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The Relationship Between Principals' Technological Leadership Competence and School Effectiveness

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Abstract
The study results revealed no statistically significant difference in teachers' perceptions of principals' technological leadership and school effectiveness in terms of teachers' gender, seniority, branch, working time at the current school, technological competence, and daily technology use. However, the findings showed a significant difference in the perceptions of technological leadership by age but not in the perceptions of school effectiveness. The analysis results revealed a strong or very strong correlation between the technological leadership and its sub-dimensions and the school effectiveness sub-dimensions. It was found that a positive increase in any sub-dimension of the technological leadership scale improved school effectiveness, and there was a significantly positive and very high relationship between school effectiveness and technological leadership. As technological leadership increased, so did school effectiveness. Accordingly, technological leadership explained 50.8% of the change in school effectiveness. Principals' technological leadership, mediated by teachers' technological literacy, affected teaching and school effectiveness.

Keywords: Effective School, Technological Leadership, Educational Institutions, Educational Manager, Instructional Leader

1. Introduction

We can call this era "the information age" because technology is constantly changing and developing in today's world. Technological innovations increase the amount, availability, and access to information. In this sense, developing excellent human resources to utilize information technologies best is a must. School principals have an important responsibility for effectively using technology in schools. These duties and responsibilities include acquiring technology, using communication technologies effectively, assisting teachers to acquire technological proficiency, and benefitting from communication technologies in school management (Şahin, 2015:2). To demonstrate technological leadership, school administrators must follow technological developments and utilize them effectively. Today, it is essential to use technology in education as in many other fields. Therefore, school administrators should be able to use technology effectively and guide teachers, students, and other school staff.

They should assist others to use technology, and thus support and enrich educational practice. The everyday use of information and communication technologies should be a means of fulfilling tasks and responsibilities. In other words, school administrators should always be willing to accept change and embrace their technological leadership roles in addition to their educational and instructional leadership. They should be well-versed in how to effectively and efficiently use technological tools in order to make sound educational decisions and adapt well to changes. School administrators' technological leadership has a key role in educational success and is also a condition for students' using technology in their academic life. School administrators' advanced technological leadership skills increase other colleagues' motivation to utilize technology in schools.

School administrators have technological leadership competence, emerging with rapid technological developments, and can meet the interests and needs of society. Those administrators can keep up with the rapidly changing technological societies of today. Although educational institutions are expected to keep up with innovations and changes to satisfy social needs, those challenging to adapt to technological development in recent years have been left behind. In this regard, the technological leadership role of educational managers has become increasingly important. Today, schools, whose importance is gradually increasing, are among the institutions open to change, where technology is widely used, staff cooperation, and practical applications are emphasized. Schools are the mainstays of an education system, and the quality of an education system depends on the quality of schools.

School administrators aim to operate and transform educational institutions to achieve predetermined goals and are responsible for effective school management and efficient resource use in the education system. The primary duty of school principals is to ensure effective teaching at school. A principal's effectiveness can be traced to students' academic success and social and affective development. It has been shown that the leading characteristics of effective principals involve assertiveness, courage, self-sacrifice, self-improvement, and proficiency in time management. The majority of educators acknowledge technology as an indicator of high-quality education. Therefore, teachers need to use technology tools effectively to facilitate people's access and use of information. For a school to function well, it must have a technological leader and infrastructure. There is a strong link between technological leadership and school effectiveness, just like the link between educational technology and teacher-student integration. Technological leadership is vital for the effective use of technology in educational institutions (Anderson and Dexter, 2005). School administrators should demonstrate technical leadership skills to prepare schools for the information and technology era and to promote school effectiveness. They should have technical skills that facilitate school reform to empower students. School administrators' technological competence contributes to prevalent technology use in education and student success (Chang, 2012).

Educational technology has become a branch of science thanks to the rapid changes in contemporary educational paradigms and technology. Changes in technology can be clearly observed in education as well, which makes practical modifications a must rather than an option. Technology has become one of the modern life necessities and is considered essential to enhance educational quality and efficiency. Additionally, school administrators should have the technical competence and knowledge to lead active use of technology by others. School administrators' technological leadership plays a vital role in school effectiveness (Bostancı, 2010: 1). In this sense, this study sought an answer to the following question: "How does school administrators' technological leadership contribute to school effectiveness?".

Method

This study used correlation and regression analysis methods to examine teachers' perceptions of the "relationship between school administrators' technological leadership and school effectiveness" in Batman province and its districts. Correlation analysis methods determine the extent of the relationship between two or more variables. Besides, regression analysis methods show how independent variables affect dependent variables.

2.1. Universe and Sample

The research population consisted of 8886 teachers working in Batman and its districts. The sample comprised 355 teachers from different branches and schools and was selected using a random sampling technique. A Google

form was sent to all school principals in Batman and its districts, and teachers were asked to fill it out. Within the scope of the research, 355 questionnaires were received back. The demographic characteristics of the participants are presented below.

