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Araştırma Makalesi * Research Article

A Study On Digital Leadership Scale (DLS) Development

Dijital Liderlik Ölçeği (Djl) Geliştirme Çalışması

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Abstract: Since digital leadership has become a critical success factor for securing sustainability in companies, it is of great importance to define scalable characteristics of it. In literature, an adequate measuring instrument is not available for assessing the perceptions regarding digital leadership. This study is about digital leadership characteristics and aims to fill the mentioned research gap by developing a "Digital Leadership Scale" based on an empirical study conducted among 526 people working at different sectors in private and public enterprises in Turkey. After the data were collected, the scope and construct validity of the scale was tested using the statistical programs SPSS and AMOS. The internal consistency coefficient of the scale is .90. As a result of the exploratory and confirmatory factor analysis, the Digital Leadership Scale (DLS) was validated in 9 items and 2 dimensions, so it can be stated that it is a reliable measuring instrument.

Keywords: Digital leadership scale, scale development, digital leadership, digital leadership characteristics, digital transformation.

Öz: Dijital liderlik kurum ve kuruluşlarda sürdürülebilirliği sağlamak için kritik bir başarı faktörü haline dönüşmesiyle birlikte dijital liderliğin ölçeklenebilir özelliklerini tanımlamak büyük önem taşımaktadır. Literatürde dijital liderliğe ilişkin algıları değerlendirmek için yeterli bir ölçüm aracı bulunmamaktadır. Bu çalışma, dijital liderlik özellikleri ile ilgili olup, Türkiye'de özel ve kamu kuruluşlarında farklı sektörlerde çalışan 526 katılımcı arasında yürütülen ampirik bir çalışmaya dayalı bir "Dijital Liderlik Ölçeği" geliştirerek söz konusu araştırma boşluğunu doldurmayı amaçlamaktadır. Veriler toplandıktan sonra ölçeğin kapsam ve yapı geçerliği SPSS ve AMOS istatistik programları kullanılarak test edilmiştir. Ölçeğin iç tutarlılık katsayısı .90'dır. Açımlayıcı

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ve doğrulayıcı faktör analizi sonucunda Dijital Liderlik Ölçeği (DLÖ) 9 madde ve 2 boyutta doğrulanmıştır, dolayısıyla geçerli ve güvenilir bir ölçme aracı olduğunu göstermiştir.
Anahtar Kelimeler: Dijital liderlik ölçeği, ölçek geliştirme, dijital liderlik, dijital liderlik özellikleri, dijital dönüşüm.

INTRODUCTION

With the development of various Industry 4.0 technologies, the digitalization process has accelerated and the transition to the digital age has begun, so today we are concerned with the digital transformation of daily life and particularly businesses. This cycle has proven the importance of digital transformation both for the private sector and the public institutions, and it is realized that this transformation is a necessity and a process which must be managed well (Tanniru, Khuntia & Weiner, 2018). While public institutions have achieved their goals such as increasing the quantity and quality of provided social services by adapting to the digital transition, businesses' digital transformation has enabled them to maintain and improve their profitability, efficiency and effectiveness in the course of digital age (El Sawy, Kræmmergaard, Amsinck & Vinther, 2016; Tanniru et al., 2018; Narbona, 2016).

Digital transformation of businesses is a comprehensive transformation process including the change of all business processes, the adaptation of innovations brought by information and technology, creating a new system, the adaptation of changes in this process to employees, making new strategic decisions, business models, business processes (Ismail, Khater & Zaki, 2018), and job descriptions and the integration of new technology into the organization structure (Goran, LaBerge & Srinivasan, 2017; Stolterman & Fors, 2004). Digital transformation is understood as a new or improved result of intellectual activity, which is developed and implemented as a product (good or service), process (technology) or method (Klein, 2020a), providing a qualitative increase in productivity compared to existing solutions. It is also an organizational transformation which provides such additional values as profit, leadership and quality advantage.

Digital transformation involves not only technological changes, but affects cultural structures as well (Bolte, Dehmer & Niemann, 2018; Kindermann, Beutel, de Lomana, Strese, Bendig, & Brettel, 2021; Tanniru, 2018; Wilson III, Goethals, Sorenson & Burns, 2004). Hence, digital transformation is an organizational transformation, which is necessary to bring ideas to life using digital thinking and maintain an innovation culture, to adapt to cultural change by using advanced technology, to be fast and solution-oriented, to produce innovative ideas which create value for customers, to be innovative service-oriented and customer-centered, to meet the needs of the business market by discovering new opportunities provided by digitalization and to put these services into operation (Dimitrov, 2018; El Sawy et al., 2016; Narbona, 2016; Tanniru, 2018). Based on the digital transformation explanations above, the need for successful management of digital transformation processes reveals the importance of digital leadership. In the digital age, digital leaders can be described as leaders who apply and adapt digital transformations to the internal and external environment, and lead change and ensure sustainability of digital organizations using their leadership characteristics such as skills and expertise (Sheninger, 2014). To put it simply, digital leadership could be clearly identified as a leadership style which not only aims to lead the digital transformation, in order create a culture of sustainable change in the organization with innovative and visionary perspective by supporting and enforcing its employees to implement the digital transformation, but also manages to lead an organization in a digital business environment (Klein, 2020b).

Although a sufficient number of studies exist in the international literature examining the characteristics which a digital leader should have (Ahlquist, 2014; Northouse, 2015; Narbona, 2016; El Sawy et al., 2016; Tanniru et al., 2018; Klein, 2020b), a study on assessing these digital leadership skills has not been conducted yet. In this respect, the main purpose of this study is to develop a reliable and valid "Digital Leadership" scale based on the digital leadership characteristics elaborated in the literature, in order to make a substantial contribution to the studies in this area and to facilitate the measurement of an abstract concept by offering an applicable tool. In addition to an extant literature review, interviews and survey methods have also been applied during the study. The validation of the scale is provided with exploratory and confirmatory factor analyses. The study is structured in four

chapters. In the following chapter the term digital leadership in the era of digital transformation is investigated thoroughly. Then, in the next chapter, the scale development methodology is described and the "Digital Leadership Scale" is introduced. The last chapter includes the conclusion part referring to the results of the study and ends up with future research directions which may provoke attention of scholars and practitioners within the field.

