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Development and Initial Validation of Leadership for Technology Integration Scale in Schools

Mehmet Durnalı[1], İbrahim Limon[2], Behiye Dağdeviren Ertaş[3]

ABSTRACT

The literature highlights the critical role of principals in fostering a digitally-enabled educational environment. In this sense, this study aims to develop and validate "The Leadership for Technology Integration Scale for School Principals (LETIS-SP)". The scale measures the principals' technology integration leadership behaviors based on teachers' perceptions. A thorough literature review was conducted and an item pool of 60 items were created. Following expert opinions and content validity ratios a draft scale with 18 items emerged. First, exploratory factor analysis (EFA) was conducted with a sample of 225 teachers. The EFA findings showed that the scale was uni-dimensional. Then, confirmatory factor analysis confirmed the uni-dimensional structure of the scale. In this step, 200 teachers participated in the study. Consequently, the findings showed that the scale included 18 items. Cronbach's Alpha internal consistency coefficient was .96 which was satisfactory. Based on these findings, it can be concluded the scale has adequate psychometric properties sought in the literature.

Keywords: Leadership, technology integration, school principal, teacher, technology, effective schools

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[1]Mehmet Durnalı, Ereğli Faculty of Education, Zonguldak Bülent Ecevit University, durnali@gmail.com, ORCID: 0000-0002-1318-9362

[2]İbrahim Limon, Sakarya Mithatpaşa Anadolu Lisesi, ibomon@gmail.com, ORCID: 0000-0002-5830-7561

[3]Corresponding Author: Behiye Dağdeviren Ertaş, Yozgat Bozok University, behiyeertas5884@gmail.com, ORCID: 0000-0003-2431-1914

Introduction

The rapidly changing digital environment of the 21st century urges educational systems to adapt to technology to effectively satisfy the needs of society (Van Niekerk & Blignaut, 2014). Integrating information and communication technologies (ICT) into schools is considered one of the main challenges of this century and is of critical importance (i.e., Durnalı, 2013; Voogt et al., 2018). The practical use of ICT in education can improve instructional methods and enhance student performance (Durnalı & Limon, 2020). Many countries initiated projects to ensure ICT integration (Leonard & Leonard, 2006), such as FATIH project in Türkiye (Durnalı et al., 2019). Drawing from a good deal of literature (i.e., Durnalı, 2019a; Durnalı, 2019b; Durnalı, 2022a; Erçetin et al., 2018; Watts, 2009), we can understand that the success of such projects, however, depends largely on the role of school leaders in technology integration. Technology integration leadership should address teachers' intrinsic commitment or moral purpose to improve student learning. As well as being aware of the informal environment, effective leaders of organizational change need to work to build a sense of moral purpose among teachers to ensure the sustainability of technology integration.

UNESCO's (2020) report "The digital transformation of education: connecting schools, empowering learners" defines educators as critical elements of the digital transformation process. For this process to run smoothly, it is emphasized that the professional development of educators should be modernized and updated. In this way, educators can effectively integrate technology into educational processes and provide students with a more motivating learning experience (Gökbulut & Durnalı, 2023; Sepúlveda, 2020). Thus, it is essential not only to provide access to technology but also to create inclusive learning environments that will reduce inequalities under the guidance of competent educators. It is recommended that school administrators provide teachers with time and space so that they can develop innovative approaches to technology integration (Byrom & Bingham, 2001). Educational leaders should create the necessary conditions for teachers to use technology effectively by supporting them in developing classroom practices (Durnalı & Akbaşlı, 2020). In this context, it is essential to provide appropriate guidance to increase educators' technology integration skills. For technology integration to be achieved effectively, such guidance and orientations will support teachers to use the tools more efficiently (Durnalı, 2019a; Gümüş et al., 2024).

Challenges persist, especially in contexts such as Türkiye, where educational technology is not included in school principal training programs. This gap requires school principals to independently develop their vision and strategies focusing on both technical knowledge and the emotional and social needs of teachers and students (Durnalı, 2019b; Erçetin et al., 2018; Tannimalai & Raman, 2018). Fullan (1991) emphasizes that principals often report that teachers need more time and resources to implement curriculum changes, including technology integration. Given the central role of principals in technology integration, professional development in technology education should be prioritized for both principals and teachers (Dawson & Rakes, 2003; Gökbulut & Durnalı, 2023). Ertmer (2005) describes the barriers to using technology in the classroom as external (e.g., lack of resources and support) and internal (e.g., teachers' self-confidence and beliefs about the value of technology). While technology coaches can support teachers' attitudes toward technology integration, the practical applicability and sustainability of this training are still being debated. Lu and Overbaugh (2009) show that providing a teacher with time and support positively impacts their ability to use technology effectively. School principals are important in providing this support and encouraging teachers' professional development to sustain successful technology integration. Social and educational change has been driven by rapid technological advances. As new and emerging technologies provide competitive advantages to instruction, developing the next generation of teachers and leaders with technology skills is more critical than ever (Gao et al., 2010).

