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The Mediating and Moderating Effects of Knowledge Management in the Relationship between Technological Leadership Behaviors of School Principals and Data-Driven Decision-Making

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Abstract

The objective of this study is to contribute to the increasing database regarding the effects of school leadership on teachers' data usage by investigating the relationship between the technological leadership behaviors of school principals and data-driven decision-making at their schools based on the mediating and moderating effects of the knowledge management variable. 408 teachers from 14 provinces of Turkey in the 2020-2021 academic year were included in the study. The School Principal Technological Leadership Competency Scale, the Knowledge Management Scale, and the Data-Driven Decision-Making in Schools Scale were used as data collection tools in this cross-sectional quantitative study. Descriptive statistics, correlation, and structural equation modeling (SEM) were used in data analysis. The study results demonstrate the school principals' practices of technological leadership, knowledge management at schools, and data-driven decision-making to be high. It has been found out in the study that knowledge management implementations play a mediating role in data-driven decision-making at schools by increasing the technological leadership competency levels of school principals, while not having a moderating effect on the relationship between technological leadership and data-driven decision-making. In addition, technological leadership and knowledge management have been identified to be significant and positive predictors of data-driven decision-making. Based on the study results, suggestions have been made to improve the technological leadership behaviors and knowledge management implementations of school principals at schools.

Keywords: Technological Leadership, Knowledge Management, Data-Driven Decision-Making, Mediating Effect, Moderating Effect

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Introduction

It is imperative for schools to use data that they can base on rational and scientific grounds in decision-making processes for them to meet the social expectations, provide public accountability, and solve the problems they encounter (Schildkamp & Kuiper, 2010). School principals need to know how to analyze, interpret, and use data to access the correct information that can enable them to make informed decisions in every field from resource allocation to instructional implementations as a result of increased standardization and accountability in education (Datnow et al., 2007; Mandinach & Gummer, 2016). In this respect, the usage of technology by principals can be a critical tool to improve teaching and learning (Chappuis & Chappuis, 2008; Schildkamp et al., 2017).

Studies show that data used for decision-making and effective implementations can increase the learning abilities of students and affect school improvement positively (Byrd & Eddy, 2010; Dejear, 2016; Huguet et al., 2014; Kerr et al., 2006; Petersen, 2007; Slavit et al., 2013). Data usage at schools has enabled software systems and technological processes to improve (Datnow et al., 2007). Similarly, developments in technology have provided educators with better opportunities to access data and facilitated data analysis, and increased data usage in education (Mandinach & Gummer, 2013). Wu (2009) has put forth the importance of school principals being trained to become competent in technology usage, and being supported with technological resources in increasing their data literacy. In this way, a principal theoretically thought to be efficient in technology usage will have made a data-driven decision by providing the necessary atmosphere to convert data into knowledge in the decision-making processes of the school. In this respect, technological leadership and knowledge management implementations in data-driven decision-making can be evaluated as factors that can increase competency for schools.

Although data-driven decision-making appears to have been initiated with the "No Child Left Behind Act" enacted in 2001 in the United States, grading the steps of knowledge management and data process in knowledge creation (Davenport & Prusak, 1998) had an effect on laying the theoretical grounds for this act. Mandinach et al. (2006) state that raw data must be converted into knowledge by locating them into an actionable context to make data-driven decisions. The significance of the created knowledge varies based on the knowledge and skills of the users, which is regarded to be the most crucial component of data-driven decision-making (Mathews, 2002).

The usage and integration of technology is an important component of knowledge management theory (Petrides & Modine, 2003). When knowledge management functions commune with principals' leadership activities, educational activities and student success rates may increase (Marsh, 1992). Regarding the issue, Dickerson et al. (2008) state that school principals competent in information and communication technology and efficient knowledge management will encourage a considerable school reform, and in this way, academic success will be able to be maintained with the

start of a transformation at schools. It is also possible to come across studies that put forth the roles of operational and transformational leadership in knowledge management that can use technology efficiently and integrate it into educational activities (Afshari et al., 2009; Analoui et al., 2013; Ng, 2008).

Technological developments have been reflected at schools in Turkey in numerous applications, especially the ones within the scope of the FATIH project (Ministry of National Education [MEB], 2012) initiated in 2010, such as the formation of computer classes, web domains created for schools, education portals, interactive boards at schools, access to overhead projectors and the internet, and knowledge management systems such as MEBBIS, TEFBIS, and e-school in which teachers, students, and education administrators can transact. These technological applications are known to be used in routine operations of educational activities. However, the position of these applications must be specified with regard to performing education in a data-driven way within the scope of a model in a leadership context. Turkey is a developing country and the Turkish education system has a centralist structure. All the decisions made for critical planning, personnel, coordination, and budget works at schools in Turkey are the responsibility of the Ministry of National Education. Although efforts were made to break the strict centralist behavior with the principle of "decentralization", it ended up being highly limited. Therefore, there is always a need to create knowledge access models that are based on the Turkish education system dynamics, comprehensive, detailed, holistic, and native data resource-based. Besides, it has been seen that school principals need to lead other partners, teachers in particular, both in remote education activities and in data-driven decision-making processes due to Covid-19. Therefore, identifying possible variables in the relationship between the technological leadership behaviors of school principals and data-driven decision-making levels is extremely crucial.