CONCEPTUAL FRAMEWORK

Digital Leadership In The Era Of Digital Transformation

Digital transformation of organizations can only be achieved through people, who manage the process of transformation and who can assure the sustainability of organizations (Estensoro, Larrea, Müller & Sisti, 2021; Matt, Pedrini, Bonfant & Orzes, 2022; Swift, Donald, Pike & Lange, 2019). Digital leaders are mostly considered as people, Digital leaders are mostly considered as people, who are responsible to carry organizations successfully through digital transformation, but what they mean for the organizations is above this. Starting with e-leadership, the definition of digital leadership has changed in line with different stages of digitalization: In the beginning of digitalization E-leadership meant just leading by using ICT (Information and Communication Technologies) to support existing organizations (Dasgupta, 2011; Horner-Long & Schoenberg, 2002; Li, Liu, Belitski, Ghobadian & O'Regan, 2016), whereas today digital leadership means leading in a knowledge-based society consisting of digital business models and digital organizations (Oberer & Erkollar, 2018). In literature, different definitions of digital leadership can be observed: The first group of them defines digital leadership as the leadership style during digital transformation process. For example according to Qualman (2012) digital leadership means transforming, adapting and inspiring in the digital age. Abbatiello, Knight, Philpot and Roy (2017) defines digital leadership as achieving improvement through an innovation culture, risk tolerance and continuous digital transformation by creating teams which allow people to stay connected and participate. Sahyaja and Rao (2018) realizes digital leadership in having digital transformation knowledge and contributing to the transition to the information and technology process. The second group of literature sources advocates that digital leadership means more than leading the transformation process: According to De Waal, van Outvorst and Ravesteyn (2016) it means combining the competence and culture of a leader to use digital technology to create value in the organization. El Sawy et al., (2016) defines digital leadership as the ability to implement business strategy, business models, corporate platform, different ways of thinking and digital skill sets. For Asri and Darma (2020) digital leaders are leaders who can use technology well, manage and direct the talents of experts to achieve their goals, and especially balance the participation of human resources and technology. Miller (2018) considers digital leaders as the leaders who use broad technology to improve the lives, well-being and conditions of others. According to Cortellazzo, Bruni and Zampieri (2019) a digital leader is responsible for formulating technological tools and digital strategies and implementing digital changes in organizations. Digital leaders are expected to have a critical understanding of change processes and to be initiators of organizational change, such as operational improvements, new business models, customer relations, employee workload, motivation, and financial conditions, based on the change needs of the organization (Sow & Aborbie, 2018; Larjovuori, Bordi, Mäkiniemi & Heikkilä-Tammi, 2016; Zeike, Bradbury, Lindert & Pfaff, 2019).

According to Klein (2020b), digital leadership involves both leading the digital transformation of an organization and leading the organization in a digital environment and a flow exists between these two aspects (see Figure 1). Today most of the companies are still in the middle of their digital transformation process and leadership plays an important role in the successful adaptation to changes induced by digital transformation (Li et. al, 2016). As the digital transformation of organizations progresses, digital leadership will increasingly mean leading a digital organization. Thus, digital leadership characteristics will have to pay attention to both aspects.

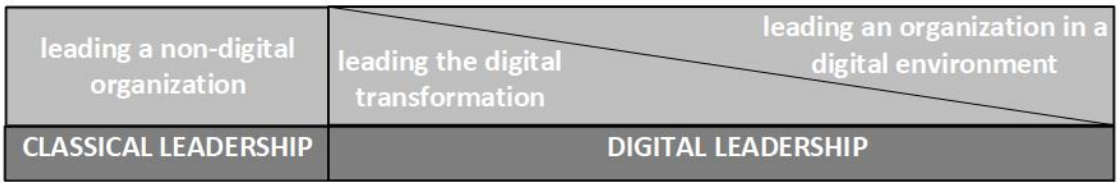

Figure 1. Digital leadership (Klein, 2020b)

In literature, it is asserted that digital leadership has overlapping conceptual fragments with especially transformational leadership (Prince, 2018). Digital leaders should act proactively to attain organizational goals, and through that process, they can trigger and encourage the development of employees, especially in terms of innovative work behaviors (Erhan, Uzunbacak & Aydin, 2021; Chen, 2014). A digital leader's transformational role is in his/her empowering approach that encourages employees for being innovative (Kieser, 2017; Judge & Bono, 2020). Digital leaders are expected to be donated with the ability to understand and utilize information based on new information technologies (Yücebalkan, 2020). A digital leader is considered as one who "believes that continuous innovation guarantees survival and ensures that everyone in the organization is committed to putting into practice the principles of continuous transformation" (Schiuma, Schettini, Santarsiero & Carlucci, 2021).

Based on all these definitions, digital leadership is defined in this study as "A leadership style which aims to implement and to enforce the digital transformation of the organization and to create a culture of sustainable change in the organization, in order to lead the organization in a wholly digital environment".

Existing studies in the literature on digital leadership can be categorized in the following groups:

- ***Conceptual theoretical studies on digital leadership:*** These studies attempt to define digital leadership and to develop conceptual frameworks for it. Herder-Wynne, Amato and Uit de Weerd (2017) define digital leadership as fast alignment and engagement of networked teams and new ways of being organized, while Herold (2016) sees it as combination of digital skills and soft skills such as diversity, ethical responsibility and agility. Oberer and Erkollar (2018) developed a 4.0 Leadership Matrix which includes certain dimensions regarding people, innovation and technology) In that study, a team-oriented and strong innovative digital leadership style were framed. Petry (2018) describes the characteristics of leadership in the digital economy as being network oriented, participatory, open and agile. Temelkova (2018) concludes that digital leaders should have skills for leading networked-based business organizations as members of high-tech economy.

