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Examining the Relationship Between Digital Leadership, Digital Literacy, and Adaptation to Digital Transformation Among Nurses

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Abstract

Objective

This study was conducted to examine the relationships between digital leadership, digital literacy, and levels of adaptation to digital transformation among nurses, and to evaluate the mediating role of digital literacy in the relationship between digital leadership and adaptation to digital transformation.

Materials and Methods

The study was designed as a cross-sectional and correlational research. The sample comprised 393 nurses employed at a private hospital in Istanbul, Türkiye, who voluntarily agreed to participate in the study. Data were collected using a personal information form, the Digital Leadership Scale, the Digital Literacy Scale as a Set of Digital Competencies, and the Digital Transformation Readiness Scale. Descriptive statistics, Pearson correlation analysis, simple linear regression analyses, and SPSS PROCESS Model 4 mediation analysis were used for data analysis. The internal consistency of the scales was assessed using Cronbach's Alpha coefficient.

Results

Positive and statistically significant relationships were found among participants' levels of digital leadership, digital literacy, and adaptation to digital transformation. It was determined that the level of digital leadership had a strong and positive effect on adaptation to digital transformation ($\beta = .915$; $p < .001$). Similarly, digital literacy was found to have a strong and positive effect on adaptation to digital transformation ($\beta = .917$; $p < .001$). In addition, a very high and positive correlation was found between digital leadership and digital literacy ($r = .965$; $p < .001$). The mediation analysis revealed that digital literacy had a partial mediating role in the relationship between digital leadership and adaptation to digital transformation.

Conclusion

The findings indicate that not only technological infrastructure but also digital leadership behaviors and the level of digital literacy play a significant role in nurses' adaptation to digital transformation. In order to sustainably manage digital transformation in nursing services, there is a need for institutional strategies that strengthen digital leadership capacity, enhance digital skills, and support employees' active participation in transformation processes.

1. INTRODUCTION

Digitalization in healthcare represents a transformation that extends beyond merely integrating new technologies into clinical settings. Electronic health records, clinical decision support systems, telehealth applications, remote monitoring tools, artificial intelligence–assisted care systems, and data-driven management approaches directly influence how care is planned and delivered. At the center of this transformation lies not only the technical infrastructure but also how healthcare professionals interpret, use, and integrate these systems into their professional practices. Nursing services are particularly important in this regard, as nurses are among the professional groups that interact most intensively with digital tools in patient care, team communication, data entry, treatment monitoring, and patient safety practices [Wynn et al., 2023; Navarro Martínez et al., 2023; Collins et al., 2024; Abou Hashish & Abdel Razek, 2026].

Digital transformation in nursing may take different forms depending on the field of practice. It has been reported that telehomecare applications transform the working patterns of practical nurses, the sustainability of care, and resource utilization; digital health tools provide new opportunities for nurses in patient education and monitoring processes; however, limitations such as training, system compatibility, device access, and workload may complicate the process [Rydgren et al., 2026; Navarro Martínez et al., 2023; Collins et al., 2024]. In more technology-intensive areas such as robotic surgery, artificial intelligence–supported care, and advanced clinical informatics systems, transformation emerges not only as a new mode of practice but also as a restructuring intertwined with professional roles, responsibilities, safety, and ethical decision-making processes [Sınmaz et al., 2025; Bodur et al., 2025; Almagharbeh et al., 2025; Nashwan et al., 2025].

In this process, nurses' adaptation to digital transformation should be considered beyond individual technology use skills. Adaptation is a multidimensional construct that includes willingness to use new digital systems, openness to change, the ability to cope with technological uncertainty, trust in digital applications, the ability to reorganize professional workflows according to new systems, and active participation

in digital processes. Qualitative studies explaining nurses' adaptation to digital transformation indicate that this adaptation does not occur instantly; rather, it is a gradual process shaped by facilitators, barriers, coping strategies, and organizational support [Abou Hashish & Abdel Razek, 2026]. Therefore, the successful implementation of digital transformation depends not only on the provision of technology but also on preparing employees for the transformation process, reducing their concerns, and supporting them in practice [Xie et al., 2025; Hussain et al., 2025; Chen et al., 2025].

Digital leadership is one of the prominent concepts for managing the human resource dimension of this transformation in healthcare institutions. It is not limited to managerial behaviors that merely encourage technology use; rather, it encompasses the capacity to develop a digital vision, prepare teams for change, create learning opportunities, facilitate the meaningful use of digital resources, build trust in new systems, and establish the ethical and managerial framework of technological transformation. Studies conducted with nurse managers indicate that digital transformation and e-leadership competencies are closely related to areas such as informatics knowledge, change management, team communication, monitoring digital processes, and supporting employees [Abou Hashish et al., 2025; Laukka et al., 2023; Navarro Martínez & Leyva-Moral, 2024]. A quasi-experimental study on digital leadership training also demonstrates that leadership interventions may play a developmental role in enhancing nurses' digital leadership competencies and innovative/creative outcomes [Ismail et al., 2025].