Table 1: The demographic characteristics of the participants

	Features	Frequency (n)	Percent (%)
Gender	Female	123	34.6
	Male	232	65.4
Age	20-30	84	23.7
	31-40	151	42.05
	41-50	107	30.1
	51 years and older	13	3.7
Branch	Turkish Language/Turkish Literature	43	12.1
	Mathematics/Geometry	40	11.3
	Physical Sciences (e.g., physics, chemistry, biology)	23	6.5
	Social Sciences/History	28	7.9
	Foreign languages	30	8.5
	Art courses (e.g., painting. music)	11	3.1
	Vocational courses (e.g., motor, electric)	5	1.4
	Religious Culture and Moral Knowledge	20	5.6
	Physical Education and Sports	12	3.4
	Classroom Teaching	90	25.4
	IT Teaching	4	1.1
	Other (……..)	49	13.8
Seniority	0-5 Years	79	22.3
	6-10 Years	93	26.2
	11-15 Years	71	20
	16-20 Years	53	14.9
	21 years and above	59	16.6
Educational Status	Associate's degree	79	22.3
	Bachelor's degree	93	26.2
	Master's degree	71	20
	Doctoral degree	53	14.9
Years working with the current principal	0-2 Years	164	46.2
	3-4 Years	103	29
	5-6 Years	50	14.1
	7-8 Years	38	10.7
Technological competence	Low	11	3.1
	Intermediate	178	50.1
	Good	134	37.7
	Advanced	32	9
Daily Technology Use	None	5	1.4
	Less than 1 hour	56	15.8
	1-3 Hours	198	50.8
	More than 3 hours	96	27

2.2. Data Collection Tools

The data were collected using a personal information form, the *"Technology Leadership Competencies Scale for Educational Administrators"* developed by Banoğlu (2012) and the *"Effective School Scale"* developed by Seyfettin ABDURREZZAK and Celal Teyyar UĞURLU (2019) and validated by experts. The participants were informed about the study, sent an online questionnaire, and asked to express their opinions objectively. 355 teachers answered the instruments, and the data were analyzed using the SPSS 22.0 program.

2.2.1. Personal Information Form

A "Personal Information Form" was prepared to collect personal information about participants' "age, gender, branch, educational status, working time at the current school, seniority, technological competence, and daily technology use."

2.2.2. The Technology Leadership Competencies Scale for Educational Administrators

The scale was developed by Banoğlu (2012). It has five sub-scales, including "visionary leadership," "digital-age learning culture," "excellence in professional development," "systematic improvement," and "digital citizenship," and 32 items rated on a 5-point Likert scale ranging from "Always (5)", "Often (4)", "Sometimes (3)", "Rarely (2)," to "Never (1)". The internal consistency reliability coefficient (Cronbach's Alpha) was 0.943, the two-half reliability coefficients were 0.898 and 0.914, and the item-total discrimination index ranged from 0.449 to 0.675.

2.2.3. The School Effectiveness Scale

The tool was developed by Seyfettin ABDURREZZAK and Celal Teyyar UĞURLU (2019) and validated by experts to determine school effectiveness. The sub-dimensions in the scale are "principals," "teachers," "school environment and education process," "students," and "school environment and parents." The Cronbach's Alpha reliability coefficient was calculated as 0.95, suggesting that the " School Effectiveness Scale" was a valid and reliable measurement tool. It has five sub-dimensions and 31 items rated on a 5-point Likert scale ranging from 5 "Strongly Agree" to 1 "Strongly Disagree."The validity and reliability analyses were conducted for both scales. The results are presented in the "Findings" section below.

Table 2: Reliability Analysis Results of the *Technology Leadership Competencies Scale*

Scale and Sub-scales	**Cronbach's Alpha**	**Item Number**
Visionary Leadership	.972	12
Digital-Age Learning Culture	.946	3
Excellence in Professional Development	.973	8
Systematic Improvement	.937	3
Digital Citizenship	.957	6
Technology Leadership Competencies Scale	**.988**	**32**

The Cronbach's Alpha reliability coefficients of the *Technological Leadership Competencies Scale for Educational Administrators* and its sub-scales were calculated above 0.90, proving its high reliability (Cronbach Alpha 0.988).

Table 3: Reliability Analysis Results of the *School Effectiveness Scale*

Factor	**Cronbach's Alpha**	**Item Number**
Principals	.890	5
Teachers	.958	7
School Environment and Education Process	.926	5
Students	.950	7
School Environment and Parents	.918	7
Total	**.967**	**31**

The reliability values of the " School Effectiveness Scale" and its sub-dimensions were calculated as 0.890 and above, indicating high reliability and internal consistency.

2.2.4. Data Collection Process

With the permission of the Provincial Directorate of National Education, the data were collected by sending the questionnaire and personal information form to the teachers working in schools in Batman city center and its districts. Participation was voluntary, the questionnaires were not analyzed for individual or organizational purposes, and personal information about the participants was not collected.

2.2.5. Data Analysis Process

SPSS 22.0 software package was used to analyze the study data. The factor analysis, reliability analysis, descriptive statistics, difference test, correlation, and regression analyses were performed, respectively.

3. Findings

T-tests and ANOVA were applied to determine whether there was a significant difference between principals' technological leadership and school effectiveness according to teachers' answers.

Table 4: Mean Scores regarding Principals' Technological Leadership

Scale	**N**	$\bar{x}$	**Sd**
Technological Leadership Competencies Scale	355	3.321	.943

Table 4 shows the teachers' arithmetic means and standard deviations regarding principals' technological leadership. Accordingly, the principals had "moderate" technological leadership competency ($\bar{x}$ =3.321; sd=0.943).