- ***Literature surveys on digital leadership:*** Most of the literature surveys aim to determine digital leadership features. Cortellazzo's et al. (2018) study is a review of articles on leadership and digitalization, in which they are categorized based on micro and macro perspective. Leader skills in the digital era is one of the categories at micro level, which include communicating through digital media, high speed decision making, managing disruptive change, managing connectivity and having technical skills. Promsri (2019) has also performed a literature review, in order to find out digital leadership characteristics. They include digital literacy and being visionary, sympathetic to customers, agile, risk taker and collaborative. De Waal et al.'s (2016) study is a literature review on developments and opportunities in digital leadership, in order to find out the implications for different stakeholders such as human agents, organizations and society. Ordu and Nayır (2021) examine studies on digital leadership, in order to find a clear definition of it not to analyze leadership characteristics. Özmen, Eriş and Özer's (2020) study is a content analysis of 111 studies about the effects of digitalization on leadership and categorizes these studies. The main purpose of the study of Sahyaja and Rao (2018) is to determine which leadership style suits the most for the digital era and how emotional intelligence affects digital leadership. Klein (2020b) examines the literature with content analysis method and puts forwards twenty three digital leadership characteristics based on the results of this extant literature survey.

- ***Empirical studies on digital leadership:*** There are several empirical studies to define digital leadership skills: In the study of Bolte et al. (2018) nine digital leadership feature categories are

analyzed in a survey with 72 participants from different sized companies. It is concluded that especially improvements in the categories communication, expectation & orientation and methods & standards are necessary on implementing digital leadership. Jakubik and Berazhny's (2017) study consists of a small-scale qualitative survey about determining which skills are necessary for digital leadership. As a result, such skills as social intelligence, passion, empathy, open mindedness, creativity, critical thinking, virtual teamwork, co-creation, collaboration, communication, delegating power, empowering others and anticipating the future are listed. In the master thesis of Kunaka (2019), having a transformative vision, being forward-looking, having digital literacy and adaptability have been identified as competences leaders require to deliver digital transformation. Larjovuori et al. (2016) executed a qualitative content analysis from data of 46 interviews to determine the effect of digital transformation on leadership, where strategic vision and action, leading cultural change, enabling and leading networks have been identified as main leadership aspects of digital business transformation. The purpose of the study of Sow and Aborbie (2018) is to identify leadership styles which impact the digital transformation of an organization, where semi-structured interview method is used to evaluate leaders involved in digital transformation. Results of that study indicate that for a successful digital transformation, leaders should adapt to change effectively, they should be flexible and they should support their employees during and after a digital transformation. There are also some empirical studies, which aren't just concentrated on skills of digital leaders. For example, Afandi's (2017) work is a survey about the role of leadership in the digital transformation process. Akkaya and Tabak (2020) interviews managers, in order to analyze relationships between agility and digital leadership. Furthermore, Hesse (2018) uses qualitative interviews, in order to analyze the effects of digitalization on leadership styles, leaders' communication and digital tools. Mihardjo, Sasmoko, Alamsjah and Elidjen (2019) define digital leadership as combination of digital culture and digital competence and measure effects of digital leadership on business model innovation and customer experience orientation. Zeike et al. (2019)'s work is a study which explores whether digital leadership is associated with psychological well-being of upper level managers. Larjovuori et al. (2016) focused on leadership as a result of their research to understand what kind of leadership is needed in the digitalization process. They decided on strategic vision and action, leading cultural change, enabling, and leading networks. Bolte et al. (2018) identified leadership characteristics in the digitalization process in businesses of different sizes and in terms of managers and employees. Kazım (2019) investigated the best leadership style and leader characteristics in the digital transformation process. This work is an empirical study about digital leadership with the aim of developing a scale which will serve as a tool for measuring the anticipated digital leadership characteristics of employees. Examining the empirical studies on leadership for digital transformations, it can be stated that these studies are mostly gathered around a general purpose, namely determining the role of the leader or the leadership style in the digitalization process. However, although they offer broad definitions on digital leadership attributes, they do not provide a tool for assessing these skills and, due to the increasing interest on this topic, it seems essential to fill this gap by developing a "digital leadership" scale.

METHODOLOGY

Scale Development

This study aims to develop and validate an instrument, the "Digital Leadership Scale" (DLS), to measure the digital leadership perceptions of managers and employees. This study has adopted both a deductive and an inductive approach by scale development, since the digital leadership characteristics are derived from literature analysis and then verified and optimized by conducting interviews.

The steps suggested by De Vaus (2002) and Crocker and Algina (1986) were followed in the development of the scale. The phases followed in the scale development and their performed activities are given in the Figure 2.