The importance of digital leadership in nursing stems not only from managers' expectations regarding system use but also from their role in creating an environment that enables employees to work with these systems in a safe, meaningful, and sustainable manner. The integration of digital technologies into care processes requires nurses to develop new competencies in clinical decision-making, information sharing, patient education, care coordination, and safety practices. Nurse leaders' experiences with digital technologies provide important insights into how digitalization is reflected in practice; these experiences indicate that leaders evaluate digital applications not merely as technical tools but as strategic elements that influence team functioning and care quality [Laukka et al., 2023]. Studies on e-leadership expectations further reveal that leaders in healthcare and social care settings are expected to take more active roles in terms of digital competence, communication, coordination, and change management [Kaihlanen et al., 2025].

Digital literacy is another fundamental concept explaining the individual competency dimension of nurses in the face of digital transformation. This concept is not limited to the ability to use computers or mobile devices. It also includes skills such as accessing digital information, evaluating it, distinguishing reliable sources, producing and sharing digital content, complying with data security and privacy principles, engaging in digital communication, and integrating digital health applications into professional processes. A recent scoping review examining digital health literacy among nurses reported that this competency is generally at low to moderate levels and is influenced by individual, interpersonal, and organizational factors [Ye et al., 2026]. A study conducted among hospital nurses in Türkiye reported a positive relationship between digital health literacy and care behaviors, highlighting the practical implications of this competency for care quality [Biyik & Onal, 2026].

In the nursing context, digital literacy is more concretely reflected in nursing informatics competencies in clinical practice. The positive relationships found between nursing informatics competency and clinical decision-making suggest that digital skills are not limited to technical usage but are also associated with decision quality, information management, and patient care processes [Al-Qudah et al., 2025]. Similarly, studies examining e-health literacy together with technology-mediated clinical practice patterns indicate that digital competency may be reflected in daily clinical behaviors such as alarm response, use of electronic records, and system optimization [Ramadan et al., 2025]. Systematic reviews on digital competency measurement tools also emphasize that this field should be addressed not only conceptually but also methodologically [D'Agostino et al., 2026; Golz et al., 2024].

The relationship between digital literacy and adaptation to digital transformation is also supported by the literature on technology acceptance and readiness. The finding that increased telehealth knowledge strengthens attitudes and readiness suggests that digital knowledge may be an important prerequisite for participation in transformation processes. The mediating role of perceived usefulness and ease of use in the relationship between technology sophistication and usage intention indicates that the mere existence of a system is not sufficient; it must also be perceived as understandable, useful, and manageable by users [Hussain et al., 2025]. Relationships among eHealth literacy, trust in technology, and perceived value also suggest that digital literacy may directly and indirectly influence attitudes toward new technologies [Chen et al., 2025].

The impact of digital transformation on nurses does not always follow a linear and positive trajectory. Technostress, technology intensity, system complexity, workload, digital uncertainty, and lack of training are among the factors that complicate adaptation. Studies examining technostress and nursing informatics competency together indicate that informatics competencies may support job performance, whereas technology complexity and overload may negatively affect performance [Baek et al., 2025]. A study conducted in Türkiye examining the conditional effects of technostress suggests that technology may function as both a supportive and a burdensome mechanism depending

on the context [Kopuz et al., 2025]. The technostress experiences of robotic surgery nurses also demonstrate that adaptation in advanced technological environments may require more specialized support mechanisms beyond standard training approaches [Sınmaz et al., 2025].

The increasing prevalence of artificial intelligence applications in nursing has further complicated discussions on digital literacy and digital leadership. Studies examining AI literacy among nursing professionals indicate that this concept cannot be explained solely by knowledge of algorithms or the ability to use technology; it must also be addressed in terms of ethical awareness, safety, data governance, professional responsibility, and the human dimension of care [Wang et al., 2026; Ibrahim et al., 2026]. Qualitative studies exploring nurses' perceptions of AI reveal that, despite its potential to reduce workload, support decision-making, and enhance monitoring capabilities, concerns remain regarding data security, ethical uncertainty, the potential erosion of professional skills, and the preservation of the human aspect of care [Bodur et al., 2025; Almagharbeh et al., 2025]. Therefore, adaptation to digital transformation is not limited to developing positive attitudes toward technology; it also requires supporting employees in ethical, emotional, and professional safety domains [Hacıalioğlu et al., 2025; El Arab et al., 2025].

Although the literature includes numerous studies examining digital leadership, digital literacy, nursing informatics competency, technology acceptance, AI literacy, and readiness for digital transformation separately, studies that evaluate digital leadership, digital literacy, and adaptation to digital transformation within the same model in nurses are limited. In particular, the direct relationship between digital leadership and adaptation, as well as its indirect effect through digital literacy, appears to be an area requiring further empirical investigation in nursing management. The fact that nurses in managerial roles and those with graduate education tend to use digital resources more intensively and have higher levels of digital health literacy suggests that a meaningful organizational-level link can be established between digital leadership and digital literacy [Comparcini et al., 2025]. Studies conducted with academic nurse educators and nursing students also indicate that digital competency is associated not only with the current workforce but also with future nursing education and professional development trajectories [Li et al., 2025; Almarwani, 2024; Abou Hashish & Alnajjar, 2024].

