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Assessing the digital competencies and transformational leadership of school administrators: the case of Adana

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Introduction: In the context of the rapid digitalization of education, developing and sustaining the digital competencies of school administrators has become a crucial factor.
Objective: The study aims to examine the digital competencies and transformational leadership of school administrators. This study examined whether school administrators' digital competency levels differed by gender and age and explored the relationship between their transformational leadership characteristics and digital competencies.
Methodology: A questionnaire consisting of three sections was employed in the study. The study sample consisted of 395 school administrators working in public schools under the Ministry of National Education in Adana, Turkey, during the 2022–2023 academic year.
Results and conclusion: The study revealed that while school administrators' digital competency levels did not differ significantly by gender, they varied significantly across age groups. A positively moderate significant relationship was identified between administrators' levels of transformational leadership and digital competencies. This study contributes to the growing body of literature on digital competencies and provides valuable insights for policymakers and professional development initiatives.

KEYWORDS
digital competence, digital transformation, transformational leadership, school administrators, digital competence of school administrators

Introduction

Digital technologies have transformed many areas of our lives—from communication, work, and leisure to how we receive news, acquire information, behave, and organize our daily routines (Redecker, 2017). In this context, it is imperative to employ technology to meet the needs of the evolving generation and enhance their learning environments. School administrators play a crucial role in managing this transformation within educational settings by integrating technology into teaching and learning processes in the digital age. As digital leaders, school administrators must possess the knowledge and skills to use digital technologies effectively in order to establish a clear, engaging, motivating, and meaningful school culture (Ordu and Nayır, 2021). Administrators who appropriately leverage digital tools and opportunities can support the digital transformation of their institutions by ensuring the necessary infrastructure and making strategic investments to improve the digital competencies of both teachers and students. Therefore, it is essential to have knowledgeable school administrators who actively advocate for the integration of digital technologies in education.

In modern educational management, schools are regarded as transformative organizations, and administrators are viewed as transformational leaders. The primary objective of transformational leadership at the school level is to create institutions that are aligned with the demands of the 21st century. Schools are no longer merely places where knowledge is transmitted; they have evolving missions, needs, expectations, social dynamics, and organizational structures. This shift in the educational landscape has redefined the role of school administrators—from instructional leadership to transformational leadership. Administrators now lead open systems that extend beyond students and teachers, integrating various social, political, economic, and cultural contexts along with external environmental factors. Transformational leadership plays a vital role in helping schools adapt to changing conditions, keep pace with scientific and technological advancements, and enhance the overall quality of education (Eraslan, 2004).

According to a comprehensive review of the literature, numerous studies have focused on teachers' digital competencies (Gümüş, 2021; Özalp, 2022; Fidan and Yeleğen, 2022; Vural et al., 2023). These studies commonly explore how effectively teachers integrate digital technologies into their instructional practices and how proficient they are in using digital tools to enhance student learning. There are limited studies addressing age- and gender-related differences in teachers' digital competence (Krumsvik et al., 2016; Lissitsa et al., 2017; Cabezas-González et al., 2020; Jiménez-Hernández et al., 2020; Palacios-Rodríguez et al., 2023; González-Medina et al., 2024). Moreover, none of these limited studies focus specifically on school administrators. There is a lack of empirical data regarding gender differences in digital competence (Sánchez-Canut et al., 2023). A similar gap in empirical data also exists concerning age-related differences in digital competence. Additionally, several studies have examined the relationship between transformational leadership and various related concepts—for example, job satisfaction (e.g., Hanaysha et al., 2012), organizational commitment (e.g., Top et al., 2015; leader fit, e.g., Guay, 2013; and leader thinking, e.g., Hai et al., 2021). It has been observed that no study to date has examined the digital competencies of school administrators within the context of transformational leadership. This gap in the literature has provided the rationale for conducting the present study. Thus, the aim of this study is to examine the digital competencies and transformational leadership of school administrators. This study examined whether school administrators' digital competency levels differed by gender and age and explored the relationship between their transformational leadership characteristics and digital competencies.

Literature review

Literature review includes sections on digital competence and transformational leadership.