Table 5: T-Test Results regarding Principals' Technological Leadership According to Teachers' Gender

Scale	**Groups**	**n**	**x**	**sd**	**t**	**p**
Technology Leadership Competencies Scale	*Female*	*123*	*3.195*	.943	-.382	*.724*
	Male	*232*	*3.235*	.944		

Table 5 shows no statistically significant difference in principals' technological leadership competencies according to teachers' gender (p>0.05).

Table 6: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' Age

Scale	**Groups**	**n**	**x**	**sd**	**t**	**p**
Technology Leadership Competencies Scale	20-30	84	3.233	0.997	3.38	0.018
	31-40	151	3.085	0.854		
	41-50	107	3.439	0.966		
	51 and older	13	2.947	1.12		
	Total	**355**	**3.221**	**0.943**		

According to the teachers' ages, principals' technological leadership competencies were statistically different (p<0.05).

Table 7: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' Seniority

Scale	Groups	n	x	sd	t	p
Technology Leadership Competencies Scale	0-5 Years	79	3.2872	0.98993	1.387	0.238
	6-10 Years	93	3.1408	0.88513		
	11-15 Years	71	3.0792	0.88598		
	16-20 Years	53	3.2282	1.01181		
	21 years and above	59	3.4285	0.95971		
	Total	**355**	**3.2219**	**0.94336**		

There was no significant difference in principals' technological leadership competencies according to teachers' seniority ($p > 0.05$).

Table 8: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' years working with the current principal

Scale	Group	N	x	Sd	F	P
Technology Leadership Competencies Scale	0-2 Years	164	3.28	0.91085	0.639	0.591
	3-4 Years	103	3.12	1.02669		
	5-6 Years	50	3.2	0.89705		
	7-8 Years	38	3.23	0.91742		
	Total	**355**	**3.22**	**0.94336**		

ANOVA test was conducted to find significant differences in principals' technological leadership according to teachers' years working with the current principal, and the results revealed no significant difference ($p > 0.05$).

Table 9: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' Daily Technology Use

Scale	Group	N	x	Sd	F	P
Technology Leadership Competencies Scale	None	5	2.38	0.925	2.33	0.074
	Less than 1 hour	56	3.03	0.948		
	1-3 Hours	198	3.26	0.874		
	More than 3 Hours	96	3.28	1.05		
	Total	**355**	**3.22**	**0.943**		

According to the ANOVA results in the table above, the principals' technological leadership competencies did not differ by teachers' daily technology use ($p > 0.05$).

Table 10: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' Technological Competence

Scale	Group	N	x	Sd	F	P
Technology Leadership Competencies Scale	Low	11	2.64	1.09	4.78	0.003
	Intermediate	178	3.15	0.903		
	Good	134	3.23	0.963		
	Advanced	32	3.71	0.859		
	Total	**355**	**3.22**	**0.943**		

The ANOVA test was performed to determine whether principals' technological leadership differed by teachers' technological competence. Accordingly, there was a significant difference in their technological leadership competencies in terms of teachers' technological competence. ($p<0.05$)

Table 11: ANOVA Results regarding Principals' Technological Leadership Competencies according to Teachers' Branch

Scale	Group	N	x	Sd	F	P
Technology Leadership Competencies Scale	Turkish Language/ Turkish Literature	43	3.25	0.866	0.706	0.733
	Mathematics/Geometry	40	2.96	0.93		
	Physical Sciences (e.g., physics, chemistry, biology)	23	3.19	0.967		
	Social Sciences/History	28	3.17	0.913		
	Foreign languages	30	3.2	0.998		
	Art Courses (e.g., painting, music)	11	3.66	0.808		
	Vocational Courses (e.g., motor, electric)	5	3.43	0.849		
	Religious Culture and Moral Knowledge	20	3.18	0.561		
	Physical Education and Sports	12	3.13	1.12		
	Classroom Teaching	90	3.32	1.01		
	IT Teaching	4	2.83	1.25		
	Other	49	3.19	0.971		
	Total	**355**	**3.22**	**0.943**		

There was no significant difference in principals' technological leadership competency according to teachers' branches ($p>0.05$).

Table 12: Mean Scores regarding *School Effectiveness Scale*

Scales	N	$\bar{x}$	Sd
School Effectiveness Scale	355	3.367	.766

The participants had moderate perceptions of school effectiveness ($\bar{x}$ =3.367; sd=0.766).

Table 13: T-Test Results regarding School Effectiveness by Teachers' Gender

Scale	Groups	n	x	sd	t	p
School Effective Scale	Female	123	3.407	.778	.707	.657
	Male	232	3.346	.760	.702	

According to the participants' gender, there was no statistically significant difference in their perceptions of school effectiveness. In other words, female and male participants had equal perceptions of school effectiveness ($p>0.05$).

Table 14: ANOVA Results regarding School Effectiveness by Teachers' Age

Scale	Group	N	x	Sd	F	P
School Effectiveness Scale	20-30	84	3.341	0.808	1.438	0.231
	31-40	151	3.3	0.703		
	41-50	107	3.493	0.799		
	51 and older	13	3.282	0.873		
	Total	355	3.367	0.766		

It was observed that there was no statistically significant difference in teachers' answers to the school effectiveness scale items according to their ages (p>0.05).