Technology Integration in Education

Technology integration in educational settings constitutes a sustainable and ongoing transformation in the prevailing social order within academic institutions; and this integration is precipitated by the implementation of technological resources to facilitate students' construction of knowledge (Thannimalai, & Raman, 2018; Tosuntaş et al., 2019). The effective integration of technology into teaching and learning processes emerged as a pivotal concern in numerous educational systems. A substantial body of research revealed that investment in technology increased in many countries to integrate technology into the educational environment (Tilya, 2008). Countries made a considerable amount of financial resources, expertise, and research in order to facilitate the integration of technology into education in a manner that optimizes the classroom environment for enhanced teaching and learning (Jhuree, 2005).

Teachers usually learn about technology integration during undergraduate education or through professional development (Gökbulut & Durnalı, 2023; Schrum et al., 2011). The conditions under which technology can be used to improve student learning effectively in the classroom is a fundamental issue surrounding the interaction between technology and education. For technology to have an impact on learning, regardless of its claimed educational benefits, it must be implemented (Zhao et al., 2002). In today's world, schools are expected to integrate learning technologies in a course or unit to facilitate students' self-directed learning skills, e-learning styles, deeper or critical thinking, creativity, or metacognition (Durnalı et al., 2022; Durnalı, 2022b; Mcload, 2015). It is accepted that technology integration can contribute to transforming education. However, it should be noted that these tools offer the potential to improve the quality of learning only when used appropriately and integrated into teaching processes. Digital technologies can make educational systems more innovative, durable, and resistant to external factors by facilitating communication, collaboration, and access to more comprehensive resources. However, these technologies are only considered as tools to achieve a higher purpose (Sepúlveda, 2020).

Technology Integration Leadership in Educational Organizations

Before explaining the technology integration leadership behavior of school principals, it is noteworthy to explain the technological leadership behavior of school principals. These concepts refer to two important leadership approaches that are frequently discussed in the educational administration literature and are related to each other but have different focal points. Technological Leadership Behavior is explained with the leadership characteristics that encourage school principals to use technology effectively and efficiently in educational environments, monitor technological innovations and support the integration of these into the school (Bülbül & Çuhadar, 2012; ISTE, 2009; Thannimalai & Raman, 2018b). Technological leadership includes elements such as administrators' developing a technological vision, a digital age learning culture, digital citizenship, excellence in professional practice, motivating teachers to use technology and providing the necessary infrastructure (Dinç & Göksoy, 2020; ISTE 2009). Technology Integration Leadership is a leadership approach that focuses on how to integrate technology into education training processes. This behavior includes guiding how to use technology for pedagogical purposes, how to include it in the curriculum, and how teachers will achieve this integration (Leonard & Leonard, 2006).

Being a digital education leader requires using information technologies and applications effectively, understanding the dynamics of institutional change, and developing a vision of the role of technology integration in education (Berkovich & Hassan, 2024; Durnalı, 2022a). In addition, educational leaders are expected to be able to integrate technology in a way that creates professional development opportunities. Educational leaders are expected to provide conditions to enhance teachers' learning experiences during the technology integration (Barton & Dexter, 2020). Educational leaders can contribute to the effective progress of this process by encouraging technology integration in schools and classrooms (Larson et al., 2010). In this context, principals are essential in directing educational processes by regulating teachers' working conditions and indirectly supporting students' academic success (Dexter & Richardson, 2020). Leadership is becoming even crucial for successfully implementing technology integration, especially in 21^{st}-century educational environments.

School leaders should set goals for teachers and students and create the conditions to facilitate their achievement (Durnalı, 2022a; Raman & Thannimalai, 2019). Researchers also suggested that effective leadership is essential for implementing ICT in schools. The contribution of principals to the successful and sustainable implementation of ICT in education became the focus of past research (Antonietti et al., 2023; Dinç & Göksoy, 2020; Leonard & Leonard, 2006; Vallance, 2008).

Today, teaching and learning processes have a very different structure than a few decades ago due to the profound effects of technology in these areas. Digital technologies offer many advantages to improve learning and teaching processes by allowing the adoption of innovative pedagogical approaches in education. In this context, educators must have the skills to transform their teaching. It has become essential for schools to support and empower educators in this transformation process, as they strive for sustainable digital transformation (Krabonja et al., 2024). Byrom and Bingham (2001) stated that school administrators are "the most important factor affecting the successful integration of technology in schools."

Effective technology leadership is not only a technical task but also includes meeting teachers' and students' social and emotional needs (Dexter et al., 2016; Durnalı, 2022a). McKenzie (1999) argues that the curriculum should include strategies that require the effective use of technology, which should be supported by strong leadership. This perspective emphasizes that school leaders should see technology as an integral part of a culture that improves the educational process (Dexter & Richardson, 2020). As Ritchie (1996) suggested, principals should be able to mobilize staff to create a technology-friendly culture. In addition, today, it is essential for educational leaders to focus on integrating technology into classrooms in a way that best serves students’ needs. The observable use of these tools in learning and teaching processes and discussions on these tools will contribute to students' global competitiveness in the 21^{st} century. The opportunities offered by the future should be evaluated with a positive approach to reshaping education and adapting to educational processes (Larson et al., 2010). Moreover, if school administrators want teachers to integrate technology into their teaching meaningfully, they should give their educators reasonable time and space to change and improve their classroom practices (Mcload, 2015).