Based on this gap, the present study examines the relationships among digital leadership, digital literacy, and adaptation to digital transformation among nurses within a single model. The starting point of the study is the assumption that digital transformation cannot be explained solely by technical infrastructure investments; rather, nurses' adaptation should be evaluated together with leadership climate, digital skills, trust, training opportunities, and professional readiness. In this context, digital leadership is expected to directly support nurses' adaptation to digital transformation, while digital literacy is anticipated to play a mediating role representing the level of individual competency. Thus, the study aims to provide a comprehensive explanatory framework for nursing management, digital transformation management in healthcare institutions, and human resource development policies.

2. METHODS

2.1. Population and Sample of the Study

The population of this study consisted of nurses working in a private hospital operating in Istanbul. Since the study aimed to examine the levels of digital leadership, digital literacy, and readiness for digital transformation among individuals involved in digitalization processes, the population encompassed a broad group of healthcare professionals. The study population included 600 nurses employed in the hospital, while the sample consisted of 393 nurses who voluntarily participated in the study. A simple random sampling method, one of the probability sampling techniques, was used in sample selection. Conducting the study in a single healthcare institution constitutes a limitation in terms of the generalizability of the findings.

2.2. Data Collection Instruments

In this study, three different scales were used as data collection instruments. The scales employed within the scope of the research enabled a multidimensional evaluation of participants' levels of digital leadership, digital literacy, and readiness for digital transformation. First, the Digital Leadership Scale was developed by Tutuş [2024] within the scope of the study titled "Development of the Digital Leadership Scale in Nurse Managers." This scale provides a comprehensive assessment by addressing nurses' digital leadership behaviors across different dimensions. It aims to determine leadership characteristics required in the digital age and to measure individuals' ability to manage digital processes, adapt to innovations, and effectively use technology. Another instrument used in the study is the Digital Literacy Scale as a Set of Digital Competencies, developed by Bayrakçı [2020]. This scale consists of 29 items and comprehensively measures fundamental digital skills such as effective use of digital environments, access to and evaluation of information, ethical and legal responsibility, security, digital content creation, and sharing. In this respect, the scale evaluates individuals' digital literacy levels within a multidimensional framework. Finally, the Digital Transformation Readiness Scale, developed by Öztırak [2025], was used to assess individuals' readiness and adaptation levels toward digital transformation processes. The scale provides important indicators regarding individuals' openness to digital change, adaptation to technological developments, and level of participation in transformation processes. When these three scales are considered

together, they enable a holistic examination of the variables addressed in the study and contribute to a multidimensional analysis of individual differences related to the digitalization process.

2.3. Research Model and Hypotheses

This study examines the effects of nurses' levels of digital leadership and digital literacy on adaptation to digital transformation. The research model is based on a structural framework in which digital leadership and digital literacy are positioned as independent variables, adaptation to digital transformation as the dependent variable, and digital literacy also as a mediating variable. Within this framework, both the direct effect of digital leadership on adaptation to digital transformation and its indirect effect through digital literacy are tested. In addition, the relationship between digital leadership and digital literacy is also examined within the model. The hypotheses developed in line with the research model are as follows:

H1

Nurses' levels of digital leadership have a positive and significant effect on their adaptation to digital transformation.

H2

Nurses' levels of digital literacy have a positive and significant effect on their adaptation to digital transformation.

H3

Nurses' levels of digital leadership have a positive and significant effect on their digital literacy levels.

H4

Digital literacy mediates the relationship between digital leadership and adaptation to digital transformation among nurses.

2.4. Data Analysis

SPSS 26 statistical software was used to analyze the data obtained from the study. Before the analysis, participants' demographic characteristics were evaluated using frequency and percentage analyses. After examining whether the data obtained from the digital leadership, digital literacy, and adaptation to digital transformation scales exhibited normal distribution, parametric tests were preferred. Accordingly, correlation analysis was conducted to determine the relationships between variables. Regression analyses were used to test the direct and indirect effects among digital leadership, digital literacy, and adaptation to digital transformation within the scope of the research hypotheses. For hypotheses H1, H2, and H3, the relationships between variables were examined using simple linear regression analysis. For hypothesis H4, mediation analysis was performed to test the mediating role of digital literacy. All findings were evaluated at a 95% confidence interval and a significance level of $p < 0.05$.

2.5. Validity and Reliability Analysis of the Scales

Cronbach's Alpha reliability analysis was conducted to determine the internal consistency levels of the scales used in the study. The normality distribution of the scales and their sub-dimensions was evaluated using the Kolmogorov–Smirnov test along with skewness and kurtosis coefficients. The findings obtained from the analysis are presented in Table 1.

Table 1
Validity and Reliability Analysis of the Digital Leadership, Digital Literacy, and Adaptation to Digital Transformation Scales

Scales	Kolmogorov-Smirnov			Skewness	Kurtosis	Cronbach's Alpha
	Statistic	df	p			
Digital Leadership Level	**,186**	**393**	**,000**	**-,173**	**-1,177**	**0,998**
Creating a Digital Vision	,168	393	,000	-,151	-1,174	0,990
Focusing on Innovation	,192	393	,000	-,089	-1,114	0,990
Digital Self-Development	,207	393	,000	-,222	-1,190	0,999
Supporting Patients' Digital Development	,205	393	,000	-1,189	-1,175	0,993
Digital Literacy Level	**,215**	**393**	**,000**	**-,101**	**-,821**	**0,993**
Ethics and Responsibility	,279	393	,000	-,284	-,617	0,992
General Knowledge and Functional Skills	,230	393	,000	-,058	-,473	0,961
Daily Use	,286	393	,000	-,241	-,666	0,986
Professional Production	,251	393	,000	,819	,085	0,977
Privacy and Security	,222	393	,000	,072	-1,026	0,962
Social Dimension	,201	393	,000	-,355	-,681	0,952
Adaptation to Digital Transformation	**,120**	**393**	**,000**	**,076**	**-,204**	**0,988**