Table 15: ANOVA Results regarding School Effectiveness by Teachers' Seniority

Scale	Group	N	X	Sd	F	P
School Effectiveness Scale	0-5 Years	79	3.354	0.87202	0.806	0.522
	6-10 Years	93	3.2973	0.70045		
	11-15 Years	71	3.3158	0.73197		
	16-20 Years	53	3.4979	0.72016		
	21 Years and above	59	3.4429	0.80073		
	Total	**355**	**3.3677**	**0.76655**		

ANOVA was conducted to determine the degree of difference in teachers' perceptions of school effectiveness according to their seniority, and the results revealed no significant difference. That is, all groups had similar perceptions of school effectiveness (p>0.05).

Table 16: ANOVA Results regarding School Effectiveness by Teachers' Year Working with the Current Principal

Scale	**Group**	**n**	**x**	**sd**	**f**	**p**
School Effectiveness Scale	0-2 Years	164	3.4024	0.77766	0.918	0.432
	3-4 Years	103	3.3858	0.79659		
	5-6 Years	50	3.2019	0.73772		
	7-8 Years	38	3.3871	0.66626		
	Total	355	3.3677	0.76655		

No significant difference was found in participants' perceptions of school effectiveness in terms of "working time at the current school" (p=0.432>0.05).

Table 17: ANOVA Results regarding School Efficiency by Teachers' Daily Technology Use

Scales	**Group**	**n**	**x**	**sd**	**f**	**p**
School Effectiveness Scale	None	5	2.72	0.373	1.71	0.163
	Less than 1 hour	56	3.32	0.756		
	1-3 Hours	198	3.42	0.715		
	More than 3 Hours	96	3.31	0.871		
	Total	**355**	**3.36**	**0.766**		

There was no significant difference in participants' perceptions of school effectiveness in terms of their "daily technology use" (p>0.05).

Table 18: ANOVA Results regarding School Effectiveness by Teachers' Technological Competence

Scale	**Group**	**n**	**x**	**sd**	**f**	**p**
School Effectiveness Scale	Low	11	3.07	0.834	1.36	0.377
	Intermediate	178	3.34	0.736		
	Good	134	3.37	0.835		
	Advanced	32	3.52	0.622		
	Total	**355**	**3.36**	**0.766**		

No significant difference was found in participants' perceptions of school effectiveness in terms of their "technological competence" (p>0.05).

Table 19: ANOVA Results regarding School Effectiveness by Teachers' Branch

Scale	Group	N	X	Sd	F	P
School Effectiveness Scale	Turkish Language/ Turkish Literature	43	3.4	0.658	1.06	0.389
	Mathematics/Geometry	40	3.07	0.606		
	Physical Sciences (e.g., physics, chemistry, biology)	23	3.45	0.894		
	Social Sciences/History	28	3.39	0.88		
	Foreign languages	30	3.29	0.939		
	Art Courses (e.g., painting, music)	11	3.41	0.77		
	Vocational Courses (e.g., engine, electric)	5	3.11	0.605		
	Religious Culture and Moral Knowledge	20	3.28	0.553		
	Physical Education and Sports	12	3.28	1.05		
	Classroom Teaching	90	3.51	0.772		
	IT Teaching	4	3.02	0.838		
	Other	49	3.39	0.701		
	Total	**355**	**3.36**	**0.766**		

ANOVA was conducted to determine the significant differences in teachers' perceptions of school effectiveness according to their branches, and the results suggested no significant difference ($F=1.06$, $p>0.05$).

Table 20: Correlational findings on Principals' technological leadership and school effectiveness

		Technological Leadership	School Effectiveness
Technological Leadership	Pearson Correlation	1	.713**
	Significance (2-tail)		.000
	N	355	355
School Effectiveness	Pearson Correlation	.713**	1
	Significance (2-tail)	.000	
	N	355	355

Although there are several classifications in the literature, it is generally interpreted as (0-300) "weak", (310-490) "moderate", (.500-.690) "strong", and (700-10) "very strong" correlation (Tavşancıl,2006).

Table 20 shows the correlation analysis results of school effectiveness and technological leadership measures. Accordingly, there was a significant positive correlation between school effectiveness and technological leadership (r=0.713 and p=0.000).

Table 21: Correlational findings on Technological Leadership and School Effectiveness Sub-Dimensions

		A	B	C	D	E	F
Technological Leadership (A)	Pearson Correlation	1					
	Significance (2-tail)						
	N	355					
Principals (B)	Pearson Correlation	.741**	1				
	Significance (2-tail)	.000					
	N	355	355				
Teachers	Pearson Correlation	.541**	.589**	1			
	Significance (2-tail)	.000	.000				

	N	355	355	355			
School Environment and Education Process (C)	Pearson Correlation	.662**	.702**	.784**	1		
	Significance (2-tail)	.000	.000	.000			
	N	355	355	355	355		
Students (D)	Pearson Correlation	.523**	.513**	.551**	.603**	1	
	Significance (2-tail)	.000	.000	.000	.000		
	N	355	355	355	355	355	
Parents (E)	Pearson Correlation	.536**	.468**	.485**	.578**	.753**	1
	Significance (2-tail)	.000	.000	.000	.000	.000	
	N	355	355	355	355	355	355

The correlation analysis results indicated a moderate or strong positive correlation between technology leadership and school effectiveness sub-dimensions. For example, there was a significant positive and strong correlation between technological leadership and the *principals* sub-dimension of the school effectiveness scale (r=0.741; p=0.000); between technological leadership and the *teacher* sub-dimension (r=0.541; p=0.000); between technological leadership and the *school environment and the education process* sub-dimension (r=0.662; p=0.000); between technological leadership and the *student* sub-dimension (r=0.523; p=0.000) and lastly between technological leadership and the *school environment and parents* sub-dimension (r=0.536; p=0.000).