The objective of this study is to investigate the mediating and moderating effects of knowledge management on school principals' relationship with technological leadership behaviors regarding data usage in decisions made to implement necessary changes at schools. The focal point of this study is data-driven decision-making. The participants have shared their opinions as teachers about the management of knowledge used in decision processes based on available data at their schools by assessing the technological capacity of their principals within the context of leadership. The opinions of teachers, who actively use knowledge in educational processes and need data usage and technological support in knowledge creation, are regarded to be important regarding these processes. With regard to being a guide for data-driven decision-making studies in Turkey, the holistic and detailed analysis of this study with the help of current information and in the model created within the study scope may contribute to the field of education management since studies holistically based on comprehensive literature research are few in number. It can also provide

policymakers, researchers, and educators with theoretical and practicable knowledge and increase awareness. It is also our hope that the study will contribute to societies and countries with educational policies and structures similar to Turkey. In this respect, the study aims to identify the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making and answer the following questions;

1. What are school principals' technological leadership behaviors, and schools' knowledge management and data-driven decision-making levels?
2. Is there a significant relationship between school principals' technological leadership behaviors and schools' knowledge management and data-driven decision-making levels?
3. Does knowledge management play a mediating role in the relationship between school principals' technological leadership behaviors and data-driven decision-making?
4. Does knowledge management play a moderating role in the relationship between school principals' technological leadership behaviors and data-driven decision-making?

Theoretical Frame

The theoretical frame of this study has been composed of theoretical and empirical studies in the field of education management and leadership (see Figure 1). This frame is concerned with competencies that principals are expected to have (technological leadership) and organizational processes (knowledge management, data-driven decision-making). Also, the theoretical frame of this study has revealed some organizational (cultural, technological structure) and individual (leadership, data/information literacy) factors affecting technological leadership, knowledge management, and data-driven decision-making. The study focuses on how principals' roles and competencies may affect the implementation and behavior processes at schools.

Technological Leadership

Technology provides access to more data and more accurate information (Golden, 2004). By collecting data in a central place, technological developments help school principals collect and analyze data and decrease their workload and accountability stress by creating reports in a faster way (Marsh et al., 2015). In a study conducted in Turkey, Töremen and Kolay (2003) classify the competencies of school principals as technical, humane, and conceptual, and emphasize the importance of training for technical competency. Technologically literate school principals are expected to unify technology with their leadership characteristics effectively in decisions made for schools to contribute and adapt to 21st century knowledge-driven society (McLeod & Richardson, 2011). Technology finds meaning with people who can create new ways and methods by focusing on the systematic development of the organization (Hayytov, 2013). Durnalı (2018) elaborates on

technological leadership under four dimensions, namely motivation, orientation, precaution, and support. The dimension of motivation covers teachers being motivated to utilize technology at schools; the dimension of orientation covers technology being enabled to be applied to the educational processes; the dimension of precaution covers the necessary information technology tools being ready for use; and the dimension of support covers the awareness of legal issues concerning the usage of technology.

The technological leadership phenomenon starting to appear in the United States in the early 1990s was analyzed by the International Society for Technology in Education (ISTE) the most extensively. ISTE listed the standards required for a technological leader under the headings of leadership and vision, learning and teaching, productiveness and professional implementation, support, execution and operations, evaluation, and social, legal, and ethical issues (ISTE, 2002). Curcio (2016) found out that teachers benefit from school principals more so than external resources for professional development regarding the usage of technology. Similarly, Hayytov (2013) detected that the technological leadership competencies of school principals have a positive effect on teachers' behaviors toward technology. According to Flanagan and Jacobsen (2003), a school principal with technological leadership characteristics needs to create a vision shared at the school, provide access to technology, and develop an atmosphere for professional development. In studies conducted on technological leadership in Turkey, it has been found that school principals usually receive training on educational technology in school administration and have high levels of self-competency regarding the usage of technology (Gültekin, 2013; Ulukaya, 2015). If the aforementioned studies are analyzed as a whole, it can be concluded that school principals need to set an example for and be leading others in the usage of technology.

Knowledge Management

The concept of knowledge management is based on a theory grounded on a set of principles by Davenport and Prusak (1998). The "scientific method" is the safest way to produce knowledge (Çınar, 2002). Knowledge management is defined as a process in which individuals turn data, information, and their intellectual existences into a lasting value. In this process, data is taken as a basis, and knowledge is produced, moderated, and used (Duffy, 2000; Palacios et al., 2009; Kianto et al., 2016; Gao et al., 2018).). The data do not provide any judgment, interpretation, or sustainable action; they are divided into categories by being placed within a context with calculations and moderations and turned into knowledge along with their content. Information is turned into knowledge by forming links through comparisons and interpretations (Davenport & Prusak, 1998). In short, it can be defined as knowledge when data are interpreted. The processes of data being turned into knowledge and data-driven decision-making are shown in Figure 1.

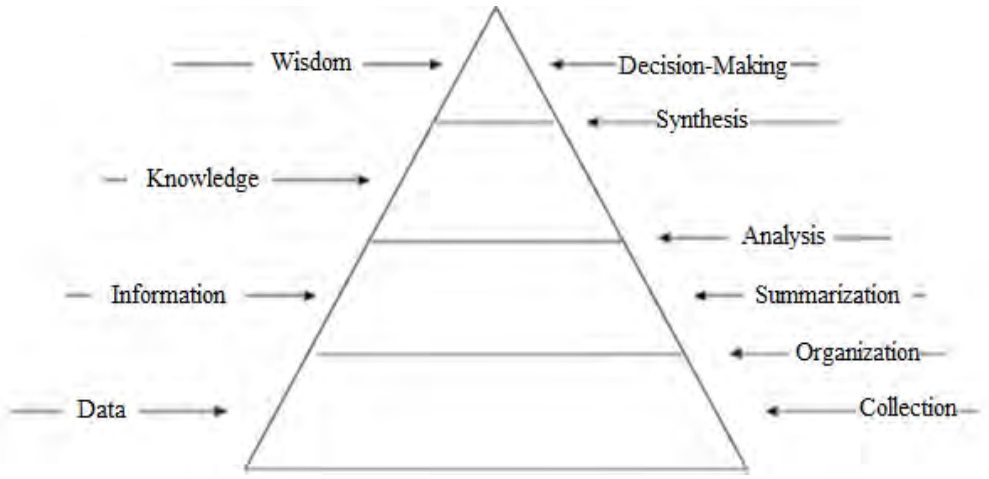

Figure 1: Knowledge spectrum (Source: Barutçugil, 2002)

Knowledge management in education is thought to be an approach of acts improving educational services and results by providing the development of a set of applications to create and share knowledge. The knowledge management theory within the context of schools demonstrates the value of data to make informed decisions (Petrides & Modine, 2003). The data make sense for educators when they are turned into practicable knowledge about educational decision-making (Duffy, 2000). Çınar (2002) models knowledge management as obtaining, sharing, using, and storing information.