Digital competence

The rapid evolution of technology and the increasing demand for its integration into everyday life have brought digital skills to the forefront (Banitalebi et al., 2025; Tarsuslu et al., 2025; Huot et al., 2025). Competence is broadly defined as the combination of knowledge, skills, and dispositions that enable individuals to perform their professional responsibilities effectively (Myyry et al., 2022). Within this scope, digital competence has emerged as a critical 21st-century competency that the next generation must possess (Toker et al., 2021). According to the European Commision (2018), digital competence encompasses a range of areas including information and data literacy, communication and collaboration, digital content creation, problem-solving and critical thinking, media literacy, intellectual property awareness, and digital safety and security. While digital competence refers to the technical use of information and communication technologies (ICT), it also represents a broader understanding that incorporates the application of knowledge and the development of a wide range of digital-era skills (Bentri et al., 2022). As Zhao et al. (2021), along with the European Commision (2018), argue, digital competence involves the ability to confidently, critically, and responsibly use digital tools to improve various aspects of life, including work, education, leisure, and civic participation. The COVID-19 pandemic has further highlighted the essential nature of digital competencies, emphasizing their role in ensuring continuity in education and communication during crisis conditions (Leoste et al., 2022; Myyry et al., 2022). The digital competence framework (Calvani et al., 2010) illustrates three dimensions of digital competence: technological, cognitive, and ethical. The technological dimension requires adaptable examination and resolution of issues related to recent technological advancements. The cognitive dimension involves scrutinizing, choosing, interpreting, and assessing data and information for significance and reliability. The ethical dimension involves engaging in beneficial interactions with a sense of responsibility to oneself and others (Calvani et al., 2010). This framework shows the integration of the technological, informational and ethical dimensions of the digital competence. This study draws upon internationally recognized ICT and digital competence frameworks developed specifically for the field of education, including the Digital Competence Framework for Educators (DigCompEdu), the UNESCO's ICT Competency Framework for Teachers (ICT CFT), the International Computer and Information Literacy Study (ICILS), and the ISTE Standards for Education Leaders.

The DigCompEdu framework is designed by the European Commission's Joint Research Center (JRC) with the purpose of identifying digital competencies unique to educators. Its objective is to empower educators to harness the potential of digital technology for innovation and improvement in education. The DigCompEdu framework offers 22 core competencies arranged into six sections that specify digital competencies tailored for educators: Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence (Redecker, 2017). Through collaboration with UNESCO, industry leaders, and subject matter experts, the ICT CFT has been formulated. This global framework recognizes the essential skills needed for successful teaching using ICT. The UNESCO ICT CFT framework outlines 18 ICT qualifications that teachers must possess, alongside 64 key objectives aligned with these qualifications. This framework covers a broad range of competencies, including comprehension of national ICT policies in education, ICT curriculum and assessment strategies, pedagogy, school management and organization, and teacher professional development (UNESCO, 2018). Subsequent studies like the Computer and Information Literacy Study (CILS) and the Second Information Technology in Education Study (SITES) modules provide updated insights into technology in education, reflecting rapid changes in how information is accessed and shared. The CILS framework is comprised of two components: information collection and management, and information production and exchange (Fraillon et al., 2013). The framework for educational leaders is designed to equip them with the requisite knowledge and behaviours to empower teachers and cultivate an environment conducive to student learning. This section of the Standards focuses on pertinent issues for administrators such as equity and digital citizenship, visionary planner, impowering leader, systems designer, and connected leader (The ISTE Standarts, 2009).

ISTE published the ISTE Standards for Administrators (ISTE-A) in 2009. However, there is still an insufficient number of studies focusing on the indicators of digital leadership (Zhong, 2017). The ISTE-A standards require administrators to demonstrate knowledge and skills in five key areas-visionary leadership, digital age learning culture, excellence in professional practice, systemic improvement, and digital citizenship-in order to be recognized as digital leaders (Zhong, 2016). Digital leadership is becoming increasingly critical with each passing day, highlighting the need for further research in this field. Nevertheless, the number of studies specifically addressing digital leadership remains quite limited (Woro and Herachwati, 2024). At this point, it is no longer possible for school administration to overlook the rapid pace of technological innovations emerging in the era of the Fourth Industrial Revolution (4IR; Okunlola and Naicker, 2025). Additionally, Georgios et al. (2021) emphasize that digital competence is essential for school leaders, as it enables them to effectively identify local needs and streamline administrative processes. School administrator's role increasingly involves making data-informed decisions, fostering a culture of innovation, and leading digital transformation initiatives that align with institutional goals. As educational environments become more digitally complex, the ability of administrators to guide and sustain these changes becomes a critical component of effective school governance.