As seen in the table, there was a significant and strong correlation between the *principals* and *teachers* sub-dimensions of the school effectiveness scale (r=0.589; p=0.000). There was also a significant and very strong correlation between the *principals* and *school environment and education process* sub-dimensions (r=0.702; p=0.000). A strong and significant correlation was found between the *"principals"* and *"students"* sub-dimensions (r=0,513; p=0,000). Lastly, a statistically significant moderate correlation was found between the *principals* and the *"school environment and parents*" sub-dimensions (r=0.468; p=0.000).

Table 22: Correlational findings on School Effectiveness and Technological Leadership Sub-scales

		A	B	C	D	E	F
School Effectiveness	Pearson Correlation	1					
	Significance (2-tail)						
	N	355					
Visionary Leadership	Pearson Correlation	.640**	1				
	Significance (2-tail)	0					
	N	355	355				
Digital-Age Learning Culture	Pearson Correlation	.681**	.877**	1			
	Significance (2-tail)	0	0				
	N	355	355	355			
Excellence in Professional Development	Pearson Correlation	.693**	.870**	.903**	1		
	Significance (2-tail)	0	0	0			
	N	355	355	355	355		
Systematic Improvement	Pearson Correlation	.642**	.815**	.834**	.891**	1	
	Significance (2-tail)	0	0	0	0		
	N	355	355	355	355	355	
Digital Citizenship	Pearson Correlation	.712**	.805**	.814**	.852**	.808**	1
	Significance (2-tail)	0	0	0	0	0	
	N	355	355	355	355	355	355

Table 22 presents the findings related to the correlation between the school effectiveness scale and the sub-scales of the technological leadership competencies scale. Accordingly, there was a strong or very strong correlation between technological leadership and all sub-dimensions. For instance, there was a strong positive correlation between school effectiveness and *visionary leadership* (r=0.640; p=0.000). Similarly, a high positive correlation was found between school effectiveness and *digital-age learning culture* (r=0.681; p=0.000). A strong positive correlation was found between school effectiveness and *excellence in professional development* sub-scale, which is statistically significant (r=0.693; p=0.000). A similar strong positive correlation was also found between school effectiveness and *systematic improvement* (r=0.642; p=0.000). Lastly, there was a very strong positive correlation between school effectiveness and *digital citizenship* (r=0.712; p=0.000).

As understood from the table, there was a strong correlation between the sub-dimensions of the technological leadership competencies scale: between *visionary leadership* and *digital-age learning culture* (r=0.877; p=0.000); between *visionary leadership* and *excellence in professional development* (r=0.870; p=0.000); between *visionary leadership* and *systematic improvement* (r=0.815; p=0.000) and between *visionary leadership* and *digital citizenship* (r=0.805; p=0.000).

Table 23: Correlational findings on School Effectiveness Sub-dimensions and Technological Leadership Sub-scales

		A	B	C	D	E	F	G	H	I	İ
Okul Yöneticisi (A)	Pearson Korelasyon	1									
	Anlamlılık (2-kuyruk)										
	N	355									
Öğretmen (B)	Pearson Korelasyon	,589**	1								
	Anlamlılık (2-kuyruk)	,000									
	N	355	355								
Okul Ortamı ve Eğitim Süreci (C)	Pearson Korelasyon	,702**	,784**	1							
	Anlamlılık (2-kuyruk)	,000	,000								
	N	355	355	355							
Öğrenciler (D)	Pearson Korelasyon	,513**	,551**	,603**	1						
	Anlamlılık (2-kuyruk)	,000	,000	,000							
	N	355	355	355	355						
Okul Çevresi ve Veli (E)	Pearson Korelasyon	,468**	,485**	,578**	,753**	1					
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000						
	N	355	355	355	355	355					
Vizyoner Liderlik (F)	Pearson Korelasyon	,672**	,494**	,603**	,455**	,477**	1				
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000	,000					
	N	355	355	355	355	355	355				
Dijital çağ (G)	Pearson Korelasyon	,692**	,515**	,626**	,511**	,520**	,877**	1			
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000	,000	,000				
	N	355	355	355	355	355	355	355			
Mesleki Gelişim (H)	Pearson Korelasyon	,724**	,500**	,632**	,530**	,530**	,870**	,903**	1		
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000	,000	,000	,000			
	N	355	355	355	355	355	355	355	355		
Sistematik Gelişim (I)	Pearson Korelasyon	,657**	,490**	,576**	,494**	,479**	,815**	,834**	,891**	1	
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000	,000	,000	,000	,000		
	N	355	355	355	355	355	355	355	355	355	
Dijital Vatandaşlık (İ)	Pearson Korelasyon	,738**	,560**	,672**	,505**	,530**	,805**	,814**	,852**	,808**	1
	Anlamlılık (2-kuyruk)	,000	,000	,000	,000	,000	,000	,000	,000	,000	
	N	355	355	355	355	355	355	355	355	355	355

According to the table, there was a significant and strong correlation between the "*principals"* sub-dimension and the "*visionary leadership"* sub-scale (r=0.672; p=0.000).