When Table 1 is examined, it is observed that the Cronbach's Alpha reliability coefficients of all scales and their sub-dimensions used in the study are above 0.90. The overall reliability coefficient was found to be 0.998 for the Digital Leadership Scale, 0.993 for the Digital Literacy Scale, and 0.988 for the Adaptation to Digital Transformation Scale. These values indicate that the scales used in the study have a high level of internal consistency. According to the results of the Kolmogorov–Smirnov test, the significance values for all scales and their sub-dimensions were found to be $p < 0.05$, indicating that the data do not statistically follow a normal distribution. However, it is well known that in large samples, the Kolmogorov–Smirnov test may yield significant results even for small deviations. Therefore, skewness and kurtosis coefficients were also examined, and it was determined that all values for the scales and their sub-dimensions were within the ± 2 range. In addition, given that the sample size was 393, it was accepted that the data sufficiently approximated a normal distribution based on the Central Limit Theorem, and thus the use of parametric test techniques in the study was considered appropriate.

3. RESULTS

Table 2 presents the findings related to the descriptive characteristics of the participants. Accordingly, the mean age of the participants was determined as 38.47 ± 9.188 years. The average total professional experience was 15.85 ± 2.278 years, while the average duration of work in the current unit was found to be 4.58 ± 2.278 years. In addition, the average daily duration of digital device use in the workplace was determined as 4.73 ± 2.02 hours. It was found that 99.5% of the participants (n = 391) were female and 0.5% (n = 2) were male; 55.7% (n = 219) were married, while 44.3% (n = 174) were single.

Table 2
Descriptive Characteristics of the Participants

Characteristics		**Min–Max**	**Mean ± SD**
Age		23–60	38.47 ± 9.188
Total Years of Professional Experience (years)		2–38	15.85 ± 2.278
Total Years in Current Unit (years)		1–12	4.58 ± 2.278
Average Daily Duration of Digital Device Use at Institution (hours)		2–8	4.73 ± 2.02
Variables	**Category**	**n**	**%**
Gender	Female	391	99,5
	Male	2	0,5
Marital Status	Married	219	55,7
	Single	174	44,3
Education Level	High School	40	10,2
	Associate Degree	99	25,2
	Bachelor's Degree	155	39,4
	Postgraduate Education	99	25,2
Institution Type	Private Hospital	393	100
Unit of Employment	Clinical Units	231	58,8
	Diagnostic/Treatment Support Units	79	20,1
	Administrative/Management/Support Units	83	21,1
Working Style	Full-time	232	59
	Shift Work	161	41
Digital Device Used to Access Internet at Work	Personal Computer	45	11,5
	Institutional Computer	297	75,6
	Personal Phone	51	13
Purpose of Using Digital Technologies in Profession	Performing managerial functions	36	9,2
	Information sharing with healthcare professionals	23	5,9
	Material and/or drug management	42	10,7
	Nursing practices (patient care, treatment follow-up, lab results monitoring, electronic health records, etc.)	287	73
	Scientific/professional development (research, postgraduate education, conferences, certifications, in-service training, etc.)	5	1,3

In terms of educational level, 10.2% of the participants (n = 40) were high school graduates, 25.2% (n = 99) held an associate degree, 39.4% (n = 155) had a bachelor's degree, and 25.2% (n = 99) had a postgraduate degree. Regarding institutional distribution, all participants (100.0%; n = 393) were employed in a private hospital. In terms of the unit of employment, 58.8% of the participants (n = 231) worked in clinical units, 20.1% (n = 79) in diagnostic/treatment support units, and 21.1% (n = 83) in administrative/management/support units. When the working pattern was examined, it was found that 59.0% (n = 232) of the participants worked on a regular (daytime) basis, while 41.0% (n = 161) worked in shifts. Regarding the digital devices used to access the internet within the institution, 75.6% of the participants (n = 297) used institutional computers, 11.5% (n = 45) used personal computers, and 13.0% (n = 51) used personal mobile phones. When the purposes of using digital technologies in professional practice were examined, it was found that 73.0% of the participants (n = 287) used them for

nursing practices (e.g., patient care, treatment monitoring, laboratory result tracking, and electronic health records), 10.7% (n = 42) for material and/or medication management, 9.2% (n = 36) for performing managerial functions, 5.9% (n = 23) for information sharing with healthcare professionals, and 1.3% (n = 5) for scientific/professional development purposes.