Transformational leadership

Educational leadership is essential, as it shapes the vision and overall effectiveness of schools, directly impacting teaching practices and student learning outcomes (Grogan, 2014; Byrne-Jiménez and Yoon, 2019). The integration of new technologies has transformed school management and culture, placing a stronger emphasis on learning, knowledge production, and innovation—all of which are increasingly supported by digitalization. This transformation calls for a critical re-evaluation of educational practices, particularly in the domain of school administration (Altınay et al., 2016). In this context, both administrators and teachers play pivotal roles as leaders in the digital transformation process (Elías et al., 2022). Transformational leadership is a leadership style that prioritizes the individual needs and motivations of followers while supporting them in realizing their full potential. Transformational leaders assess and respond to the distinct needs of their followers, treating them as individuals and encouraging personal and professional growth. This leadership approach is often characterized by charismatic and visionary qualities, which serve to inspire team members to surpass their expected levels of performance (Northouse, 2013). Leaders who adopt this approach and possess strong digital competencies are better positioned to demonstrate effective digital leadership. They are also more likely to manage administrative responsibilities with greater efficiency and innovation (Antonopoulou et al., 2020).

Transformational leadership comprises four key subdimensions (Bass and Riggio, 2006; Judge and Piccolo, 2004; Northouse, 2013; Yukl, 2013): idealized influence (charisma), inspirational motivation, intellectual stimulation, and individualized consideration. Idealized influence (charisma) refers to the extent to which followers identify with and emulate the leader due to their exemplary behavior. A charismatic leader appeals to followers' emotions, articulates core values, and takes principled stands on critical issues. Inspirational motivation involves providing a clear, compelling, and inspiring vision that energizes and motivates followers toward collective goals. Intellectual stimulation reflects the leader's ability to encourage innovation and critical thinking by challenging assumptions, inviting diverse perspectives, and promoting creative problem-solving. Leaders exhibiting this trait take calculated risks and actively solicit input from team members, thereby fostering an environment of imaginative engagement. Finally, individualized consideration entails offering a supportive and empathetic environment in which the leader listens attentively to followers' needs, provides mentoring or coaching, and demonstrates a genuine commitment to their personal and professional development (Judge and Piccolo, 2004). Collectively, these four subdimensions illustrate how transformational leaders build strong commitment, nurture growth, and enhance overall organizational effectiveness.

Transformational leadership has emerged as a prominent area of inquiry within educational research (Zadok et al., 2024). The findings of Buil et al. (2019) indicate that transformational leadership has a positive effect on employee performance. Furthermore, numerous studies have explored the relationship between transformational leadership and a variety of organizational outcomes, including administrative creativity, employee empowerment, knowledge management practices, job enrichment, organizational commitment, morale, job satisfaction, and organizational citizenship behavior (Saad Alessa, 2021). Taken together, these findings highlight the critical role of transformational leadership in cultivating positive employee attitudes and enhancing overall organizational effectiveness.

Methodology

Aim and scope

Many studies have been conducted on the digital competencies of pre-service teachers, in-service teachers, and students (e.g., Aziz, 2015; Tor et al., 2022; Bentri et al., 2022; Elías et al., 2022; Myyry et al., 2022; Zhu et al., 2024; Masoumi and Noroozi, 2025; Abdo-Salloum and Al-Mousawi, 2025; Usart et al., 2025). However, there remains untapped potential for research on digital competence among school administrators. At the same time, a growing body of literature has begun to explore the transformational leadership practices of school administrators (e.g., Berkovich and Eyal, 2021; Morales, 2022; Metaferia et al., 2023; Champarat and Nuangchalerm, 2025; Erdoğan et al., 2025). According to this comprehensive literature review, no study to date has simultaneously examined the digital competencies and transformational leadership qualities of school administrators. Based on this identified gap in literature, the research questions guiding this study were formulated as follows:

RQ1. Is there a significant difference in digital competencies according to their gender and age?