Studies have put forth the necessity for information technology tools (Al-Alawi et al., 2007; Gupta & Govindarajan, 2000; Mohamed et al., 2006), that leadership characteristics play an important role in every stage of knowledge management (Donate & de Pablo, 2015; Singh, 2008), and the importance of organizational culture in the distribution of knowledge (Özgözgü, 2015; Suppiah & Sandhu, 2011). Besides, emphasizing that education is necessary to produce knowledge, Hemmati (2017) underlines a significant relationship between knowledge literacy and knowledge management. In studies carried out on the knowledge management competencies of school principals and teachers in Turkey, it has been found that educators receiving training on knowledge management have higher averages than those not receiving such training (Akçakaza, 2009).

Data-Driven Decision-Making at Schools

Data-driven decision-making at schools is defined by Schildkamp and Kuiper (2010) as reviewing, systematically analyzing, and interpreting data, and implementing the outcome of data resources to educational developments at schools. From this definition, it can be said that the data-driven decision-making process is the center of significant school reforms and an education-management system where educators can acquire accurate information. The data-driven decision-making process at schools sets the ground for revealing strong and weak aspects, recognizing the

interval between the intended and the current profile, and clearly understanding the areas needing improvement by acting on a mutual purpose (Bernhardt, 1998).

Accountability, school-based decision-making, and data-driven decision-making concepts came to the forefront and started to be examined in the United States with the NCLB Act. With these developments in the United States, these concepts went beyond accountability and started to develop as a process. Data usage in all associations under the Ministry of National Education in Turkey became a current issue with "data-driven management" mentioned in the 2023 Vision Statement introduced to the public in 2018. In the Vision Statement, data-driven applications are predicted to have a great potential to monitor student statuses in a detailed way, decrease the difference of success rates among schools and regions, eliminate failures in educational reforms, and create an educational atmosphere needed by educators and students (Ministry of National Education [MEB], 2018).

Studies discussing schools within a system theory emphasize creating an organizational, professional, technical, and processual capacity in data-driven decision-making processes (Breiter & Light, 2006; Datnow et al., 2007). Doğan and Ottekin Demirbolat (2021) divide data usage at schools based on the literature into four components, namely *data usage culture, data literacy, technological infrastructure and hardware, and data usage purpose.* The data usage culture dimension covers open norms for data usage at schools; the data literacy dimension covers necessary knowledge and skills to use and understand data; the technological infrastructure and hardware dimension covers basic systems such as access to data, data collection, analysis, and storage; and the data usage purpose dimension covers the usage of data fit for purpose at schools.

Studies show school principals to be the key actor in and primarily responsible for data usage implementations (Buttram & Farley-Ripple, 2016; Christman et al., 2009; Huguet et al., 2014). Expected to have data literacy knowledge and skill, school principals should set a model for teachers regarding data usage, provide necessary structures and support, and create a culture in which data implementations are turned into norms (Marsh et al., 2015; Park & Datnow, 2017). In the Turkish educational system,which has a centralist administration, decisions are mostly made by the ministry, and school principals have to play the role of “implementers” of orders coming from their superiors (Doğan, 2021). Therefore, studies on data-driven decision-making in Turkey are extremely limited (Demir, 2009; Dilekçi et al., 2020).

Educators need to be able to access reliable information for them to make accurate decisions. Knowledge and skills necessary for data collection, analysis, and interpretation are defined as data literacy, also known as the process of converting raw data into knowledge. The management of knowledge acquired by turning data into information is also important for the process of data-driven decision-making (Mandinach, 2012). Regarded to be an important component of data literacy, technological literacy requires having basic technological knowledge and skills and is a primary

factor in data-driven decision-making (Means et al., 2010). However, despite these relations seeming to be theoretically strong, no study focusing on the effects of knowledge management and technological leadership role on data-driven decision-making has been encountered in the literature. In this respect, the theoretical relations network formed among the variables of the study is given in Figure 2.