Table 3
Descriptive Statistics of Digital Leadership, Digital Literacy, and Adaptation to Digital Transformation Levels

Scale and Subscales	Minimum (Min)	Maximum (Max)	Mean (M)	Standard Deviation (SD)
Digital Leadership Level	1,85	5,00	3,62	0,99
Creating a Digital Vision	2,00	5,00	3,72	0,94
Focusing on Innovation	1,50	5,00	3,27	1,03
Digital Self-Development	2,00	5,00	3,80	1,03
Supporting Patients' Digital Development	1,67	5,00	3,48	1,03
Digital Literacy Level	2,28	4,83	3,61	0,69
Ethics and Responsibility	2,71	4,86	4,08	0,63
General Knowledge and Functional Skills	2,00	4,83	3,33	0,71
Daily Use	2,50	5,00	4,06	0,64
Professional Production	1,00	5,00	1,83	0,86
Privacy and Security	2,25	5,00	4,12	0,73
Social Dimension	1,50	5,00	2,94	0,89
Adaptation to Digital Transformation	2,00	5,00	3,71	0,90

When Table 3 is examined, it is observed that the mean score of participants' digital leadership level is 3.62 ± 0.99. When the sub-dimensions of digital leadership are evaluated, the highest mean is found in the "Self-Development in a Digital Context" sub-dimension (3.80 ± 1.03), followed by the "Creating a Digital Vision" sub-dimension with a mean of 3.72 ± 0.94. The mean score of the "Developing Patients in a Digital Context" sub-dimension is 3.48 ± 1.03, while the "Focusing on Innovation" sub-dimension has a mean of 3.27 ± 1.03. The mean digital literacy level of the participants is determined as 3.61 ± 0.69. When the sub-dimensions are examined, the highest mean scores are observed in the "Privacy and Security" (4.12 ± 0.73) and "Ethics and Responsibility" (4.08 ± 0.63) dimensions. In contrast, the "Professional Production" sub-dimension has a relatively lower mean score (1.83 ± 0.86) compared to the other dimensions. The mean level of adaptation to digital transformation is found to be 3.71 ± 0.90, indicating that participants' adaptation to digital transformation is at a moderate-to-high level.

Table 4
Descriptive Statistics of the Research Variables and Correlation Results Between Variables

Scale and Subscales	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Digital Leadership Level													
2. Creating a Digital Vision	,998**	1											
3. Focusing on Innovation	,997**	,994**	1										
4. Digital Self-Development	,998**	,994**	,991**	1									
5. Supporting Patients' Digital Development	,998**	,994**	,994**	,997**	1								
6. **Digital Literacy Level**	,965**	,966**	,968**	,956**	,960**	1							
7. Ethics and Responsibility	,930**	,933**	,927**	,923**	,923**	,984**	1						
8. General Knowledge and Functional Skills	,946**	,947**	,955**	,934**	,942**	,993**	,974**	1					
9. Daily Use	,921**	,923**	,920**	,914**	,915**	,981**	,989**	,967**	1				
10. **Professional Production**	,858**	,859**	,878**	,839**	,855**	,827**	,732**	,836**	,712**	1			
11. Privacy and Security	,952**	,954**	,946**	,950**	,947**	,985**	,984**	,963**	,988**	,746**	1		
12. Social Dimension	,978**	,977**	,984**	,969**	,977**	,977**	,926**	,968**	,927**	,904**	,948**	1	
13. **Adaptation to Digital Transformation**	,939**	,939**	,935**	,935**	,937**	,942**	,914**	,932**	,905**	,829**	,927**	,938**	1

The Pearson correlation analysis results presented in Table 4 comprehensively reveal the relationships among digital leadership level, digital literacy level, and readiness for digital transformation. The findings indicate that there are positive and statistically significant relationships among all variables ($p < 0.001$). These results are important in demonstrating that increases in digital leadership skills support higher levels of digital literacy and readiness for digital transformation. When evaluated in terms of overall dimensions, a very strong and positive relationship is observed between digital leadership (DL) and digital literacy (DLit) ($r = 0.965$). This finding suggests that as the level of digital leadership increases, individuals' ability to effectively use digital technologies, access digital information, and apply digital skills also increases. Similarly, a strong and positive relationship is found between digital leadership and readiness for digital transformation (DT) ($r = 0.939$). This indicates that individuals or organizations with strong digital leadership characteristics are more prepared for digital transformation processes. In addition, a very strong relationship is identified between digital literacy and readiness for digital transformation ($r = 0.942$), highlighting that digital knowledge and skills are key determinants in adapting to digital transformation processes. When the sub-dimensions of digital leadership are examined, it is seen that "Creating a Digital Vision," "Focusing on Innovation," "Self-Development in a Digital Context," and "Developing Patients in a Digital Context" all demonstrate very strong positive relationships with both digital literacy and readiness for digital transformation. In particular, the relationship between "Focusing on Innovation" and digital literacy is remarkably high ($r = 0.968$). This finding suggests that individuals who adopt innovative approaches are more competent in using digital tools and technologies. Similarly, a strong relationship is observed between "Creating a Digital Vision" and readiness for digital transformation ($r = 0.939$), indicating that developing a strategic vision is a critical component of digital transformation processes. When the sub-dimensions of digital literacy are evaluated, it is found that "Ethics and Responsibility," "General Knowledge and Functional Skills," "Daily Use," "Privacy and Security," and "Social Dimension" are all highly correlated with both digital leadership and readiness for digital transformation. In particular, there is a very strong relationship between "General Knowledge and Functional Skills" and the total digital literacy score ($r = 0.993$).