In line with all this literature, as the importance of technology integration increases, the leadership roles and effects of school principals in this process still need to be examined sufficiently. This study aims to develop the Leadership for Technology Integration Scale in Schools. There are tools in the literature to measure teachers' technology integration (Antonietti et al., 2023; Finger et al., 2006). There are also scales for school principals' technology leadership (Banoğlu, 2012; Bülbül, & Çuhadar, 2012; Dinç & Göksoy, 2020; Hacıfazlıoğlu et al., 2011; Raman et al., 2019; Sincar, 2009). In addition, there is a scale development study on school principals' leadership for technology by Leonard and Leonard, (2006). However, the scale of Leonard and Leonard, (2006) is evaluated according to the opinions of principals. Therefore, according to the opinions of teachers, a comprehensive assessment tool that allows school principals to effectively manage technology integration has not been found. Therefore, the scale developed within the scope of the current research provides a comprehensive assessment tool that allows school principals to effectively manage technology integration. In addition to addressing these gaps in the literature, this study aims to understand the competencies of school principals in using technology integration and to examine teachers' views on this issue. In this context, this study seeks to answer the question of whether the Leadership for Technology Integration Scale in Schools is a reliable and valid measurement tool.

Method

This is a scale development study which followed the fundamental steps such as content validity, (literature review for draft item generation, revising items, applying to expert opinions, content validity ratios etc.), construct validity (exploratory factor analysis (EFA) and confirmatory factor analysis (CFA)) and reliability analysis. All analyses were conducted on MS Excel, SPSS, and AMOS software's. To collect data, we used a purposeful sampling strategy. Explanatory Factor Analysis (EFA) involved 225 teachers whereas Confirmatory Factor Analysis (CFA) 200 teachers.

Participants

Two distinct study groups were reached for this research. Data from the first study group was used for the EFA, while data from the second study group for the CFA. The first group comprised 229 teachers employed in public secondary schools in Ankara, whereas the second group included 206 teachers from public secondary schools in Zonguldak. With 18 items, the data collected for our EFA and CFA analyses is supported as sufficient by the literature. For instance, it is stated that the sample size should be at least five times the number of observed variables (Tabachnick & Fidell, 2012). Similarly, Tavşancıl (2014) emphasized that in scale development studies, the sample size should be at least five times, or preferably ten times, the number of items. A purposeful sampling strategy was employed to select participants. This approach allows researchers to target individuals who minimize the margin of error in the required data, are easily accessible, and are geographically convenient, thereby offering significant efficiency and practicality within a limited timeframe. Additionally, this method is cost-effective. As highlighted in the literature, purposeful sampling is advantageous because selecting participants with well-defined characteristics simplifies the research process (Yıldırım & Şimşek, 2016). Table 1 presents the demographics of participants from both study groups.

Table 1. Demographics of the participants

EFA				CFA			
Variable		**Frequency (*f*)**	**Percent (%)**	**Variable**		**Frequency (*f*)**	**Percent (%)**
Gender	*Female*	129	57.33	**Gender**	*Female*	113	56.50
	Male	96	42.67		*Male*	87	43.50
Educational level	*Undergraduate*	164	72.89	**Educational level**	*Undergraduate*	156	78.00
	Graduate	61	27.11		*Graduate*	44	22.00
Experience	*0-5 years*	53	23.56	**Experience**	*0-5 years*	35	17.50
	6-10 years	41	18.22		*6-10 years*	42	21.00
	11-15 years	63	28.00		*11-15 years*	47	23.50
	15-20 years	42	18.67		*15-20 years*	48	24.00
	21 years and above	26	11.56		*21 years and above*	28	14.00
Age	*20-30 years*	42	18.67	**Age**	*20-30 years*	39	19.50
	31-40 years	121	53.78		*31-40 years*	98	49.00
	41-50 years	45	20.00		*41-50 years*	44	22.00
	51 year and over	17	7.56		*51 year and over*	19	9.50
Total		225	100	**Total**		200	100

As Table 1 illustrates, the first study group, utilized for Exploratory Factor Analysis (EFA), comprises 225 participants. Of these participants, 129 (57.33%) are female, and 96 (42.67%) are male. As for educational level, 164 participants (72.89%) have undergraduate, while 61 participants (27.11%) have graduate degrees. The second study group, employed for Confirmatory Factor Analysis (CFA), consists of 200 participants. Within this group, 113 participants (56.50%) are female, and 87 participants (43.50%) are male. Regarding educational level, 156 participants (78.00%) have undergraduate degrees, whereas 44 participants (22.00%) have graduate degrees.