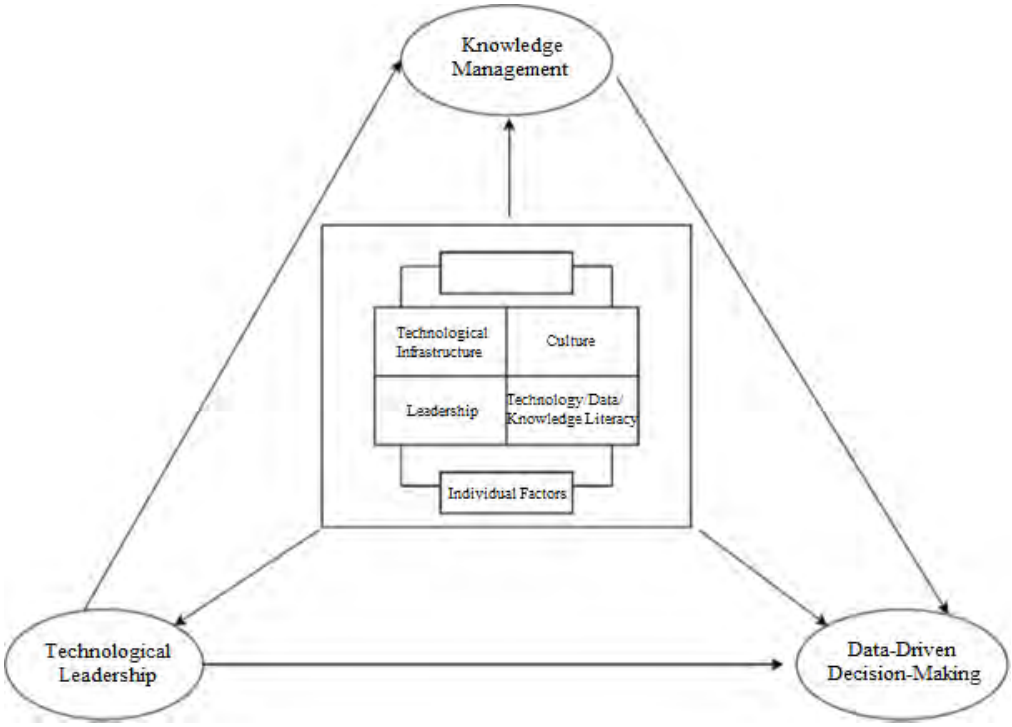

Figure 2. Conceptual model

Method

Research Model

Aiming to detect the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making, this study was designed in a relational screening model, which is a research model that aims to find the relationship among variables without any intervention (Fraenkel & Wallen, 2000). Mediating and moderating effects analysis was used to find out in which situations the indirect effect and relationship among variables increase or decrease. In this context, the independent variable, mediating and moderating variable, and dependent variable of the study are school principals' technological leadership behaviors, knowledge management, and data-driven decision-making respectively.

Research Group

The study has been conducted with the participation of 408 teachers working in different provinces, primarily Siirt and Kahramanmaraş, of Turkey (also including Istanbul, Balıkesir, Gaziantep, Hatay, Konya, Eskişehir, Nevşehir, Şanlıurfa, Aksaray, Kayseri, Muğla, and Malatya) during the 2021-2022 academic year. It is not an external but an internal validity study as it aims to detect the relationship among variables. Therefore, the study does not aim to make a generalization for any universe (Büyüköztürk et al., 2021). Among the participants, 150 (36.8%) are male, 258 (63.2%) are female; 66 (16.2%) are single, 342 (83.8%) are married; 59 (14.5%) work in Siirt, 81 (19.9%) work in Kahramanmaraş, and 268 (65.7%) work in other provinces (Istanbul, Balıkesir, Gaziantep, Hatay, Konya, Eskişehir, Nevşehir, Şanlıurfa, Aksaray, Kayseri, Muğla, and Malatya). The mean age and professional seniority values of the teachers are 39.54 and 15.26 respectively.

Data Collection Tools

The study data were collected with the “School Principals Technological Leadership Behavior Scale” (SPTLB-S) developed by Durnalı (2018), the “Knowledge Management Scale” (KM-S) developed by Özgözgü (2015), and the “Data-Driven Decision-Making in Schools Scale” (DDDMS-S) by Doğan and Ottekin Demirbolat (2021).

The School Principals Technological Leadership Behavior Scale (SPTLB-S) is composed of 18 items and 4 dimensions (motivation, orientation, precaution, and support). SPTLB-S is developed to measure the technological leadership behaviors of school principals based on teachers' points of view, and is a 5-Likert type scale answered with the choices of "strongly disagree", "disagree", "undecided”, “agree”, and “strongly agree”. High points obtained from the scale reflect the school principal to exhibit high levels of technological leadership behaviors, while low points obtained from the scale reflect the school principal to exhibit low levels of technological leadership behaviors. The Cronbach’s alpha coefficient of the scale is .90 for the motivation dimension, .88 for the orientation dimension, .87 for the precaution dimension, .70 for the support dimension, and .72 for the whole scale. The goodness of fit values found as a result of the confirmatory factor analysis (CFA) conducted during the developmental process of SPTLB-S (x^2/df=1.68, RMSEA: .053, SRMR=.060, CFI=.92, NFI=.83, NNFI=.90, GFI=.91) have been reported to be fit (Durnalı, 2018). The validity and reliability of SPTLB-S have been recalculated for this study. The CFA goodness of fit values of the current study (x^2/df=3.63, RMSEA:.080, SRMR=.041, CFI=.94, TLI=.93) have also been found to be fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach’s alpha reliability coefficient of the study has been found to be .90 for the motivation dimension, .89 for the orientation dimension, .92 for the precaution dimension, .87 for the support dimension, and .93 for the whole scale. Based on all these results, SPTLB-S can be stated to be a valid and reliable scale tool for the study data.

The Knowledge Management Scale (KM-S) is composed of 25 items and 4 dimensions (obtaining information, using information, sharing information, and storing information). Developed to measure the knowledge management levels of schools from teachers' point of view, KM-S is a 5-Likert type scale composed of the choices "never", "slightly", "somewhat", "very much", and "completely". High scores obtained from KM-S reflect the school to have high levels of knowledge management, while low scores obtained from KM-S reflect the school to have low levels of knowledge management. The Cronbach's alpha reliability coefficient of the scale is .90 in the obtaining knowledge dimension, .93 in the using knowledge dimension, .91 in the sharing knowledge dimension, .90 in the storing knowledge dimension, and .97 for the whole scale. The four-factor structure of the scale was determined with CFA. The CFA results obtained during the developmental process of the scale show the goodness of fit values (x^2/df=3.07, RMSEA: .07, SRMR=.04, PNFI=.87, NNFI=.98, CFI=.98) to be fit (Özgözgü, 2015). In the context of this study, the validity and reliability of KM-S were recalculated, and the CFA goodness of fit values (x^2/df=3.81, RMSEA:.083, SRMR=.041, CFI=.92, TLI=.91) were determined to be fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach's alpha reliability coefficient of the study has been found to be .92 in the obtaining knowledge dimension, .90 in the using knowledge dimension, .94 in the sharing knowledge dimension, .91 in the storing knowledge dimension, and .97 for the whole scale. Based on the validity and reliability results of the current study, KM-S is understood to be a valid and reliable scale tool in terms of the study data.