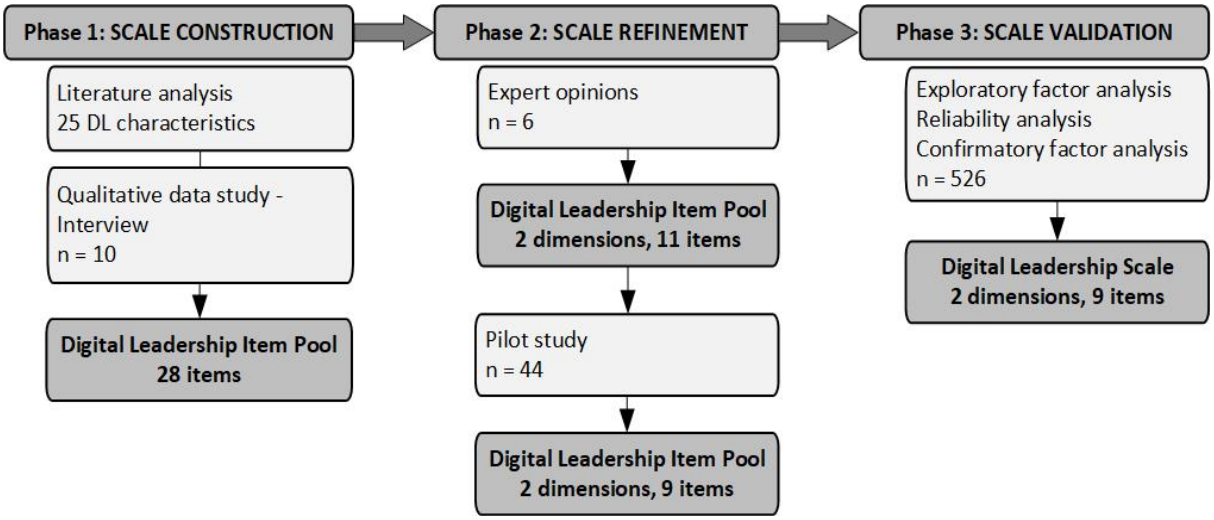

Figure 2. *Scale development process for DLS (Authors)*

Phase 1. Scale Construction

The first phase of the scale development process is the phase of scale construction, which is based on a qualitative data study and on results of the literature survey. Qualitative data was collected by conducting preliminary interviews with 10 managers working in companies using Industry 4.0 technologies in order to develop an item pool for digital leadership characteristics. "What is the digital leadership?", "What are the qualities that a digital leader should have?", "How should the attitudes of digital leaders towards the internal and external environment for which they are responsible, be in digital transformation?" are some of the questions answers of which are sought. While writing digital leadership scale items, characteristics obtained from literature analysis about digital leadership were also taken into account. The results of the interviews were aligned with literature analysis based on the overlapping characteristics mentioned in both methods, and consequently, twenty five digital leadership characteristics which are listed in Table 1 were identified. While creating the digital leadership characteristics item pool in this study, all the listed items in Table 1 were turned into propositions suggesting the behavioral reflection of the relevant adjective. For example, for the "learning by errors" characteristic, the item was verbalized as "the leader learns from the made mistakes", or for "encouraging" attribute, the item was written as "the leader encourages and motivates employees when encountering difficulties in the digital transformation process". As a result of the interviews with managers 3 additional characteristics, to name, "responsive", "extraverted", and "pragmatic" were added to the pool. At the end, a preliminary pool consisting of 28 items was constituted.

Table 1. *Digital leadership characteristics – literature analysis*

DL CHARACTERISTICS	LITERATURE SOURCES
Innovative	Bolte, Dehmer & Niemann, 2018; Bosch, Hentschel & Kramer, 2018; Davutoğlu, 2018; Eberl & Drews, 2021; Fisk, 2002; Larjovuori, Bordi & Heikkilä-Tammi, 2018; Klein, 2020b; Mihardjo, Sasmoko, Alamsjah & Elidjen, 2019;Ordu & Nayır, 2021; Schiuma et al, 2021
Networking	Fisk, 2002; Larjovuori, Bordi & Heikkilä-Tammi, 2018; Klein, 2020b; Oberer & Erkollar, 2018; Sikora, 2017
Digitally keen	Eberl & Drews, 2021; Fisk, 2002; Henderikx & Stoffers, 2021; Klein, 2020b; McCarthy et al, 2021; Ordu & Nayır, 2021; Sikora, 2017
Headhunter for digital	Klein, 2020b
Expert for complexity	Fisk, 2002; Klein, 2020b

Ambidextrous	Bosch, Hentschel & Kramer, 2018; Fisk, 2002; Klein, 2020b
Encouraging	Bosch, Hentschel & Kramer, 2018; Eberl & Drews, 2021; Henderikx & Stoffers, 2021; Klein, 2020b; Larjovuori, Bordi & Heikkilä-Tammi, 2018; Yüksel & Genç, 2018
Digital idol	Eberl & Drews, 2021; Klein, 2020b; Yüksel & Genç, 2018
Employee-focused	Bolte, Dehmer & Niemann, 2018; Eberl & Drews, 2021; Henderikx & Stoffers, 2021; Klein, 2020b
Customer-centric	Eberl & Drews, 2021; McCarthy et al, 2021
Data-oriented	Davutoğlu, 2018; Schiuma et al, 2021
Collaborative	Bolte, Dehmer & Niemann, 2018; Eberl & Drews, 2021; Fisk, 2002; Henderikx & Stoffers, 2021; Prince, 2017; Yüksel & Genç, 2018
Engaging	Fisk, 2002
Delegative	Klein, 2020b; Yüksel & Genç, 2018
Transparent	Bolte, Dehmer & Niemann, 2018; Eberl & Drews, 2021; Klein, 2020b; Oberer & Erkollar, 2018; Prince, 2017; Sikora, 2017
Divergent	Bosch, Hentschel & Kramer, 2018; Eberl & Drews, 2021; Henderikx & Klein, 2020b; Stoffers, 2021
Flexible	Bolte, Dehmer & Niemann, 2018; Eberl & Drews, 2021; Henderikx & Stoffers, 2021; Klein, 2020b;Oberer & Erkollar, 2018; Yüksel & Genç, 2018
Agile	Eberl & Drews, 2021; Lindner & Greff, 2019; McCarthy et al, 2021; Klein, 2020b; Oberer & Erkollar, 2018
Inquisitive	Henderikx & Stoffers, 2021; Klein, 2020b; Mihardjo, Sasmoko, Alamsjah & Elidjen, 2019
Determining	Mihardjo, Sasmoko, Alamsjah & Elidjen, 2019
Conscious	Klus & Müller, 2019
Creative	Henderikx & Stoffers, 2021; Mihardjo, Sasmoko, Alamsjah & Elidjen, 2019; Yüksel & Genç, 2018
Learning by errors	Bolte, Dehmer & Niemann, 2018; Klein, 2020b; Oberer & Erkollar, 2018
Business optimizer	Klein, 2020b; McCarthy et al, 2021; Sikora, 2017
Team-builder	Bosch, Hentschel & Kramer, 2018; Huang, Kahai & Jestice, 2010; Oberer & Erkollar, 2018