There was a significant and strong correlation between the "*principals"* sub-dimension and the "*digital-age learning culture"* sub-scale (*r*=0.692; *p*=0.000).
There was a significant and very strong correlation between the "*principals"* sub-dimension and the "*excellence in professional development"* sub-scale (*r*=0.724; *p*=0.000).
There was a significant and strong correlation between the "*principals"* sub-dimension and the "*systematic improvement"* sub-scale (*r*=0.657; *p*=0.000).
A significant and very strong correlation was found between the "*principals"* sub-dimension and the "*digital citizenship"* sub-scale (*r*=0.738; *p*=0.000).
There was a significant moderate correlation between the "*teachers"* sub-dimension and the "*visionary leadership"* sub-scale (*r*=0.494; *p*=0.000).
There was a significant and strong correlation between the "*teachers"* sub-dimension and the "*digital-age learning culture"* sub-scale (*r*=0.515; *p*=0.000).
There was a significant and strong correlation between the "*teachers"* sub-dimension and the "*excellence in professional development"* sub-scale (*r*=0.500; *p*=0.000).
There was a significant moderate correlation between the "*teachers"* sub-dimension and the "*systematic improvement"* sub-scale (*r*=0.490; *p*=0.000).
There was a significant and strong correlation between the "*teachers"* sub-dimension and the "*digital citizenship"* factor sub-scale (*r*=0.560; *p*=0.000).
There was a significant and strong correlation between the *"school environment and "education process"* sub-dimension and the "*visionary leadership"* sub-scale (*r*=0.603; *p*=0.000).
There was a significant and strong correlation between the *"school environment and education process"* sub-dimension and the "*digital-age learning culture"* sub-scale (*r*=0.626; *p*=0.000).
There was a significant and strong correlation between the *"school environment and education process"* sub-dimension and the "*excellence in professional development"* sub-scale (*r*=0.632; *p*=0.000).
There was a significant and strong correlation between the *"school environment and education process"* sub-dimension and the "*systematic improvement"* sub-scale (*r*=0.576; *p*=0.000).
There was a significant and strong correlation between the *"school environment and education process"* sub-dimension and the "*digital citizenship"* sub-scale (*r*=0.672; *p*=0.000).
There was a significant moderate correlation between the "*students"* sub-dimension and the "*visionary leadership"* sub-scale (*r*=0.455; *p*=0.000).
There was a significant and strong correlation between the "*students"* sub-dimension and the "*digital-age learning culture"* sub-scale (*r*=0.515; *p*=0.000).
There was a significant and strong correlation between the "*students"* sub-dimension and the "*excellence in professional development"* sub-scale (*r*=0.530; *p*=0.000).
There was a significant moderate correlation between the "*students"* sub-dimension and the "*systematic improvement"* sub-scale (*r*=0.494; *p*=0.000).
There was a significant and strong correlation between the "*students"* sub-dimension and the "*digital citizenship"* factor in the sub-scale (*r*=0.505; *p*=0.000).
There was a significant moderate correlation between the "*school environment and parents"* sub-dimension and the "*visionary leadership"* sub-scale (*r*=0.477; *p*=0.000).
There was a significant and strong correlation between the "*school environment and parents"* sub-dimension and the "*digital-age learning culture"* sub-scale (*r*=0.520; *p*=0.000).
There was a significant and strong correlation between the "*school environment and parents"* sub-dimension and the "*excellence in professional development"* sub-scale (*r*=0.530; *p*=0.000).
There was a significant moderate correlation between the "*school environment and parents"* sub-dimension and the "*systematic improvement"* sub-scale (*r*=0.479; *p*=0.000).
There was a significant and strong correlation between the "*school environment and parents"* sub-dimension and the "*digital citizenship"* sub-scale (*r*=0.530; *p*=0.000).
The regression analysis results regarding the relationship between technological leadership and school effectiveness are shown in Table 24.

Table 24: Regression Analysis Results

Model	R	R^2	Adjusted R^2	Standard Error of Estimates
1	.713[a]	.508	.507	.53832

a. Predictors: (Fixed), Technological Leadership

According to the table, $R^2 = 0.508$ (adjusted $R^2 = 0.507$). Therefore, technological leadership, the independent variable, explained 50.8% of the variance of school effectiveness. In other words, a 50.8% change in school effectiveness was due to the effects of technological leadership variables.

Table 25: Regression Analysis Results

Model		Total Square	s.d.	Mean Square	F	Significance (Sig.)
1	Regression	105.715	1	105.715	364.795	.000b
	Residue Total	102.297	353	.290		
		208.012	354			

The regression analysis (ANOVA) results are shown in Table 25. Accordingly, there was a statistically significant relationship between the dependent and independent variables at the 95% confidence interval (F=364.795 and $p \leq 0.05$). It can be inferred that the model is statistically significant.

Table 26: Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Significance(sig.)
1	Technological Leadership	1.501	.102		14.746	.000
		.579	.030	.713	19.100	.000

Dependent Variable: School Effectiveness

The regression model coefficients are shown in Table 26. The correlation between technological leadership and school effectiveness was statistically significant (p=0.000), and the beta value was 0.713. Accordingly, technological leadership increased by 1 unit, and the school effectiveness increased by 0.713 units. In other words, adopting a leading role in technology in schools contributed to school effectiveness.