Furthermore, the “Privacy and Security” dimension shows strong relationships with both digital literacy (r = 0.985) and digital leadership (r = 0.952), indicating that security awareness is of critical importance in digital processes. The relationship between the “Social Dimension” and digital leadership is also found to be quite high (r = 0.978), suggesting that digital communication and social interaction skills support leadership processes. Another notable finding in the analysis is that the “Professional Production” dimension demonstrates relatively lower, yet still significant and positive relationships compared to the other dimensions. For example, the relationship between “Professional Production” and readiness for digital transformation is at the level of r = 0.829. This suggests that while the ability to produce professional digital content is important for digital transformation, it may have a relatively more limited effect compared to other areas of digital competence. Overall, the findings indicate that digital leadership, digital literacy, and readiness for digital transformation are strongly and positively interrelated. In particular, the development of digital leadership skills enhances individuals’ digital competencies and enables them to become more prepared for digital transformation processes. In addition, the sub-dimensions of digital literacy-such as ethics, security, information use, and social interaction-play a significant role in the successful implementation of digital transformation.

Table 5
Findings Related to Regression Analyses

Dependent Variable	Independent Variable	B	Standard Error	β	t	p	F
Adaptation to Digital Transformation	Constant	,670	,070		9,576	<,001	2031,913
	Digital Leadership Level	,031	,001	,915	45,077	<,001	
R = 0,915 R²=0,838 Durbin Watson = 1,389							
Adaptation to Digital Transformation	Constant	-,601	,097		-6,222	<,001	2070,417
	Digital Literacy Level	1,191	,026	,917	45,502	<,001	
R = 0,917 R²=0,840 Durbin Watson = 1,295							
Digital Literacy Level	Constant	1,154	,035		32,730	<,001	5267,679
	Digital Leadership Level	,025	,000	,965	72,579	<,001	
R = 0,965 R²=0,930 Durbin Watson = 0,959							

*p<,001.

Table 5 presents the findings of the simple linear regression analyses conducted to examine the predictive relationships among digital leadership level, digital literacy level, and adaptation to digital transformation. The analysis results indicate that all regression models established are statistically significant ($p < .01$). In the first model, the effect of digital leadership level on adaptation to digital transformation was examined. The analysis results show that the model is statistically significant ($F(1,396) = 2031.913$; $p < .01$). The explanatory power of the model is quite high, with digital leadership explaining 83.8% of the total variance in adaptation to digital transformation scores ($R^2 = .838$). Furthermore, the Durbin–Watson coefficient of 1.389 indicates that there is no autocorrelation problem in the model. Examination of the regression coefficients reveals that digital leadership has a strong, positive, and significant effect on adaptation to digital transformation ($\beta = .915$; $p < .01$). This finding suggests that as the level of digital leadership increases, the level of adaptation to digital transformation also increases. In the second model, the effect of digital literacy level on adaptation to digital transformation was evaluated. The results indicate that the model is statistically significant ($F(1,396) = 2070.417$; $p < .01$). Digital literacy explains 84.0% of the total variance in adaptation to digital transformation scores ($R^2 = .840$). The Durbin–Watson coefficient of 1.295 suggests that there is no autocorrelation issue in the model. The regression coefficients show that digital literacy has a strong, positive, and significant effect on adaptation to digital transformation ($\beta = .917$; $p < .01$). This result indicates that as individuals’ levels of digital knowledge and skills increase, their level of adaptation to digital transformation also increases. In the third model, the effect of digital leadership level on digital literacy level was examined. The analysis results demonstrate that the model is statistically significant ($F(1,396) = 5267.679$; $p < .01$). The explanatory power of the model is very high, with digital leadership explaining 93.0% of the total variance in digital literacy scores ($R^2 = .930$). The Durbin–Watson coefficient of 0.959, although borderline, can still be considered within an acceptable range in terms of autocorrelation. Examination of the regression coefficients indicates that digital leadership has a very strong, positive, and significant effect on digital literacy ($\beta = .965$; $p < .01$). This finding suggests that digital leadership skills are an important determinant in enhancing individuals’ digital literacy levels. Overall, the findings demonstrate that digital leadership has a strong effect on both adaptation to digital transformation and digital literacy. In addition, digital literacy is also identified as a significant predictor of adaptation to digital transformation. These results indicate that leadership skills and digital competencies are complementary and mutually reinforcing elements in digital transformation processes. Specifically, the results of the first regression model indicated that digital leadership had a strong, positive, and statistically significant effect on adaptation to digital transformation ($\beta = .915$; $p < .001$). Therefore, H1 (Nurses’ levels of digital

leadership have a positive and significant effect on their adaptation to digital transformation) was accepted. Similarly, the second regression model demonstrated that digital literacy had a strong, positive, and statistically significant effect on adaptation to digital transformation (β = .917; p < .001). Accordingly, H2 (Nurses' levels of digital literacy have a positive and significant effect on their adaptation to digital transformation) was accepted. In the third regression model, digital leadership was found to have a very strong, positive, and statistically significant effect on digital literacy (β = .965; p < .001). Thus, H3 (Nurses' levels of digital leadership have a positive and significant effect on their digital literacy levels) was accepted.