Phase 2. Scale Refinement

The second step of the scale development study is the phase of scale refinement. First, items were purified according to expert opinions and relevant items were selected. Four assessment and evaluation experts, who are university professors at three different universities in Turkey specialized in leadership studies and two language experts, one specialized in English and the

other one in Turkish studies, have examined the items in terms of content validity, grammar, face validity and semantic clarity in order to evaluate the items gathered in the item pool. Changes were made in the wording of some items in line with expert opinions. As a result, 17 items ("expert for complexity", "customer-centric", "data-oriented", "collaborative", "engaging", "delegative", "extraverted", "transparent", "divergent", "pragmatic", "inquisitive", "determining", "conscious", "creative", "learning by errors", "business optimizer", "team-builder") which are not seen unique to digital leadership but found in many leadership styles were removed from the item pool and the remaining items were classified under two dimensions, as "Innovative" and "Supportive". Characteristics belonging to the "Innovative" dimension emerged as "innovative", "networking", "flexible", "digitally keen", "agile", "ambidextrous", "headhunter for digital" and "responsive", and the ones belonging to the "Supportive" dimension were listed as "encouraging", "digital idol", and "employee-focused".

Secondly, a pilot study was conducted on 44 people with the demographic features listed in Table 2. The scale was prepared on a five-point Likert type, ranging from "I strongly disagree"- (1) to "I strongly agree"- (5) with remaining 11 items. In the pilot application, a highly reliable Cronbach Alpha value of 0.81 was obtained. At this stage, 2 items with low reliability values were removed from the scale. The two items with low reliability were "flexible" and "responsive". The final version of the scale

before validation consisted of 9-items in two dimensions "Innovative" (6 items) and "Supportive" (3 items).

Table 2. *Pilot study – demographic features*

Personal Characteristic	Type	Frequency	%
Age	25-30	9	20,45%
	30-35	13	29,54%
	35-40	10	22,72%
	40-50	12	27,27%
Gender	Female	22	50%
	Male	22	50%
Education	High school	9	20,45%
	Undergraduate	19	43,18%
	Postgraduate	16	36,36%
Marital Status	Married	22	50%
	Single	22	50%
Position (Are you a manager?)	Yes	25	56,80%
	No	19	43,18%
Working time in the institution	0-1 year	9	20,45%
	2-5 year	10	22,72%
	6-10 year	10	22,72%
	11-15 year	10	22,72%
	16-20 year	5	11,36%
Total working time	0-5 year	19	43,18%

Phase 3. Scale validation

The target population of the scale validation study consisted of managers and employees working in private and public enterprises at different sectors in Turkey. Snowball sampling technique was applied as the data collection method. An online e-mail communication tool was used to reach the sample group. 200 managers and 326 employees have participated in the survey via Google-Forms. Before the scale was applied, the participants were given the necessary information on the scale form and they were told that there were no right or wrong answers in the scale, and each answer should reflect their personal views and beliefs. Participants were asked to fill in the online volunteer consent form.

First, exploratory factor analysis (EFA) was performed to determine the construct validity of the scale. Before performing EFA, Kaiser Meyer Olkin (KMO) sample adequacy coefficient and Barlett Sphericity test significance value should be calculated to determine the suitability of the data for factor analysis. A KMO value greater than 0.50 means that each variable in the scale can predict other variables (Field, 2013). As a result of the analysis performed in this study, the KMO sample adequacy coefficient was calculated as 0.858, and the result of the Barlett Sphericity test was also found to be significant ($\chi 2$= 3968.044, sd= 36; $p<.01$). Therefore, it was determined that the data obtained from the scale was suitable for factor analysis. The factors obtained as a result of the EFA analyses are shown in Figure 3.

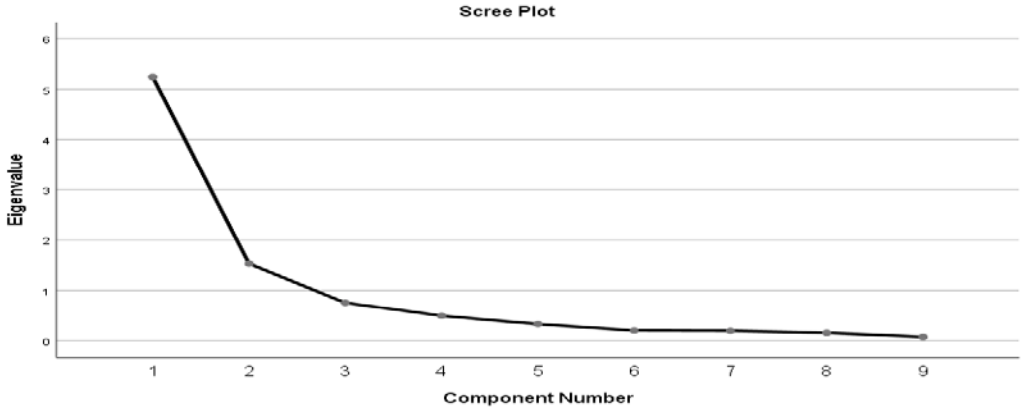

Figure 3. *Slope graph of DLS's factor count (Authors)*

Examining the slope-slump plot, it is concluded that DLS consists of two dimensions, since only two dimensions exist with an eigenvalue higher than 1. According to Field (2013) and De Vaus (2002), the sudden and rapid decreases in the graph indicate the number of factors. The eigenvalues and variances of the factors reached as a result of EFA are given in Table 3. Examining Table 3, it is observed that DLS, which consists of two factors, explains a very large amount of the total variance (75.32%). According to Kline (2011) it is sufficient if the total variance explained in scales consisting of more than one factor is above 41%. The innovative dimension constitutes 43.21% and the supportive dimension constitutes 32.10% of the total explained variance.

Table 3. *Factor Structure of DLS*

Factor Order	Factors	Factor Eigenvalue	Percentage of Variance (%)	Percentage of Total Variance (%)
1	Innovative	3,889	43,21	43,21
2	Supportive	2,890	32,10	75,32

As the second step of the scale validation phase, reliability calculations were conducted for the items in each sub-dimension of the scale. As a result of the reliability analysis, the Cronbach's Alpha coefficient of the whole scale was found to be 0.91, which indicates that the scale can be considered highly reliable. Findings regarding the reliability of the sub-factors are given in Table 4. Examining Table 4, it can be suggested that the sub-dimensions constituting the DLS have been also found to be at a highly reliable level. Alpha values were calculated as 0.90 for the dimension "Innovative" and 0.95 for the dimension "Supportive".