The Data-Driven Decision-Making in Schools Scale (DDDMS-S) is composed of 23 items and 4 dimensions (technological infrastructure and hardware, data usage culture, data usage purpose, and data literacy). DDDMS-S was developed to measure data-driven decision-making levels at schools from teachers' point of view. It is a 5-Likert type scale with the choices "never", "seldom", "sometimes", "frequently", and "always". High scores obtained from DDDMS-S reflect schools to have high levels of data-driven decision-making, while low scores obtained from the scale reflect schools to have low levels of data-driven decision-making. Doğan and Ottekin Demirbolat (2021) determined the construct validity of the scale with only exploratory factor analysis (EFA), based on which the first dimension variance ratio of the scale is 16.211%, the second dimension variance ratio of the scale is 15.407%, the third dimension variance ratio of the scaleis 13.294%, the fourth dimension variance ratio of the scale is 8.522%, and the total explained variance is 53.435%. The item factor load values of DDDMS-S range between .491 and .789, its total item correlation values range between .313 and .719, and its eigenvalues range between 1.960 and 3.729. The Cronbach's alpha reliability coefficient of the scale has been found to be .850 for the technological infrastructure and hardware dimension, .814 for the data usage culture dimension, .789 for the data usage purpose dimension, and .602 for the data literacy dimension (Doğan & Ottekin Demirbolat, 2021). In the context of this study, the validity and reliability of DDDMS-S were recalculated and the CFA

goodness of fit values (x^2/df=3.45, RMSEA: .078, SRMR=.055, CFI=.90, TLI=.88) were deemed fit (Kline, 2011; Schumacker & Lomax, 2004). The Cronbach's alpha reliability coefficient of the study has been found to be .84 for the technological infrastructure and hardware dimension, .85 for the data usage culture dimension, .84 for the data usage purpose dimension, .90 for the data literacy dimension, and .93 for the whole scale. Consequently, the validity and reliability results of the study deem DDDMS-S to be a valid and reliable scale tool in terms of the study data.

Data Analysis

The study-related data were obtained through an online form. It took about 18 minutes to fill out the scales. It was initially analyzed in the study whether the data obtained from 422 teachers were suitable for the analyses to be performed. In this respect, the extreme values of the data were checked. The scores of the scales were converted to *Z* scores and 14 data that were out of the -3 and +3 range (Çokluk et al., 2012) and whose Mahalanobis distance was not suitable were excluded from the scale, after which the assumptions of normality of the data obtained from 408 teachers were reviewed. In this respect, the total scores of the scales were examined in terms of the skewness and kurtosis values. The skewness and kurtosis values of the school principals' technological leadership behavior scale were -.301 and -.396 respectively; the skewness and kurtosis values of the knowledge management scale were -.314 and -.777 respectively; and the skewness and kurtosis values of the data-driven decision-making in schools scale were -.242 and -.676 respectively. The skewness and kurtosis values of the study data being between -1.5 and +1.5 reflect a normal distribution on part of the data (Tabachnick & Fidell, 2013). Different values were determined as criteria in the study to find out whether there were multicollinearity and autocorrelation problems in the study. Accordingly, the relationship among variables being between .67 and .89 and therefore less than .90, and the Durbin-Watson value being 1.637, the Tolerance value being .539, the VIF value being 1.854, and the CI value being between 1 and 24.413 and less than 30 demonstrate that there are no multicollinearity and autocorrelation problems in the study (Field, 2005; Green & Salkind, 2010; Sümer, 2000). All these values indicate that the study data meet the necessary assumptions for the analyses to be performed.

The descriptive statistics and Pearson's product-moment correlation analyses of the study were conducted with SPSS 24.00, while its confirmatory factor analysis and mediating and moderating effect analyses were performed with the Mplus 7.00 statistics software program. Whether the variables had a significant predictiveness and the mediation test was determined with a structural equation modeling (SEM). The bootstrapping coefficient and confidence intervals (GA/CI) were reviewed with 10000 resamplings to examine the significance of the indirect effects of school principals' technological leadership behaviors on data-driven decision-making via knowledge management. The significance of the confidence intervals determined as a result of the bootstrapping analysis was evaluated based on whether they contained zero (Hayes, 2013), and all the study-related

analyses were interpreted according to the significance level of .01 and .05. The evaluation of the standardized β coefficients was conducted based on Kline's (2013) effect size classification accepting .10 - .30 to be small, .30 - .50 to be medium, and .50 and above to be large.

Results

Results Related to Descriptive Statistics and Correlation Analysis

The relationships between the levels of school principals' technological leadership behaviors and schools' knowledge management and data-driven decision-making from teachers' point of view, and the variables were analyzed. Accordingly, the descriptive statistics and correlation analysis results related to the study are given in Table 1.