Scale Development Steps

Data Analysis

We utilized a substantial sample size (225 for EFA and 200 for CFA) and adhered to Field's (2009) recommendation, emphasizing the importance of visually examining the distribution's shape alongside evaluating the skewness and kurtosis coefficients, rather than focusing solely on their statistical significance. That said, our analysis revealed that the skewness and kurtosis values for both EFA and CFA datasets fell within the acceptable range of ±1.96. Furthermore, the visual assessment of the distribution's shape confirmed compliance with the criteria for normality assumptions.

A data screening process was conducted prior to the factor analysis. To identify and address outliers, the Boxplot technique was applied, resulting in the removal of four data for the EFA and six for the CFA. Both datasets have no missing data as we collected the data online using Google Forms, ensuring there were no missing responses, as the platform requires participants to complete all survey items before submission.

Generating Item Pool and the Content Validity of the Instrument

Firstly, the literature was thoroughly reviewed, and a conceptual framework was established based on the existing literature. An item pool for the technology integration leadership behaviors that the school principal exhibits in the process of integrating technology into the school organization was generated. When delving into literature to develop scale items, we found a good deal of studies using this approach (i.e., Durnalı, 2022a) which yielded a pool of 60 items. Table 2 presents two sample expressions.

Table 2. The sample items

Reference	**Item**
Among the behaviors that should be exhibited by school principals who will contribute to the successful integration of technology in schools… there is the behavior of sharing leadership roles (Byrom & Bingham, 2001:6-7).	shares leadership roles to contribute to successful technology integration in schools.
One of the ten items taken from successful projects that will guide school principals in integrating successful technology applications with the school is to involve teachers in the process (Meltzer & Sherman, 1997:23-31).	involves teachers in the process of integrating successful technology applications with the school.

Then, the expressions were carefully examined again. Expressions stating similar behaviors were combined during this process. Additionally, expressions that did not fit the aforementioned leadership behaviors were excluded from the item pool. 32 items in the draft instrument item pool were still open for expert review at the end of the procedure. On the basis of the following three criteria, professional views were sought for each item: items' clarity, content validity, and suitability for the intended sample readers.

The Lawshe technique's Content Validity Ratio (CVR) was employed to examine the validity of the instrument. This method suggested by Lawshe (1975) was used by some other scholars (i.e., Durnalı, 2022a). In this method, researchers can apply to the opinion of experts between five and forty. In this study, 32-items were emailed to twelve academicians in the field of educational sciences holding a variety of majors across nine different universities. Within a week, seven academicians sent their feedback. The expert views were then compiled in accordance with Lawshe's (1975) formula, and the CVR was computed independently for each item.

For each item to be retained, the cut-off points for CVR value suggested by Lawshe (1975) is .75. Finally, there were a total of 18 items which satisfied this criterion. Two Turkish language experts examined the items to see whether they were correctly written, grammatically accurate, and effectively communicated. The items were then evaluated for comprehension by two teachers. The necessary modifications were made based on their comments, and before the EFA, the instrument’s final draft had 18 items.

The Construct Validity

The EFA and the CFA were performed to evaluate the construct validity of the LETIS-SP.

Exploratory Factor Analysis (EFA)

The findings suggested that The Kaiser-Meyer-Olkin (KMO) was .79 which showed that the data was suitable for factor analysis since Field (2009) suggested that the KMO should be higher than .50.

On the other hand, Bartlett's Test of Sphericity, Chi-Square and degree of freedom values were found to be significant ($X^2{}_{(df)}= 1051.13_{233.32}$; p<.05). Furthermore, the evaluation of multivariate normality assumptions through Mardia's (1974) test for multivariate skewness and kurtosis indicated significant results ($p<.001$), with values surpassing the critical threshold of 5.00. Consequently, multivariate non-normality was assumed. In response to this non-normality, the "principal axis factoring" extraction method was employed, recognizing that alternative factor extraction methods typically produce comparable results (Tabachnick et al., 2019). The only factor with an eigenvalue of higher than 1.00 explained 63.35 of the total variance. Additionally, scree plot with the sharp elbow after one factor confirmed the unidimensional structure of the scale (See Fig. 1).