Table 4. *Alpha reliability values of dimensions of DLS*

Dimension Name	Items	Alpha Value
Innovative	Innovative: Has an innovative vision. Networking: Has the ability to build and coordinate teams quickly. Digitally keen: Has up-to-date knowledge and skills about digital technologies and digital transformation. Agile: Acts proactively in the digital transformation process in organization. Ambidextrous: Balances new and existing business areas, modern trends and past traditions, and innovation and integration. Headhunter for digital: Finds ways to attract new digital talent to organization.	.90
Supportive	Encouraging: Encourages employees when encountering difficulties in the digital transformation process. Digital idol: Acts as a guide and role model for those who work in the digital transformation process.	.95

	Employee-focused: Focuses on employees' wellbeing during digital transformation

In line with the findings, the factor loadings of the scale items and their distribution according to the factors are given in Table 5. As can be seen in Table 5, the factor loadings of the items consisting of the "Innovative" dimension vary between 0.69 and 0.87. The items constituting the "Supportive" dimension vary between 0.90 and 0.94.

Table 5. *Factor loading for a 9 item DLS*

Dimension Name	Items	1st Dimension	2nd Dimension
Innovative	Digitally keen	,865	
	Innovative	,825	
	Agile	,785	
	Headhunter for digital	,769	
	Networking	,759	
	Ambidextrous	,692	
Supportive	Encouraging		,936
	Employee-focused		,921
	Digital idol		,903

As the third step of scale validation phase, confirmatory factor analysis (CFA) was conducted to ensure the validity of the data. For CFA fit, chi-square divided by degrees of freedom [χ2/sd], adjusted goodness-of-fit index (AGFI), general fit index (GFI), incremental fit index (IFI), root mean square error of approximation (RMSEA), and comparative fit index (CFI)) values were regarded as basic criteria (Çelik & Yılmaz, 2013; Kline, 2011). In the CFA analysis, theoretically supported error bindings modifications were made among the variables to improve the fit index values for the relevant model. Confirmatory factor analysis (CFA) was performed on DLS and the two-factor structure obtained by exploratory factor analysis (EFA) was tested. The obtained CFA results gave consistent results with the results obtained by EFA, and the fit indices were at very good levels [(χ2=89.395, sd=23, p<0.01, χ2/sd=3.887, RMSEA=0.07, GFI=0, 96, AGFI=0.93, IFI=0.98, CFI=0.98)]. In order to determine the adequacy of the theoretical model with the CFA analysis in terms of the data obtained, the values of the fit indices and the fit values for the CFA model are given in Table 6. As can be seen in Table 6, the tested theoretical model has a structure compatible with the data set and the model fit indexes are at an excellent level. A value of χ2 between 2 and 5 is the first parameter determining that the model is compatible with the data at an acceptable level (Kline, 2011). The fact that the RMSEA value, another fit criterion, is below 0.08, indicates an acceptable level of fit of the model with the data set. The excellent level of fit criteria also showed that the tested model generally fitted well with the data.

Table 6. *Fit values* of the digital leadership scale fit indices and fit of the model*

Fit Indexes	Perfect Fit Criteria	Acceptable Fit Criteria	Fit Indices	Decision
χ2/sd	0 ≤ χ2/sd ≤ 2	2 ≤ χ2/sd ≤ 5	3,887	Acceptable Fit
RMSEA	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.07	Acceptable Fit
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI ≤ .95	.98	Perfect Fit
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI ≤ .95	.96	Perfect Fit
AGFI	.95 ≤ AGFI ≤ 1.00	.85 ≤ AGFI ≤ .90	.93	Perfect Fit
IFI	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI ≤ .95	.98	Perfect Fit

*(Çelik & Yılmaz, 2013; Kline, 2011)

In order to test the structural validity of the digital leadership scale (DLS), the two-dimensional structure obtained by EFA and the fit indices tested with DFA were found to be at an excellent level. In Figure 4, DFA applied to DLS is visualized.

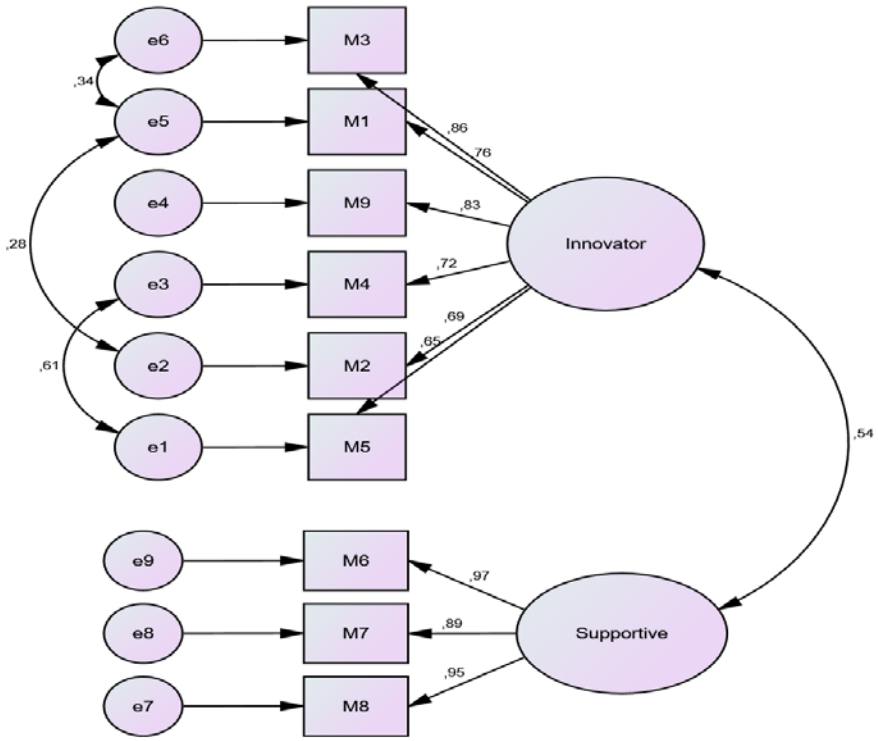

Figure 4. *Digital leadership scale confirmatory factor analysis results*

The answers given to the items in the scale were as follows; Strongly Disagree [1], Partially Disagree [2], Undecided [3], Partially Agree [4], and Strongly Agree [5]. The scores in Table 7 are based on the interpretation of the item ranges. As can be seen in Table 7, as the scores obtained from DLS increase, the digital leadership perceptions of the employees towards their managers also increase positively.