Table 1. Descriptive statistics and correlation analysis results

Variables	$\overline{X}$	sd	Skewness	Kurtosis	Technological Leadership	Knowledge Management	Data-Driven Decision-Making
Technological Leadership	4.26	.51	-.301	-.396	1		
Knowledge Management	4.22	.56	-.314	-.777	.67**	1	
Data-Driven Decision-Making	4.23	.44	-.242	-.676	.84**	.89**	1

**p < .01

As is seen in Table 1, school principals' technological leadership behaviors ($\overline{X}$ =4.26; sd=.51), schools' knowledge management ($\overline{X}$ =4.22; sd=.56), and data-driven decision-making ($\overline{X}$ =4.23; sd=.44) levels were found to be "high". The skewness values of the variables are observed to range from -.242 and -.314, while their kurtosis values are seen ranging from -.396 and -.777. Based on Pearson's product-moment correlation values, while there is a moderate positive correlation (r = .67; p< .01) between school principals' technological leadership behaviors and knowledge management, a strong positive correlation between school principals' technological leadership behaviors and data-driven decision-making (r = .84; p< .01) and also between knowledge management and data-driven decision-making (r = .89; p< .01) has been observed.

Mediating Effect-Related Results

A structural equation model (SEM) was used to determine the mediating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making. In this respect, the standardized path coefficients related to the developed structural equation model are shown in Figure 3 (in Figure 3 - *tlo*: Technological leadership scale; *mtv:* Motivation; *ynldrm:* Orientation; *alyp:* Infrastructure; *hkk:* Support; *byo:* Knowledge management scale; *biel:* Obtaining knowledge; *bilk:* Using knowledge; *bilpy:* Sharing

knowledge; *bildp:* Storing knowledge; *vdk:* Data-driven decision-making scale; *dnm:* Technological infrastructure and hardware; *kltr:* Data usage culture; *amac:* Data usage purpose; *okur:* Data literacy).

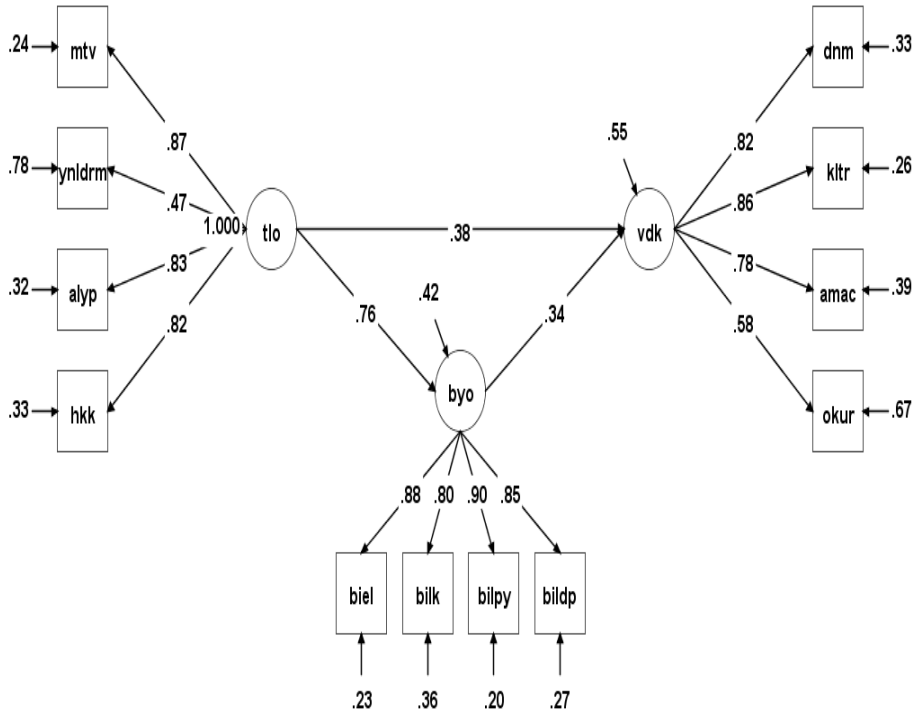

Figure 3. The mediating effect of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making

As is seen in Figure 3, it has been observed in the developed structural equation model that while technological leadership predicts knowledge management (β=.76, p< .01, 95% GA/CI= .743, .972) and data-driven decision-making (β=.38, p< .01, 95% GA/CI= .226, .524) in a positive and significant way, knowledge management also predicts data-driven decision-making positively and significantly (β=.34, p< .01, 95% GA/CI= .143, .351). In terms of indirect effects, technological leadership predicts data-driven decision-making significantly via knowledge management (β=.26, p< .01, 95% GA/CI= .152, .372).Accordingly, it has been discovered that technological leadership has a large effect on knowledge management, technological leadership and knowledge management have a moderate effect on data-driven decision-making, and technological leadership has a small indirect effect on data-driven decision-making via knowledge management (Kline, 2013). Besides, the model constructed in Figure 3 has been detected to have required fit values (x^2/df=2.56, RMSEA: .062, SRMR=.033, CFI=.97, TLI=.96) (Kline, 2011; Schumacker & Lomax, 2004). The standardized path coefficients of the structural equation model developed in relation to the study model are summed in Table 2.

Table 2. Bootstrap analysis results related to the mediation test

Direct Effects	β	%95 Confidence Interval (GA/IC)		Effect Size
		Lower Limit	Upper Limit	
Technological Leadership ⟶ Knowledge Management	.76	.743	.972	Large
Technological Leadership ⟶ Data-Driven Decision-Making	.38	.226	.524	Moderate
Knowledge Management ⟶ Data-Driven Decision-Making	.34	.143	.351	Moderate
Indirect Effects				
Technological Leadership ⟶ Knowledge Management ⟶ Data-Driven Decision-Making	.26	.152	.372	Small

Based on the direct and indirect effects shown in Table 2, the VAF (Variance Accounted For) was calculated to determine whether the effects of knowledge management were partially or completely mediating between technological leadership and data-driven decision-making. The VAF value being less than .20 reflects no mediating effect, while it being between .20 and .80 reflects a partial mediating effect, and it being .80 and above reflects a complete mediating effect (Hair et al., 2013). The VAF value of this study has been calculated to be .41. Therefore, it is understood that knowledge management has a partial mediating effect between technological leadership and data-driven decision-making.