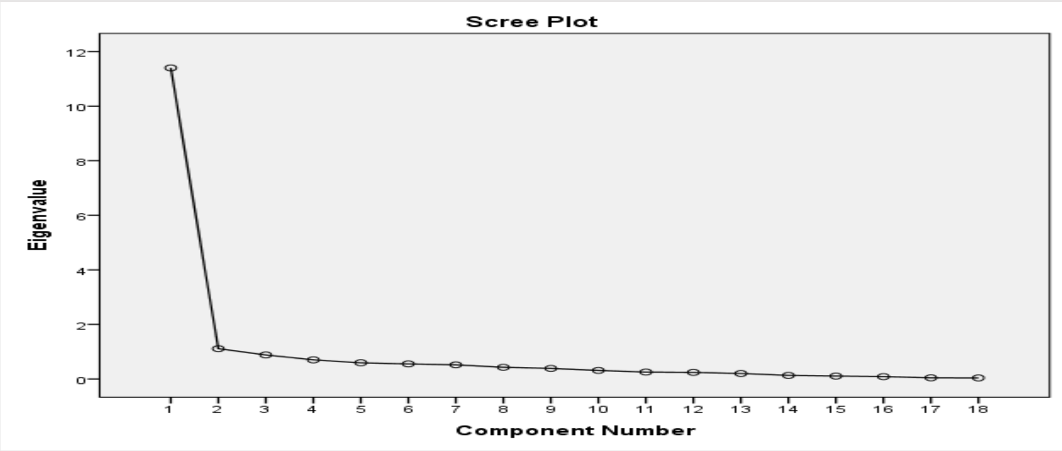

Figure 1. Scree plot

Prior to "Varimax with Kaiser Normalization" rotation, no items were discarded as all items had factor loadings higher than .40. For this, we followed the suggestions of the scholars (i.e., Büyüköztürk, 2016; Çokluk et al., 2012; Worthington & Whittaker, 2006). They emphasized that factor loadings should be $\geq .40$.

Corrected item-total correlations show the correlations between each item and the total score from the scale. To ensure the reliability of the scale these values should exceed .30 which suggests that items correlate well with the total (Field, 2009). As Table 3 indicates, these values range between .62-.91 for the scale. Thus, it can be concluded that each item has a high correlation with the total and supports reliability.

Table 3. EFA item-total correlations after rotation

Item No	**Corrected Item Total Correlations**	**Item No**	**Corrected Item Total Correlations**
1	.62	10	.88
2	.70	11	.81
3	.70	12	.69
4	.70	13	.75
5	.73	14	.72
6	.79	15	.75
7	.71	16	.77
8	.78	17	.89
9	.91	18	.89

Table 4. t-test results for item means of %27 of the Lower and Upper groups of the LETIS-SP

Item No	Group	N	Mean Difference	Sd	t	*p*
I1	Upper % 27	61	-1.79	.07	17.87	.00
	Lower % 27	61	-1.79	.07		
I2	Upper % 27	61	-1.54	.13	11.50	.00
	Lower % 27	61	-1.54	.13		
I3	Upper % 27	61	-1.72	.12	14.49	.00
	Lower % 27	61	-1.72	.12		
I4	Upper % 27	61	-1.69	.12	13.69	.00
	Lower % 27	61	-1.69	.12		
I5	Upper % 27	61	-1.85	.14	13.56	.00
	Lower % 27	61	-1.85	.14		
I6	Upper % 27	61	-1.46	.14	10.26	.00
	Lower % 27	61	-1.46	.14		
I7	Upper % 27	61	-1.69	.13	12.83	.00
	Lower % 27	61	-1.69	.13		
I8	Upper % 27	61	-1.70	.15	11.72	.00
	Lower % 27	61	-1.70	.15		
I9	Upper % 27	61	-1.90	.13	15.20	.00
	Lower % 27	61	-1.90	.13		
I10	Upper % 27	61	-2.08	.11	18.92	.00
	Lower % 27	61	-2.08	.11		
I11	Upper % 27	61	-1.87	.12	15.23	.00
	Lower % 27	61	-1.87	.12		
I12	Upper % 27	61	-2.05	.13	15.31	.00
	Lower % 27	61	-2.05	.13		
I13	Upper % 27	61	-1.69	.14	12.49	.00
	Lower % 27	61	-1.69	.14		
I14	Upper % 27	61	-1.69	.13	12.90	.00
	Lower % 27	61	-1.69	.13		
I15	Upper % 27	61	-1.80	.14	12.92	.00
	Lower % 27	61	-1.80	.14		
I16	Upper % 27	61	-1.59	.11	14.24	.00
	Lower % 27	61	-1.59	.11		
I17	Upper % 27	61	-1.59	.12	13.60	.00
	Lower % 27	61	-1.59	.12		
I18	Upper % 27	61	-2.28	.12	19.48	.00
	Lower % 27	61	-2.28	.12		

*%27 Upper-Lower, t-test, N= 225, %27 n1=n2=61, sd= 164, *p=.01*

The differences between the Upper-Lower 27% groups' means scores for all items are significant, as seen in Table 4. These findings suggest that all items can differentiate individuals in terms of their perceptions of technological leadership well.

Confirmatory Factor Analysis (CFA)

The CFA can be used to test a hypothesized measurement model (Kline, 2013). Thus, we employed a CFA test on the data including 200 teachers with the LETIS-SP's 18-item framework, which EFA revealed. To test multivariate normality assumption, we ran Mardia's (1974) test for multivariate skewness and kurtosis. The analysis yielded significant results (p<.001), with values exceeding the critical threshold of 5.00, indicating multivariate non-normality. Accordingly, we applied the Robust Maximum Likelihood (MLR) estimation method. The findings showed that all the items had standardized factor loadings higher than .50 which satisfied the cut-off point suggested by Hair Jr et al. (2019) and they were all significant. Table 5 presents the standardized factor loadings.