Table 27: Regression Model Summary of the Subscales

Model	R	R^2	Adjusted R^2	Standard Error of Estimates
1	.736[a]	.542	.535	.52251

a. Predictors: (Fixed), visionary leadership, digital-age learning culture, excellence in professional development, systematic improvement, digital citizenship.

Table 27 shows the results of the regression analysis that was performed to reveal the possible effects of the technological leadership sub-dimensions (i.e., "visionary leadership," "digital-age learning culture," "excellence in professional development," "systematic improvement," and "digital citizenship") on school effectiveness. Here, $R^2 = 0.542$ (adjusted $R^2 = 0.535$). In other words, the independent variables (i.e., "visionary leadership," "digital-age learning culture," "excellence in professional development," "systematic improvement," and "digital citizenship") explained 53.5% of the variance in school effectiveness (the dependent variable). That is, 53.5% of changes in school effectiveness resulted from the effects of the "visionary leadership," "digital-age learning culture," "excellence in professional development," "systematic improvement," and "digital citizenship."

Table 28: Regression Analysis Summary of Subscales (ANOVA Results)

Model		Total Square	s.d.	Mean Square	F	Significance (Sig.)
1	Regression	112.728	5	22.546	82.579	.000b
	Residue Total	95.284	349	.273		

	208.012	354

Table 28 shows the regression analysis results indicating a statistically significant relationship between the independent and dependent variables at the 95% confidence interval (F=82.579 and p≤0.05).

Table 29: Regression Model Coefficients of Sub-Dimensions

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Significance (sig.)
Visionary Leadership	-.032	.066	-.041	-.488	.626
Digital-age Learning Culture	.162	.070	.219	2.320	.021
Excellence in Professional Development	.134	.086	.175	1.570	.117
Systematic Improvement	-.002	.058	-.002	-.029	.977
Digital Citizenship	.318	.055	.420	5.768	.000

a. Dependent Variable: School Effectiveness

According to Table 29, the effect of digital citizenship (independent variable) on school effectiveness (dependent variable) was statistically significant (p≤0.05), but no significant relationship was found between visionary leadership, digital-age learning culture, excellence in professional development, systematic improvement and school effectiveness (p>0.005).

There was a significant relationship between the digital citizenship subscale and school effectiveness, with a normalized beta value of 0.420 (p=0.000). In other words, each additional digital citizenship unit increased the school's effectiveness by 0.420 units. Adopting a digital citizenship approach in schools can positively increase school effectiveness.

4. Discussion, Conclusion, and Recommendations

4.1. Discussion

The study findings revealed the positive effects of technological leadership competence on school effectiveness. The principals who had advanced technological leadership skills positively affected school effectiveness. The results showed that the human-centered, supportive, and visionary sub-dimensions of technological leadership had a positive and significant effect on school performance. In contrast, communication and cooperation dimensions did not affect school effectiveness. The correlation analysis results indicated that technological leadership and its sub-dimensions positively and significantly affected school effectiveness. It can be inferred that improving the technological leadership skills of school administrators would significantly contribute to school effectiveness.

Technological leadership, an independent variable, explained 50.8% of the variance of school effectiveness, a dependent variable. In other words, 50.8% of the change in school effectiveness was due to the effect of technology leadership variables. It is considered that school effectiveness would increase in schools where principals adopt and implement human-centered, supportive, and visionary technological leadership. The technological leader of a school is expected to create a technology vision, meet the school's technological needs, establish a technology team, renew the school technology plan, and update technological tools at school, which would improve school effectiveness. Including educational technologies in the curriculums and the frequent use of educational software in teaching would improve digital-age learning culture and school effectiveness.

An improvement was observed in school effectiveness when teachers used educational technologies effectively and principals adopted a human-centered approach, which had a central place in technology leadership behaviors. The school's effectiveness also increased with the support of teachers when principals promoted all shareholders' involvement and equal benefit from educational technologies. In this sense, students should be informed about the effective use of educational technologies in schools. Besides, the equal access to digital tools and technologies at schools, taking steps to use the internet for only educational purposes, developing education policies for the legal, ethical, and safe use of technology, close monitoring of students' technology-related negative behaviors, and

taking countermeasures, the effective use of educational technologies by teachers and the adoption of a human-centered approach by principals would lead to positive outcomes in school effectiveness. School effectiveness also improved when principals addressed the issues surrounding equal access to technology and benefit from educational technologies by considering teachers' opinions and suggestions about the issue.

Additionally, it was concluded that the principals' promotive and supportive behaviors in educational technologies contributed to school effectiveness. Using technology to promote student development, following the recent innovations, creating an environment that meets students' technological needs, and supporting students' technology use would positively affect academic success and school effectiveness. As a result of the correlation and regression analysis, a strong or very strong significant correlation was found between the sub-dimensions of technological leadership and the sub-dimension of school effectiveness.