Moderating Effect-Related Results

The regression analysis results containing the bootstrap method related to the moderating effect of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making are given in Table 3.

Table 3. Analysis results related to the moderating effect

Variables	b^*	SE	t	p	%95 Confidence Interval (GA/IC)	
					Lower Limit	Upper Limit
Constant	4.222	.008	528.624	.000**	4.206	4.238
Technological Leadership	.38	.016	24.300	.000**	.349	.410
Knowledge Management	.47	.015	31.082	.000**	.442	.501
Interaction Variable (Technological Leadership x Knowledge Management)	.03	.022	1.130	.258	-.020	.068

*b: Unstandardized beta coefficient, **p<.001, SE: Standard Error, R=.95, R^2=.91

Based on Table 3, all the variables included in the regression analysis have been determined to explain 91% (R^2=.91) of the change in schools' data-driven decision-making levels. Both technological leadership (b=.38, p<.001) and knowledge management (b=.47, p<.001) have been

identified as positive and significant predictors of data-driven decision-making. It can also be seen that the interaction variable, obtained by multiplying technological leadership by knowledge management, does not have any significant effect on data-driven decision-making (b=.03, p>.05). Therefore, knowledge management can be stated to have no moderating effect on the relationship between technological leadership and data-driven decision-making.

Discussion, Conclusion and Recommendations

The objective of this study is to determine the mediating and moderating effects of knowledge management on the relationship between school principals' technological leadership behaviors and data-driven decision-making. The initial study results show schools' knowledge management and data-driven decision-making levels, and school principals' technological leadership levels to be high. These results are supported by various studies in the literature (Akçakaza, 2009; Almış, 2010; Anderson & Dexter, 2005; Baybara, 2018; Demirsoy, 2016; Durnalı, 2018; Fidan, 2007; Irmak, 2015; McCray, 2014; Özsarıkamış, 2009; Sakarya, 2006). The results can be interpreted to state that school principal leadership is imperative in the implementation and usage of the Fatih Project, which aims to combine technology with education, and such systems as e-school, MEBBIS, and TEFBIS, and that these implementations accelerate information flow. In addition, this result may be related to the fact that remote education activities, which have gained more importance during the Covid-19 period, have contributed to the technological leadership behaviors of school principals who may have recognized their technological shortcomings.

A significant correlation between data-driven decision-making, and knowledge management, and technological leadership. It can be claimed that at a school with high levels of technological leadership and knowledge management, there will also be high levels of data-driven decision-making. The literature related to data-driven decision-making has created the theory of data-driven school leadership (Sun et al., 2016). The two most important dimensions of data-driven school leadership are principals providing the necessary support and help in technology usage, and creating an atmosphere where teachers can cooperatively share knowledge by enabling them to access accurate information. Considering these conceptual definitions, technological leadership and knowledge management are expected to be positively correlated to data-driven decision-making. Also, a moderate correlation has been observed between knowledge management and technological leadership. This result has parallels with the study results of Durnalı (2018). Flanagan and Jacobsen (2003) explain this correlation by defining technological leadership as a function-based leadership incorporating technology to the daily activities of an organization, increasing the database and data usage skills of workers, and encouraging them to share knowledge.

Another important result of the study is the discovered mediating effect of knowledge management between school principals displaying technological leadership characteristicsand data-

driven decision-making at their schools. Accordingly, it can be stated that via knowledge management, school principals with technological competencies improve educational activities and make decisions using current data by cooperating with partners at the school. In other words, it is understood that as principals encourage and orientate teachers for technology usage, and provide necessary infrastructure, data-driven decision-making is supported through the encouragement of obtaining, using, sharing, and storing knowledge. Bahar's (2011) finding that human resources with technological competencies give importance to knowledge management and provide improvements by making organizational arrangements with accurate decisions supports the model developed for this study.

It has been determined in the study that knowledge management implementations at schools do not have any moderating effect between school principals' technological leadership characteristics and data-driven decision-making at their schools. In other words, it can be stated that knowledge management is not a variable that decreases, increases, or eliminates the strength of the relationship between technological leadership and data-driven decision-making. It can also be said that a low, moderate, or high level of knowledge management is not a determinative variable for school principals'' technological leadership behaviors and data-driven decision-making levels. On the other hand, upon reviewing the direct effects, it can be seen that school principals displaying technological leadership characteristics have a large, positive, and significant effect on knowledge management implementations at schools. The most important role in the world in which the age of information has arrived lays, without a doubt, on the shoulders of school leaders (Buluç, 1998). Teachers can be stated to need their principals to have technological competencies on the basis of motivation, orientation, precaution, and support dimensions so that they can actively operate the processes of obtaining, using, sharing, and storing knowledge. This result has parallels with the study results of Durnalı (2018), and Srivastava and Joshi (2018). Similarly, in some studies conducted in Turkey, Yavuz and Coşkun (2008) define principals' technology usage as the ability to put scientific knowledge into practice regarding educational issues, while Çavaş (2005) has discovered that principals' technology usage improves teachers' top tier skills such as the configuration of knowledge, analysis, synthesis, and execution. However, Ergişi (2005) states that although school principals in Turkey are attentive to technology usage in executive actions, they do not provide the necessary support for technological usage in educational processes or other units of schools. Principals distancing themselves from information and communications technology are highly unlikely to monitor teachers and help them access information for the fields where they have shortcomings (Benedetto, 2006).