Table 5. CFA standardized regression weights

Item No	SRW value	Item No	SRW value	Item No	SRW value
I1	.65*	I7	.74*	I13	.78*
I2	.72*	I8	.78*	I14	.73*
I3	.74*	I9	.92*	I15	.77*
I4	.74*	I10	.90*	I16	.81*
I5	.75*	I11	.83*	I17	.90*
I6	.81*	I12	.70*	I18	.92*

**p<.01*

As shown in table 5, standardized factor loadings range between .65 (Item1) and .92 (Items 9 and 18). Figure 2 below depicts the path diagram for the model.

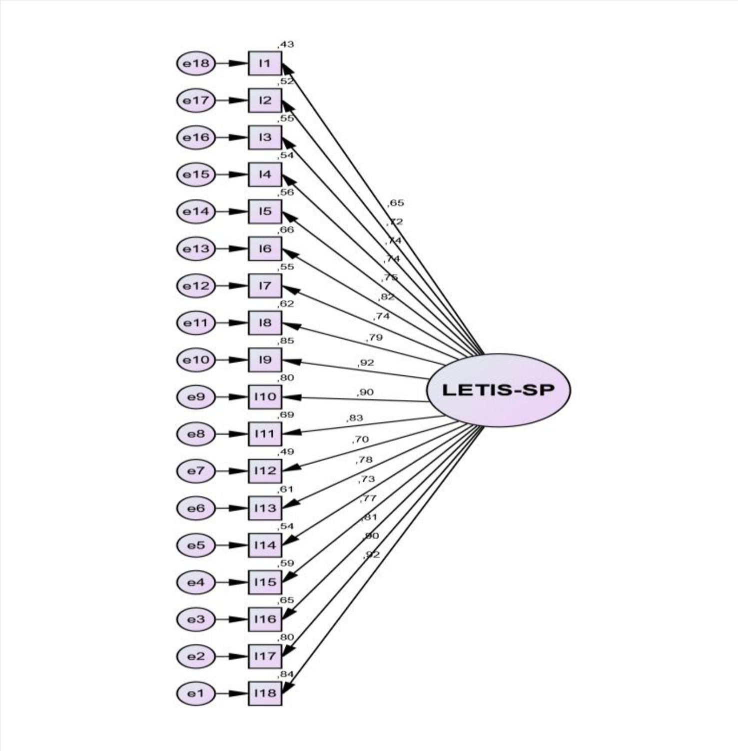

Figure 2. Path diagram of the LETIS-SP model

Table 6. Model fit indices

Indices	Perfect fit	Acceptable fit	LETIS-SP	Interpretation
x2 /df [1,5]	<2.00	<5.00	4.85	Acceptable
RMSEA[3,5]	<.05	<.08	.079	Acceptable
SRMR[4,5]	<.05	<.08	.074	Acceptable
CFI[3,5]	>.95	>.90	.90	Acceptable
NFI[3,5]	>.95	>.90	.89	Acceptable
NNFI[1,5]	>.95	>.90	.88	Acceptable
GFI[2,5]	>.95	>.90	.90	Acceptable

[1] (Hoe, 2008), [2] (Schermelleh-Engel, Moosbrugger, and Müller, 2003), [3] (Hooper, Coughlan, and Mullen, 2008), [4] (Hu and Bentler, 1999), [5](Wang and Wang, 2012). RMSEA: Root Mean Squared Error of Approximation; SRMR: Standardized Root Mean Square Residual; CFI: Comparative Fit Index; NFI: Normed Fit Index; NNFI: Non-Normed Fit Index; GFI: Goodness of Fit Index

In Table 6, fit indices for the unidimensional structure of the scale are presented. The findings showed that the fit indices of the model were as follows: $\chi 2/sd = 4.85$, RMSEA=.079, SRMR=.074, CFI=.90, NFI=.89, NNFI=.88, and GFI=.90. According to Hu and Bentler (1999) these values were acceptable. Based on these findings, it can be concluded that the unidimensional structure of the scale was confirmed by the CFA.

Reliability

In order to evaluate the reliabilityof the LETIS-SP, Cronbach's Alpha, the McDonald's Omega (ω), and Correlation Coefficient were also computed in this study. Table 7 shows the means, standard deviations, correlation coefficients' between the items, and Cronbach's Alpha coefficient.

Table 7. The mean (M), standard deviation (SD), correlation coefficients and Cronbach's Alpha coefficients for the scale