5. Conclusion

The arithmetic means and standard deviation scores related to principals' technological leadership competence indicated that they had moderate technological leadership behaviors (x=3.321). In other words, in all statistical analyses of the variables, including gender, age, seniority, branch, technological competence, daily technology use, and working time at the current school, the teachers believed that principals had moderate technological leadership competencies. This finding overlaps with the findings of Biçer (2019), Durnalı (2018), Irmak (2015), Gençay (2018), Teke and Deniz (2020), Sağbaş (2019), Kırlıoğlu (2021), and Öztürk (2021). However, in their research, Smart (2019), Aktaş (2016), Çıkrık (2020), Dinç (2019), Görgülü, Küçükali and Ada (2013), Kurt (2019), Weng and Tang (2014) and Alkrdem (2014) found that school administrators had sufficient technological leadership.

The participating teachers' perceptions of school effectiveness were also "moderate" (x=3.367). They found school effectiveness and its sub-dimensions "moderate."

According to the technological leadership competencies scale, teachers' perceptions of principals' technological leadership did not differ by their gender, which is consistent with several findings in the literature (e.g., Smart, 2019; Atılgan, 2019; Bülbül and Çuhadar,2012; Çakır and Aktay, 2018; Eren and Şişman,2010; Ertuğrul, 2014; Scales, 2014; Irmak, 2015; Gençay, 2018; Gürkan, 2017; Kırlıoğlu, 2021; Kurt, 2019; Teke, 2019).

It was observed that there was a statistically significant difference in participants' answers about technological leadership by age. However, there was no statistically significant difference in the answers about the school effectiveness by age. Bicer (2019) and Kırlıoğlu (2021) found that school administrators' technological leadership competencies fifered by age criteria. On the other hand, Durnali,2018; Dinc, 2019; Sağbaş, 2019; Yumlu, 2020; and Çırık, 2020 determined no significant difference by age. Similarly, there was no statistically significant difference in the answers to the school effectiveness scale by teachers' age. It parallels the findings of Tarhan,2008; Yumlu, 2020; Abdurrezzak, 2015; Atcıoğlu, 2018. However, Şahin (2020) found a significant difference in school administrators' perceptions of school effectiveness by age.

There was no significant difference in principals' technological leadership competencies by teachers' seniority. Similarly, Ertuğrul (2014), Aşçı (2017), Cantürk and Aksu (2017), Çırık (2020), Dinç (2019), Görgülü, Küçükali and Ada (2013), Sağbaş (2019), Yumlu (2020), Alkrdem (2014) and Irmak (2015) also found no significant difference in technological leadership competencies between the opinions of inexperienced and experienced teachers. Seniority also did not significantly affect teachers' perceptions of school effectiveness. In other words, seniority did not play an effective role in teachers' opinions about school effectiveness. Similarly, in the studies conducted by Atcıoğlu (2018), Atılgan (2019), Adurrezzak (2015), Yumlu (2020), and Tarhan (2008), teachers' perceptions of school effectiveness did not change by their seniority. Thus, regardless of seniority, it was observed that teachers had similar perceptions about their schools' effectiveness.

There was no significant difference in participants' perceptions of principals' technological leadership or school effectiveness according to the teachers' working time at the current school. In other words, working time at the

current school did not play an influential role in teachers' belief in school performance or effectiveness, which overlaps with the findings of Atcıoğlu (2018), Irmak (2015), and Tarhan (2008).

There was no significant difference in participants' perceptions of principals' technological leadership or school effectiveness according to the teachers' daily technology use.

A significant difference was found in participants' perceptions of principals' technological leadership according to their technological competence. However, there was no difference in participants' answers about school effectiveness by their technological competence.

6. Recommendations

For Practitioners: A technological leader must first internalize the use of technology and be aware of their responsibility. In this sense, technology education at the undergraduate level is insufficient due to technology's constantly changing nature. Technological leaders should continually update themselves and follow the relevant literature. They should make a sound and elaborate plan to enhance the potential uses of technology in learning and teaching. The use of technology is not only a matter of hardware and the internet. The critical point is integrating technology into the curriculum. It entails regular tasks of following recent innovations, integrating technology into the school environment and system, and providing training and updating. It is known that a technology plan is a roadmap for implementing technology.

As technological leaders, principals and teachers should develop a vision for technology integration and implementation and promote technological changes in educational environments. Technological leaders should assist all students in using technology effectively in learning, experiencing new processes, and assessment. They should create effective and optimal learning environments to maximize learning outcomes. They should analyze technology and develop vocational training programs. They should assess the effects of those programs on students' learning. They should ensure students' and teachers' equal access to technological tools, models, and resources. They should always enhance professional, pedagogical, and technological knowledge and skills. Only in this way can they contribute to school effectiveness.

For researchers: It is a quantitative study limited to Batman province. Qualitative studies with different variables can be carried out comprehensively in other provinces. Also, this study examined the relationship between principals' technological leadership and school performance. Future studies can focus on related other variables in educational institutions other than schools.

For policymakers: Multiple factors affect school effectiveness. Principals' leadership characteristics are one of the important factors playing a role in school effectiveness. Since information technology is considered an indicator of progress worldwide, a leader's technology knowledge becomes more critical. Better technological leadership skills would facilitate the use of technological tools in schools. Therefore, principal appointment and promotion criteria should consider the adaptation skill to new technology. In this sense, policymakers should develop policies and procedures considering the mentioned issues, which would, in turn, increase school effectiveness.

In this age of rapid technological development, principals cannot disclaim their technological leadership roles. They should closely follow technological developments and be a pioneer in the integration of technology into the education process. They should be role models that promote technology integration, implement changes, and provide the necessary momentum for all stakeholders.

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