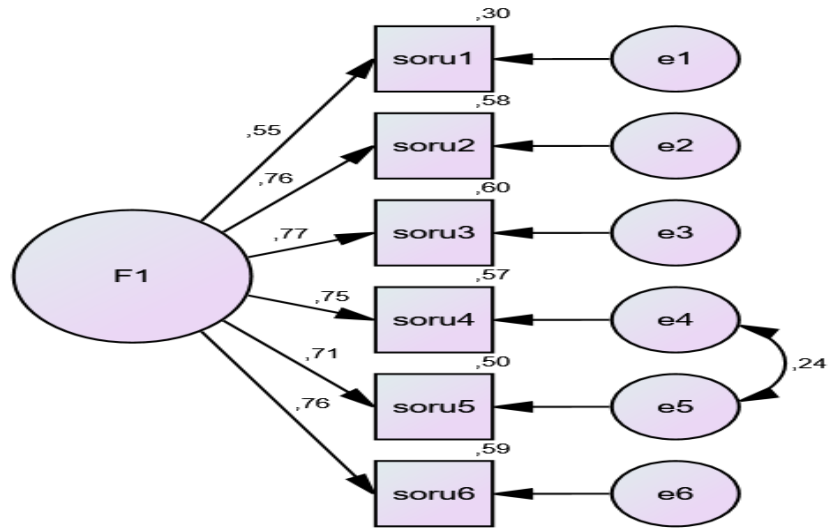
CMIN=40,444; DF=17; CMIN/DF=2,379; RMSEA=,054; CFI=,981; GFI=,972

Conclusion

The present study aimed to adapt a scale into Turkish, which could be used to research digital leadership, which has become quite widespread and gained importance at present and is thought to be appropriate for environmental conditions.

To achieve this aim, a two-stage study was conducted for the Turkish adaptation of the scale which was developed by Zeike et al. The first pre-test was practiced with the teachers. According to pre-test results, it was found that the data showed normality, the values obtained through correlation analysis were significant, and the relationship between the items was adequate. It was also realized that the values obtained via exploratory factor analysis and confirmatory factor analysis were within the ranges of the desired value. Furthermore, in the exploratory factor analysis, a one-dimensional structure appeared, which was also tested through confirmatory factor analysis, and it was observed that it had a one-dimensional structure.

Due to the fact that desired values were obtained in the pre-test, the analysis made for the academicians was initiated. The analysis in the pre-test was repeated at this stage in the same way. The results indicated that the obtained results were also within the desired range of values at this stage.

In the study conducted by Matsunaga (2022), the reliability values of the scale were found to be McDonald's omega (ω) .82. In the study carried out by Zhu et al. (2022), the scale was one-dimensional, and the reliability coefficient Cronbach Alpha was determined to be .85. In the original study by Zeike et al. (2019), the Cronbach's Alpha value was found to be .87. In the present study, the Cronbach's Alpha value was found as .87 in the first EFA and .85 in the second EFA. The values found were consistent with the literature. However, different from the literature, Combined Reliability (CR) value and Average Explained Variance (AVE) value were calculated in this study. In this respect, it is seen that the present study contributed to the reliability and validity of the scale.

   Despite the fact that the scale was defined as two-dimensional by Zeike et al. (2019), the scale was gathered under one dimension in the statistical model. The one-dimensional structure has been proved by invariance analysis. Furthermore, the study conducted by Zhu et al. (2022) supports the one-dimensional structure.

   The present study showed that this scale had a one-dimensional structure. It is thought that this scale, which had the desired values when the pre-test and post-test results were considered, can be used in different studies. Scale adaptation studies are of great significance both for disseminating a scale at the national level and enabling an alternative to existing ones. In this regard, the study is considered to have importance for the literature. However, the results of the present scale adaptation study need to be supported by other studies to be conducted and to be addressed with different samples.

Declarations
Acknowledgements
Not applicable.

Disclosure Statement
No potential conflict of interest was reported by the authors.

Ethics Approval
Not applicable.

Funding Acknowledgements
Not applicable.

Citation to this article
Oktaysoy, O., Topcuoglu, E., & Kaygin, E. (2022). A study on digital leadership scale adaptation. *International Journal of Organizational Leadership, 11*(4), 407-425. https://doi.org/10.33844/ijol.2022.60342

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Appendix A

Turkish version of the scale

English		Turkish	
Digital Leadership		Dijital Liderlik	
Question 1	"I think using digital tools is fun"	Soru 1	Dijital araçları kullanmanın eğlenceli olduğunu düşünüyorum.
Question 2	"I would say I am a digital expert"	Soru 2	Dijital cihazlar ve uygulamalar konusunda uzmanı olduğumu söyleyebilirim
Question 3	"When it comes to digital knowledge, I am always up to date"	Soru 3	Dijital gelişmeleri sürekli takip ederim.
Question 4	"I am driving the digital transformation forward proactively in our unit"	Soru 4	Çalıştığım birim veya kurumun dijital dönüşümü konusunda öncülük etmekteyim.
Question 5	"I can make others enthusiastic about the digital transformation"	Soru 5	Çalışma arkadaşlarımı dijital dönüşüm konusunda yönlendiririm.
Question 6	"I have a clear idea of the structures and processes that are needed for the digital transformation"	Soru 6	Dijital dönüşüm için ihtiyaç duyulan yapılar ve süreçler hakkında net bir fikrim vardır.