Table 7. *Intervals based on the interpretation of scores from the scale and their meanings*

	Statements	**Point Interval**	**Digital Leadership Level**
Digital Leadership	Strongly Disagree	1,00-1,80	Minimal level digital leadership
	Partially Disagree	1,81-2,60	Low level digital leadership
	Undecided	2,61-3,40	Intermediate level digital leadership
	Partially Agree	3,41-4,20	High digital leadership
	Strongly Agree	4,21-5,00	Very high level digital leadership

As a result of the researches and analyzes, it was concluded that DLS, an 9-item measurement tool consisting of innovative and supportive dimensions, is a reliable and valid measurement tool and can be used to measure the perceptions of digital leadership. Statistical analyses and fit indices conducted within the scope of the study reveal that the scale has a perfect fit. It can be stated that the resulting scale has become a successful scale which can measure the extent of digital leadership applied.

CONCLUSION

The rapid spread of digital transformation has differentiated the roles of both employees and organizations. The digitalization process is an innovative process, and the need for successful management has revealed the importance of digital leadership. In a digital age where all kinds of technology are rapidly changing and developing, a different leadership style is needed in order to successfully manage the digital transformation process in both private and public enterprises and to manage the digital organization as well. This leadership style is called digital leadership. While, in the past, it was believed that "lack of technological knowledge and the prevalence of legacy systems" were the common barriers to successful digital transformation, recent literature studies support the idea that

this problem is often caused by a "lack of leadership" for such a transformation (Whitehurst, 2015; Baculard, 2017; Kahre et al., 2017; Afandi, 2017:1-4; cited in Asiltürk, 2020). With the realization that the leader is effective in the success of digital transformation, studies have been conducted on which leadership increases performance in this process, but it has been determined that the current leadership styles do not fully meet the needs in this process. The studies investigating what kind of characteristics a leader should have, have been mentioned above. As a result, digital leadership is the most appropriate leadership style for the digitalization process. There are studies stating that digital leadership shares common characteristics with transformational leadership (Fisk, 2002; Qualman, 2012; Toduk, 2014; Westerman, Bonnet & McAfee, 2014; Zhu, 2015; Zhong, 2017; Jakubik & Berazhny, 2017; Irge, 2018; Promsri, 2019; Çelen, 2020; Ordu & Nayır, 2021). Although it shares common characteristics such as creating a vision, innovation, and motivating its employees, digital leadership has a wider content than transformational leadership. The most important characteristics distinguishing digital leadership from other leadership types are that the digital leader is visionary and innovative, has knowledge and skills about digital technologies, and constantly updates himself in this regard, creates a team accordingly, supports, encourages, motivates and guides his employees in the digital transformation process. An effective digital leader develops an innovative and supportive work environment, highlighting the qualities (i.e., characteristics and behaviors) which can facilitate digitalization, making conscious choices about the focus areas and priorities transforming the organization's internal and external environment, and thus, move both the organization and the employees forward. Digital leadership is defined in this study as "a leadership style that aims to implement and to enforce the digital transformation of the organization and to create a culture of sustainable change in the organization, in order to lead the organization in a wholly digital environment".

As a result of literature review, no scale related directly to measure digital leadership was found. The aim of this study is to develop a measurement tool which scales the digital leadership perception of employees and managers. While creating the main themes of the digital leadership scale, innovative and supportive themes were created according to combined results of literature analysis about digital leadership and the interviews made with managers. As a result,, it can be argued that the propositions under the innovation dimension of "Digital Leadership Scale" (DLS) correspond to the leadership characteristics innovative, networking, digitally keen, headhunter for digital, agile and ambidexterity which majorly imply a broader perspective for the interaction with the environment and staying tuned with the advancements whereas the propositions under the supporting dimension coincide with the features encouraging, employee-focused and digital idol which may correspond to a more personal-level interaction and exchange with the followers. It was concluded that the DLS, which consists of two dimensions (Innovative and Supportive dimensions) and 9 propositions, is a valid and reliable measurement tool. Using the DLS with different variables in different studies can contribute to the literature. This study extends earlier studies in digital leadership. Since this study constitutes the first attempt to develop a scale for measuring digital leadership features, it is a significant contribution to the development of leadership and organization research. Four studies, including qualitative insights from interviews with managers and from expert opinions and two quantitative studies from a relevant population, confirm the reliability and the validity of the scale. This study also offers useful insights for practitioners. The digital leadership scale provides some benefits by helping companies to allocate leadership characteristics for digital transformation appropriately. Organizations should be offering opportunities for employees to develop their technological know-how to ensure their well-being and to reduce the technostress they may encounter due to the increased levels of information technology usage especially in remote working scenarios at digital workplaces (Marsh, Vallejos, & Spence, 2022; Taser, Aydin, Torgaloz, & Rofcanin, 2022). Digital leaders, in this sense, are expected to serve as process facilitators in a way that encourages and motivates their followers, helps to reduce their stress levels and promotes innovative behavior during their adaptation to the dynamic requirements of the digital age.