Table 6
Mediation Model Findings

Indirect Effect	c	c'	Effect	BootSE	BootLLCI	BootULCI
Digital Leadership Level → Digital Literacy Level → Adaptation to Digital Transformation	,0152	,0152	,0159	,0037	,0084	,0224

c: total effect; c': direct effect; BootSE: bootstrap standard error; BootLLCI: lower limit; BootULCI: upper limit (95% confidence interval). Since the confidence interval does not include zero, the indirect effect is statistically significant.

When Table 6 is examined, it is observed that mediation analyses were conducted using SPSS PROCESS Model 4 to examine the effect of digital leadership on adaptation to digital transformation through digital literacy. First, when the findings related to the path from digital leadership to adaptation to digital transformation are evaluated, it is determined that the total effect of digital leadership on adaptation to digital transformation is statistically significant (c = .0152; p < .01). When the mediating variable, digital literacy, is included in the model, the direct effect of digital leadership on adaptation to digital transformation remains significant and unchanged (c' = .0152; p < .01). According to the bootstrap analysis results for the indirect effect, the indirect effect of digital leadership on adaptation to digital transformation through digital literacy is found to be significant (effect = .0159). It is also observed that the 95% confidence interval for the indirect effect does not include zero (BootLLCI = .0084; BootULCI = .0224). Based on these findings, it is concluded that digital literacy plays a partial mediating role in the relationship between digital leadership and adaptation to digital transformation. Finally, the mediation analysis results revealed that digital literacy had a statistically significant indirect effect on the relationship between digital leadership and adaptation to digital transformation, and the confidence interval did not include zero (BootLLCI = .0084; BootULCI = .0224). Since the direct effect remained significant after including the mediator, this indicates partial mediation. Therefore, H4 (Digital literacy mediates the relationship between digital leadership and adaptation to digital transformation among nurses) was accepted as partial mediation.

4. DISCUSSION

The findings of this study reveal a high level of consistency with the current literature regarding the relationships among digital leadership, digital literacy, and adaptation to digital transformation among nurses. The regression analysis findings provide strong empirical evidence regarding the determinants of nurses' adaptation to digital transformation. The results demonstrated that digital leadership has a very strong and positive effect on adaptation to digital transformation (β = .915), explaining a substantial proportion of variance (R^2 = .838). This finding indicates that leadership behaviors characterized by vision, innovation, and digital competence play a critical role in shaping nurses' readiness for digital transformation. In parallel, digital literacy was also found to be a powerful predictor of adaptation (β = .917; R^2 = .840), suggesting that nurses' ability to effectively access, use, and manage digital information significantly enhances their capacity to adapt to technologically evolving healthcare environments. Another notable finding is the exceptionally strong effect of digital leadership on digital literacy (β = .965; R^2 = .930). This result highlights that digital leadership is not only a direct driver of transformation but also an indirect enabler through strengthening digital competencies. In this sense, leaders who support digital vision, continuous learning, and innovation contribute significantly to improving the digital skill sets of healthcare professionals. Furthermore, the mediation analysis revealed that digital literacy partially mediates the relationship between digital leadership and adaptation to digital transformation. This finding indicates that digital leadership influences adaptation both directly and indirectly through digital literacy. The partial nature of the mediation also shows that digital leadership remains a fundamental and independent factor beyond its contribution through digital competencies. From a theoretical perspective, these findings contribute to the growing body of literature emphasizing the interaction between leadership and individual competencies in digital transformation processes. The results support the view that digital transformation should not be conceptualized solely as a technological change, but rather as a socio-technical process shaped by leadership practices and human capital. In this context, digital leadership can be interpreted as a dynamic capability that enables organizations to respond to technological change, while digital literacy represents an individual-level resource that facilitates the effective use of these capabilities.

In recent years, studies have increasingly demonstrated that digital literacy is not merely a technical skill, but also has multidimensional effects on outcomes such as job performance, clinical decision-making, and quality of care. For instance, a study that conceptualized digital literacy and nursing informatics competencies as job resources found that these variables increased work engagement and produced