	M	*SD*	*I1*	*I2*	*I3*	*I4*	*I6*	*I7*	*I8*	*I10*	*I11*	*I12*	*I14*	*I15*	*I16*	*I17*	*I18*	*I5*	*I9*	*I13*
I1	3.77	.95	1																	
I2	3.93	.93	.51	1																
I3	3.96	.95	.42	.70	1															
I4	3.86	.97	.51	.56	.50	1														
I6	3.69	.92	.42	.61	.57	.55	1													
I7	3.81	.96	.48	.47	.46	.52	.61	1												
I8	3.84	.96	.39	.53	.56	.53	.72	.57	1											
I10	3.84	.87	.65	.68	.68	.72	.64	.64	.67	1										
I11	3.74	.99	.54	.51	.52	.54	.66	.68	.69	.66	1									
I12	3.42	.94	.37	.37	.38	.48	.58	.55	.62	.58	.72	1								
I14	3.60	1.00	.36	.51	.49	.51	.65	.52	.81	.62	.61	.56	1							
I15	3.97	.80	.46	.56	.58	.52	.62	.39	.70	.73	.50	.54	.58	1						
I16	4.00	.80	.54	.56	.63	.52	.61	.59	.47	.74	.59	.51	.41	.78	1					
I17	3.67	1.01	.57	.63	.61	.58	.75	.67	.73	.70	.81	.71	.74	.65	.69	1				
I18	3.80	.94	.70	.68	.70	.63	.72	.57	.63	.86	.73	.61	.58	.74	.78	.82	1			
I5	3.83	.88	.50	.45	.54	.48	.57	.59	.56	.67	.60	.49	.55	.54	.66	.66	.68	1		
I9	3.83	.93	.54	.68	.70	.70	.75	.64	.77	.83	.81	.68	.60	.72	.76	.80	.82	.68	1	
I13	3.76	.93	.49	.54	.47	.69	.60	.59	.47	.71	.63	.54	.62	.50	.62	.72	.70	.59	.67	1
Cronbach Alpha Coefficient							*.96*													
McDonald's Omega Coefficients (ω)							*.91*													

N=225; ***I1****: Item 1*

The Cronbach's Alpha internal consistency coefficient was .96, as shown in Table 7. With the coefficient of. 96 we obtained for the instrument, we can confidently infer from the research of the scholars (Kalaycı, 2010; Kline, 2009) that the items constituting the instrument were found to have a high level of reliability and were suitable for measuring the same behavior.

Additionally, as shown in Table 6, the Pearson correlation coefficients between the items range from r=.36 to .82. These findings show that the relationships shown in Table 6 are linear, positive and significant (Russo, 2004) which is another sign of the instrument's internal consistency.

Discussion and Conclusion

This study focuses on technology integration leadership, which attracts a growing interest in educational administration and technological leadership. An item pool was created for the technology integration leadership behaviors that the school principal might exhibit in integrating technology into the school organization. When we reviewed the literature to develop and generate the scale items, we found many studies that adopted the same technique (i.e., Durnalı, 2022a). The sentences quoted regarding the focus of the scale items were rephrased without changing their core meaning. The scale development process was initiated with a draft item pool of 60 items. With the revisions and suggestions of experts, the draft form of LETIS-SP was ready for implementation with 32 items. We calculated the CVR values for these items which resulted in the exclusion of 14 items. Finally, exploratory factor analysis (EFA) including 225 teachers, and confirmatory factor analysis (CFA) including 200 teachers were conducted with 18 items.

Firstly, in order to reveal the factor structure of LETIS-SP, EFA was performed. At this stage, a unidimensional structure emerged. Thus, a valid scale with 18 items and a unidimensional structure was obtained with the EFA. After the EFA, the structure consisting of 18 items was tested through CFA. The fit indices indicated an "acceptable" fit (Çokluk et al., 2020; Kline, 2009). Proctor et al. (2003) developed the technological integration scale, consisting of a single dimension and forty-five items. A 10-item unidimensional scale was also used in the studies of Karaca et al. (2013). The scales developed in the these studies were reported to be highly valid which were consistent with the current study's findings. In Sincar's (2009) study, a 29-item scale was developed and its validity and reliability were found to be high. Similarly, Antonietti et al., (2023) developed a 12-item technological integration scale for teachers and found its validity and reliability to be high. It is consistent with the Curriculum Integration Performance scale developed by Finger et al., (2006).

The reliability of LETIS-SP was examined for the overall scale using a dataset of 225 teachers. To this end, Cronbach's alpha coefficient suggested that LETIS-SP is a highly reliable data collection tool. This finding is consistent with the studies of Finger et al., (2006), Raman,et al. (2019), Proctor et al. (2003) and Karaca et al. (2013). The technological integration scale used in the relevant studies was reported to be highly reliable. In addition, the correlation coefficients between the items of LETIS-SP were positive and significant. This indicates that the measurement tool's internal consistency was achieved, as in the studies of Proctor et al. (2003) and Antonietti et al., (2023) which support the findings of the current study.

Finally, the unidimensional structure of LETIS-SP developed in the current study is consistent with the studies in the literature. When both EFA and CFA results are examined, it is concluded that LETIS-SP is a valid and reliable measurement tool that will reveal school principals' technology integration leadership behaviors based on teachers' perceptions. This study is limited to the development of LETIS-SP. The validity and reliability of the scale can be tested again with the participation of more teachers in further studies and on different samples. The relationships between LETIS-SP's technology integration leadership of school principals and teachers' innovation competencies, school climate, technology use levels, and other variables related to organizational behavior can be examined.

Suggestions

Conducting validity and reliability analyses of the scale in different cultures may contribute to understanding cross-cultural differences in technological leadership. It is recommended that studies be conducted comparing technology integration leadership with different leadership models (e.g., transformational leadership or distributed leadership). Longitudinal studies should be conducted to examine the change in technology integration leadership over time. Focus can be placed on studies investigating the effects of technology integration leadership on teachers and students.