This study has some limitations. The literature is limited to national and international peer-reviewed articles, research-based articles, and books in digital databases. The scale data obtained within the scope of the study is limited to 526 (manager and employee) participants and their opinions, who participated in the survey in 2021 and worked in different sectors in private and public institutions/organizations in Turkey. With regard to the scale development process, a more balanced

and diverse review from different countries might capture a wider application of digital leadership, since culture might have an impact on leadership expectations.

For future research, it has been concluded that the "Digital Leadership" scale can be used in measurement with the items and dimensions since that it has emerged as a reliable and valid measurement tool. The DLS scale can be investigated together with other related concepts in the national and international literature, and a contribution to the literature can be made by selecting different sample groups and specific sectors. It is thought that the quantitative research which researchers will conduct in this field can make significant contributions to the current literature and future research.

NİHAİ ÖLÇEK ÇALIŞMASI

DİJİTAL LİDERLİK ÖLÇEĞİ (DJL) GELİŞTİRME ÇALIŞMASI*

Sayın katılımcı sizi ***Tuğba Dikbaş ve Tuba Büyükbeşe*** tarafından yürütülen ***01.09.21 tarihinde Başvuru: 56 Karar No.1 Kayseri Üniversitesi Bilimsel Etik Kurulundan,*** *Bilimsel Etik izni alınmış*, ''Dijital Liderlik Ölçek Geliştirme Çalışması'' araştırmasına davet ediyoruz. Bu araştırmaya katılıp katılmama kararını vermeden önce, araştırmanın neden ve nasıl yapılacağını bilmeniz gerekmektedir. Bu nedenle sizlere dağılmış/gönderilmiş olan onam formunun okunup anlaşılması ve onam formunu onaylamanız araştırma için büyük önem taşımaktadır. Eğer araştırmanın amacı ile ilgili verilen bu bilgiler dışında daha fazla bilgiye ihtiyaç duyarsanız araştırmacıların size vermiş olduğu telefon ve e-posta adresinden araştırmacılara ulaşabilirsiniz.

Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. Çalışmaya katılmama veya katıldıktan sonra herhangi bir anda çalışmadan çıkma hakkında sahipsiniz. Çalışmayı eksiksiz yanıtlamanız, araştırmaya katılım için onam verdiğiniz biçiminde yorumlanacaktır. Size verilen formlardaki soruları yanıtlarken kimsenin baskısı veya telkini altında olmayın. Bu formlardan elde edilecek bilgiler tamamen bilimsel araştırma amaç ile kullanılacaktır. KVKK gereği kişisel bilgilerinize yer verilmeyecektir.

Lütfen aşağıda yer alan maddelerin sizi ne düzeyde yansıttığını ya da yansıtmadığını örnek değerlendirmeye göre "X" ile işaretleyiniz. Katılımınız için teşekkür ederiz.

1	2	3	4	5
Kesinlikle Katılmıyorum	**Kısmen Katılmıyorum**	**Kararsızım**	**Kısmen Katılıyorum**	**Kesinlikle Katılıyorum**

	DİJİTAL LİDERLİK ÖLÇEĞİ	**1**	**2**	**3**	**4**	**5**
Liderim/Yöneticim	**YENİLİKÇİ**					
1	Yenilikçi bir vizyona sahiptir.					
2	Hızlı ekip kurarak organize etme becerisine sahiptir.					
3	Dijital teknolojiler ve dijital dönüşüm hakkında güncel bilgi ve becerilere sahiptir.					
4	Kurumumuzda dijital dönüşüm sürecinde proaktiftir.					
5	Yeni ve mevcut iş alanları, modern trendler ile geçmiş gelenekler ve yenilik ile entegrasyon arasında denge sağlar.					
6	Yeni dijital yetenekleri kendi kurumumuza çekmenin yollarını bulur.					
	DESTEKLEYİCİ					
7	Dijital dönüşüm sürecinde zorluklarla karşılaşıldığında çalışanlarını cesaretlendirir.					
8	Dijital dönüşüm sürecinde çalışanlara yol gösterici ve rol modeldir.					
9	Dijital dönüşüm sürecinde çalışanların refahına odaklanır.					

A STUDY ON DIGITAL LEADERSHIP SCALE (DLS) DEVELOPMENT*

Dear Participant we invite you to the "Digital Leadership Scale Development Study" conducted by ***Tuğba Dikbaş and Tuba Büyükbeşe***, with the Scientific Ethics Permission obtained from the Scientific Ethics Committee of ***Kayseri University, Application: 56 Decision No.1 on 01.09.21.*** Before deciding whether or not to participate in this research, you need to know why and how to do the research. For this reason, it is of great importance for the research that the consent form scattered/sent to you is read and understood and that youapprove the consent form. If you need any further information about the purpose of the research, you can reach the researchers via phone and e-mail address provided by the researchers.

Participating in this study is entirely on a voluntary basis. You are free about not participating in the study or cancelling the study any time after participating. If you respond to every questionin the study, thiswill be interpreted as your consent for participation in the research. Do not be under the pressure or suggestion of anyone when answering the questions in the forms given to you. The information to be obtained from these forms will be completely used for scientific research purposes. Your personal information will not be included in accordance with KVKK. Please mark with "X" to what extent the items below reflect or do not reflect you according to the according to the evaluation degrees. Thanks for your participation.

1	2	3	4	5
I strongly disagree	**I partially disagree**	**I'm undecided**	**Partially I agree**	**Absolutely I agree**

	DIGITAL LEADERSHIP SCALE	**1**	**2**	**3**	**4**	**5**
My Leader/Manager	**INNOVATIVE**					
1	Has an innovative vision.					
2	Has the ability to build and coordinate teams quickly.					
3	Has up-to-date knowledge and skills about digital technologies and digital transformation.					
4	Acts proactively in the digital transformation process in the organization.					
5	Balances new and existing business areas, modern trends and past traditions, and innovation and integration.					
6	Finds ways to attract new digital talent to organization					
	SUPPORTIVE					
7	Encourages employees when encountering difficulties in the digital transformation process.					
8	Acts as a guide and role model for those who work in the digital transformation process.					
9	Focuses on employees' wellbeing during digital transformation.					

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