indirect effects through organizational culture [Chung et al., 2025]. The same study also reported that digital literacy had significant indirect effects on job outcomes via organizational culture, which supports the mediating role identified in the present study. Similarly, a recent study examining the impact of digital literacy on clinical performance found that digital literacy was a significant predictor of clinical decision-making skills, explaining 15% of the variance [Almalki, 2026]. This result indicates that digital competencies extend beyond technology use and are directly associated with clinical reasoning processes. In a study conducted in Türkiye, digital health literacy was found to have a significant effect on care behaviors (Bıyık & Önal, 2026), with digital education and data security skills identified as significant predictors of care quality ($\beta = 0.214$, $p < .01$). This finding is consistent with the strong effect of digital literacy on adaptation to digital transformation observed in this study. In addition, research conducted with neonatal intensive care nurses showed that e-health literacy is directly associated with technology-supported clinical practices [Ramadan et al., 2025], highlighting the importance of digital competencies in integrating technology into clinical processes. When the determinants of digital literacy are examined, a multidimensional structure emerges. A recent systematic review reported that digital health literacy among nurses is influenced by factors such as education, organizational support, and access to technology [Ye et al., 2026]. This helps explain the strong relationship between digital leadership and digital literacy identified in this study, as leadership plays a key role in creating supportive environments and facilitating access to digital resources. In terms of digital leadership, recent studies indicate that this concept is being addressed in a more systematic and multidimensional manner. A scale developed in 2026 identified digital leadership as consisting of four main dimensions: technology use, digital security management, digital collaboration, and organizational influence [Kim et al., 2026]. These findings suggest that digital leadership is a strategic construct that goes beyond traditional leadership approaches and plays a central role in organizational transformation. From an organizational perspective, the very high explanatory power of the regression models suggests that digital leadership and digital literacy together form a critical foundation for successful digital transformation in healthcare institutions. This implies that investments limited to technological infrastructure may be insufficient unless they are accompanied by leadership development and workforce capacity building. In particular, healthcare managers should prioritize the development of digital leadership competencies, foster a culture of continuous learning, and implement structured training programs aimed at improving digital literacy among nurses. Moreover, creating supportive organizational environments that encourage experimentation, innovation, and the use of digital tools may further strengthen adaptation processes. Overall, the findings of this study emphasize that adaptation to digital transformation in nursing is a multidimensional process shaped by both leadership dynamics and individual competencies. Digital leadership emerges as a strategic element that supports transformation processes both directly and indirectly, while digital literacy functions as a key mechanism enabling this effect at the individual level. Therefore, digital transformation in healthcare cannot be explained solely by technological infrastructure; rather, leadership, individual competencies, and the interaction between these factors are decisive. In this context, integrating digital transformation strategies with leadership development programs and digital skills training is of critical importance for healthcare institutions.

5. CONCLUSION

This study examined the relationships among digital leadership, digital literacy, and adaptation to digital transformation among nurses within a unified model and tested the mediating role of digital literacy using quantitative methods. The findings clearly demonstrate that both digital leadership and digital literacy exert strong and positive effects on nurses' adaptation to digital transformation. Furthermore, digital literacy was found to partially mediate the relationship between digital leadership and adaptation, indicating that leadership influences transformation not only directly but also indirectly by enhancing individual digital competencies. These results suggest that successful adaptation to digital transformation in healthcare settings cannot be explained solely by technological infrastructure. Rather, it is a multifaceted process shaped by leadership practices, organizational climate, and the digital competency levels of healthcare professionals. In this context, digital leadership emerges as a strategic driver that fosters a supportive learning environment, encourages technology adoption, and strengthens employees' digital skill development. Simultaneously, digital literacy functions as a critical mechanism through which these leadership efforts translate into improved adaptation outcomes at the individual level. The findings provide several important implications for nursing management and healthcare policy. First, developing digital leadership capacity should be prioritized as a core component of organizational strategy. Such development should extend beyond promoting technology use and include fostering a shared digital vision, supporting change management processes, and strengthening organizational support systems. Second, digital skills training programs for nurses should be designed in a more comprehensive manner. In addition to clinical applications, these programs should incorporate competencies such as digital content creation, professional knowledge sharing, data security awareness, and the critical evaluation of digital information. Addressing these areas is particularly important given the relatively low levels observed in the professional production dimension. Despite its contributions, this study has several limitations. The use of a convenience sample and the restriction of the research setting to a single private hospital limit the generalizability of the findings. Additionally, the cross-sectional design constrains the ability to draw causal inferences. Future research should adopt multi-center and longitudinal designs to enhance external validity and better capture the dynamic nature of digital transformation processes. Moreover, incorporating additional mediating variables (e.g., job satisfaction, organizational trust) and moderating factors (e.g., organizational culture, leadership style, technological infrastructure) would

provide a more comprehensive understanding of the mechanisms underlying digital transformation in healthcare settings. In conclusion, this study highlights that digital transformation in healthcare is not merely a technological shift but a complex socio-organizational process. Effectively managing this process requires the integration of strong digital leadership and well-developed digital competencies among nurses. Therefore, healthcare organizations should adopt holistic strategies that simultaneously address leadership development and digital skill enhancement to ensure sustainable and effective digital transformation.

Declarations

Contributions

Conceptualization: C.S.; **Data curation:** H.D.; **Formal analysis:** C.S. & S.O.; **Investigation:** H.D.; **Methodology:** C.S. & S.O.; **Project administration:** C.S.; **Resources:** C.S. & H.D.; **Software:** C.S. & S.O.; **Supervision:** C.S.; **Validation:** S.O.; **Visualization**: C.S. & S.O.; **Writing – original draft:** C.S. (excluding discussion and conclusion), H.D. (introduction); **Writing – review & editing:** F.A. (discussion and conclusion), all authors.

Conflict of Interest Statement

The authors declared that no conflict of interest.

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Human Ethics and Consent to Participate declarations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval for this study was obtained from the Ethics Committee of Sakarya University of Applied Sciences (Decision No: 63/30, Meeting Date: November 27, 2025; Document Date: December 1, 2025). The study titled “The Relationship Between Digital Leadership, Digital Literacy, and Adaptation to Digital Transformation Among Nurses” was evaluated and approved as ethically appropriate by unanimous decision of the committee members. Participant confidentiality was strictly maintained; no personal data were shared with third parties, and all data were used solely for scientific purposes.

Consent to Participate

Written informed consent was obtained from all participants included in the study after they were fully informed about the purpose and scope of the research.

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Clinical Trial Number

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Availability of Data

Data available on request due to privacy/ethical restrictions

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