Regular training programs should be developed to increase school leaders' awareness of technology integration. Support mechanisms can be established where experienced leaders can act as mentors to develop technology integration leadership. Technology integration should be considered as a process in which not only leaders but also teachers, students and parents contribute to. Strategic planning and policies should be created to support technology integration leadership. Guidance materials can be prepared to enable school leaders to effectively manage technological resources.

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Conflicts of Interest

No potential conflict of interest exists between authors.

Ethics

The ethics application for the study was made on 04/10/2024 and the research was carried out with the approval of Zonguldak Bülent Ecevit University Ethics Commission dated 01/11/2024 and numbered 816. After approval by the Ethics Committee, voluntary participation was obtained from the participants through informed consent forms. During the research process, utmost care was taken to ensure the privacy and anonymity of the participants, and the data obtained were used only for research purposes.

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Appendix A: The Scale of Leadership for Technology Integration in Schools (Okul Teknoloji Bütünleşme Liderlik Ölçeği)

My School Principal (Okul müdürüm)	**Strongly Disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1. The school principal guides others through an example to contribute to school technology integration. (Okul müdürü, okul teknoloji bütünleşmesine katkı sağlamak için bir örnek üzerinden yol gösterir.)					
2. The school principal displays supportive behaviors toward staff in the process of school technology integration. (Okul müdürü, okul teknoloji bütünleşmesi sürecinde çalışanları destekleyici davranışlar sergiler.)					
3. The school principal fosters a supportive school environment during the technology integration process.(Okul müdürü, okul teknoloji bütünleşme sürecinde destekleyici bir okul ortamının gelişimini sağlayıcı davranışlar sergiler.)					
4. The school principal shares leadership roles with subordinates to contribute to school technology integration.(Okul müdürü, okul teknoloji bütünleşmesine katkı sağlamak için liderlik rollerini astlarıyla paylaşır.)					
5. The school principal builds networks/connections to achieve school technology integration goals.(Okul müdürü, okul teknoloji bütünleşme amaçlarını gerçekleştirmek için ağlar/bağlantılar oluşturur.)					
6. The school principal provides a necessary technology coordinator for school technology integration.(Okul müdürü, okul teknoloji bütünleşmesi noktasında gerekli teknoloji koordinatörünü sağlar.)					
7. The school principal procures technological tools to support school technology integration.(Okul müdürü, okul teknoloji bütünleşmesini desteklemek için teknolojik gereçleri temin eder.)					
8. The school principal ensures that staff have equal access to technology in the school technology integration process.(Okul müdürü, okul teknoloji bütünleşmesi sürecinde çalışanların teknolojiye eşit oranda erişimini sağlayıcı davranışlar sergiler.)					
9. The school principal promotes the development of the school's technology infrastructure during the technology integration process.(Okul müdürü, okul teknoloji bütünleşme sürecinde okul teknoloji altyapısının gelişimini sağlayıcı davranışlar sergiler.)					
10. The school principal supports my development in terms of school technology integration.(Okul müdürü, okul teknoloji bütünleşme konusunda gelişimimi sağlayıcı davranışlar sergiler.)					
11. The school principal assesses hardware to determine the level of school technology integration.(Okul müdürü, okul teknoloji bütünleşme seviyesini belirlemek için donanımı değerlendirir.)					

My School Principal (Okul müdürüm)	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
12. The school principal assesses software to determine the level of school technology integration.(Okul müdürü, okul teknoloji bütünleşme seviyesini belirlemek için yazılımı değerlendirir.)					
13. The school principal evaluates educators' use of technology to determine the level of school technology integration.(Okul müdürü, okul teknoloji bütünleşme seviyesini belirlemek için teknolojinin eğitimcilerce kullanımını değerlendirir.)					
14. The school principal evaluates students' use of technology to determine the level of school technology integration.(Okul müdürü, okul teknoloji bütünleşme seviyesini belirlemek için teknolojinin öğrencilerce kullanımını değerlendirir.)					
15. The school principal reflects their knowledge of technology in their actions.(Okul müdürü, teknoloji hakkında bilgi sahibi olduğunu davranışlarına yansıtır.)					
16. The school principal facilitates technology integration into the teaching and learning process.(Okul müdürü, öğretme ve öğrenme sürecine teknoloji bütünleşmesini kolaylaştırıcı davranışlar sergiler.)					
17. The school principal demonstrates a focus on in-class applications for school technology integration.(Okul müdürü, okul teknoloji bütünleşmesi için sınıf içi uygulamalara odaklandığını gösteren davranışlar sergiler.)					
18. The school principal applies strategies to support teachers with technology integration in classroom activities.(Okul müdürü, sınıf içi etkinliklere teknoloji bütünleşmesi sürecinde öğretmenlere yardımcı olacak stratejiler uygular.)					

Note*: You can use the scale for your scientific research, provided that you cite it without getting permission from the authors. However, if you are going to use it for projects that have a budget, or for some efforts to generate income, it is mandatory to contact the authors for the license*