According to the study results, knowledge management implementations at schools affect data-driven decision-making positively and significantly. Data and knowledge are the main factors of the knowledge management theory, and the literature states that knowledge management has played a

role in the historical development of data-driven decision-making (Duffy, 2000; Mandinach et al., 2006). The result that knowledge management is an important predictor of data-driven decision-making at schools confirms theoretical knowledge. Datnow et al. (2007) mention that knowledge management systems are mandatory for data-driven decision-making at schools. Knowledge management makes use of data-driven processes to discover the secret messages and information found in great quantities within data, explains what kind of a correlation there is among data in these processes, and helps educators form a correlation between these data and contextual information (Johnson, 2015; Swan, 2009). It is apparent that there is a need to create a knowledge management capacity for data-driven decision-making implementations at schools.

Lastly, school principals' technological leadership competenciesaffect data-driven decision-making at schools positively. The literature on data-driven decision-making shows that leadership is the most important organizational factor that affects teachers' data-driven decision-making (Schildkamp et al., 2017). Studies suggest that school principals' tendencies to use technology, and support and encourage teachers in this issue affect how teachers discover and use data, and put forth the relationship between these data and different contexts (Copland et al., 2009; Ikemoto & Marsh, 2007; Park & Datnow, 2009). The data from Epp's (2011) study suggest that principals' shortcomings in technological skills are a factor that hinders data-driven decision-making. According to Epp (2011), school principals wanting to use data efficiently must have necessary technological structures and a sufficient competency to make use of technology because having technological skills in collecting and analyzing data requires being able to use technology efficiently in educational activities (Datnow et al., 2007). Technology provides teachers with numerous opportunities such as storing data, accessing data rapidly, and developing programs and applications (Mandinach et al., 2006). Indeed, a school principal who can make use of technology efficiently is also an efficient data warehouse user (Drake, 2015).

This study indicates that technological leadership has an effect on data-driven decision-making at schools, which is regarded to be crucial in increasing student success levels, both directly and via knowledge management, and supports previous study results. On the other hand, knowledge management does not have a moderating effect on the relationship between technological leadership and data-driven decision-making. Based on the study results, it can be suggested that awareness studies and activities be concentrated on so that principals' technological leadership competencies can increase in educational organizations that are both trainers and operators of human resources, and principals that have high levels of technological leadership behavior be awarded. Also, that school principals thriving in technological leadership behaviors share their experiences with other school principals may be beneficial. Schools can be provided with tools of informatics that will lead to efficiency in every knowledge management and technological leadership process. The study results

related to researchers can be reviewed with qualitative data in a more detailed and comprehensive way. Confirmative studies can be conducted on the conceptual model created within the theoretical frame of this study. Reasons behind the significant effects found in the study can be investigated in a more detailed fashion with demographically varying participant groups. Lastly, it is believed that this study, designed cross-sectionally, can also be reviewed longitudinally.

Policy Implications

School administrators must exhibit technological leadership behaviors for the developing technology to be successfully applied in educational organizations (İbili & Özbaş, 2022). In other words, the technological leadership of school administrators is essential in ensuring the efficiency of educational processes (Turan, 2020). However, technological leadership has a dynamic feature and is highly affected by environmental conditions (Hoy & Miskel, 2015). For this reason, many variables, especially environmental conditions, should be considered when determining educational policies and strategies for technological leadership (Özdemir, 2019; Şimşek, 1999). On the one hand, processes related to technological leadership in schools can be shaped according to the characteristics of schools and teachers, as well as the contents of education policies and strategies (Petko et al., 2018; Taimalu & Luik, 2019). The ability to obtain and manage information can be considered one of these contents (Ololube et al., 2015). Because the ability to acquire knowledge or manage knowledge is closely related to the technological leadership characteristics of school administrators (Roblyer & Doering, 2014).

Knowledge management is a necessary implementation strategy for organizational learning, globalization, and competition. Knowledge management is a management strategy that can be functional in organizations (Cheng, 2015; Glines-Kotecki, 2011). However, the functionality of knowledge management in the school context depends on the school administrators' ability to use technology effectively in the decisions to be taken (McLeod & Richardson, 2011). Research proves a significant positive relationship between technological leadership and knowledge management (Durnalı, 2018; Srivastava & Joshi, 2018). On the other hand, it can be said that technological leadership in schools and knowledge management facilitates realistic and applicable decision-making processes and contributes to the formation of a data-based culture. In other words, data-based decisions can gain meaning with school administrators' technological leadership behaviors and knowledge management skills (Epp, 2011; Means et al., 2010). This inference points to the importance of data-based practices that are recommended and expected to become widespread in school organizations (Schildkamp et al., 2017). Similarly, policymakers support the data-based decision-making processes of schools and expect them to make data-based decisions (Mandinach & Schildkamp, 2021).

Ikemoto and Marsh (2007) state that determining education policies and strategies based on data can be realized by providing educators with professional development and helping them access information. Thus, data-based decision-making became a common discourse and widespread practice influencing education policies worldwide, especially in US public schools (Lai & McNaughton, 2016; Young et al., 2018). In Turkey, this situation has shaped education policies and strategies. For example, in the 2023 Education Vision Document of the Ministry of National Education (MEB, 2018), it was stated that all the ministry's decisions would be based on data, data control units would be established, and educational data warehouses would be worked on. Furthermore, within the framework of schools, it was stated that teacher-parent-school interaction would be established through the "Data Information System", and a "Geographic Information System" would be included to determine the schools' capacities in effectively managing educational resources. All these explanations can be shown as evidence that school administrators' technological leadership, knowledge management skills, and data-based decision practices are related to education policies and strategies.

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