RQ2: Is there a significant relationship between school managers' digital competencies and transformational leadership abilities?

Thus, the study aims to examine the digital competencies and transformational leadership of school administrators.

Sampling

The research population consisted of public educational institutions in the province of Adana, and the sample included school administrators working in public schools during the 2022–2023 academic year. The convenience sampling method was employed to collect the data. In this study, the convenience sampling method was employed due to accessibility and time constraints. The participants were school administrators working in public schools within a single province in Türkiye. While this approach facilitated data collection from a relevant and accessible population, it also presents limitations in terms of representativeness, as discussed in the Limitations and Further Research section. The sample may not fully reflect the diversity of school administrators across different regions, school types (e.g., private), or socio-economic contexts. Therefore, the findings should be interpreted with caution, particularly when attempting to generalize them beyond the specific geographic and institutional context of the study. The study was conducted by distributing Google-based questionnaire forms to school administrators via email and WhatsApp. Participation was voluntary, and an informed consent statement was provided to each participant. A total of 395 individuals initially took part in the study. Responses from four participants were excluded due to a high amount of missing or incomplete information. Thus, the final sample consisted of 391 school administrators.

Data collection

The questionnaire was established as the primary data collection instrument. In the first section of the questionnaire, the Teacher Digital Competence Questionnaire developed by Gümüş (2021) in the study Digital Competences of Teachers was employed. In developing the scale, Gümüş (2021) adopted the DigComp 2.1 framework, which was introduced by the European Commission and provides a contemporary structure for assessing digital competence. The "Teacher Digital Competence Scale," constructed based on this framework, was developed in accordance with the scale development principles. This scale was deemed appropriate in the context of Türkiye, as school administrators are always selected from among teachers and are still required to perform teaching duties for a certain number of hours while serving in administrative roles. Therefore, this scale is considered contextually appropriate for measuring digital competence among school administrators in Türkiye, as it reflects both their ongoing teaching responsibilities and their foundational professional background as educators. The items in the scale were adapted for managers. To further assess the psychometric robustness of the instrument, Exploratory Factor Analysis (EFA) was conducted to examine the construct validity of the digital competence scale and to identify its underlying factor structure.

This scale operates digital competence across six dimensions-information and data literacy, communication and collaboration, digital content creation, security, problem solving, and ethics-and contains a total of 46 items. The second section comprised the English version of the short transformational leadership scale developed by Berger et al. (2012) in their study Psychometric Properties of the Spanish Human System Audit Short-Scale of Transformational Leadership. This scale includes eight items designed to measure transformational leadership behaviors. The items in the scale were translated into Turkish and adapted for use with school administrators. A pre-test was conducted for the adapted version of the scale. In the first two sections of the questionnaire, a 5-point Likert scale was employed for each item, ranging from 1 (Strongly disagree) to 5 (Strongly agree). The final section included a 'Personal Information' that collected demographic variables such as age and gender, as well as professional characteristics including school type.

Analysis and results

In this section, demographic information is presented first, followed by the validity and reliability results, normality test results, digital competence findings, and the findings related to digital competence and transformational leadership. Table 1 presents the demographic characteristics of the school administrators who participated in the study.

According to Table 1, 71.9% of the participants were male administrators, whereas 28.1% were female administrators. With respect to age, the group with the highest participation consisted of administrators aged 43–57, representing 47% of the sample (185 participants). This was followed by the 36–45 age group, with 121

TABLE 1 Demographic characteristics.

Variables		f	%
Gender	Male	281	71,9
	Female	110	28,1
	Total	391	100
Age	43–57 years old	185	47,3
	36–42 years old	121	30,9
	25–35 years old	77	19,7
	57 years old and older	8	2
	Total	391	100
School types	High School	153	39,1
	Secondary School	108	27,6
	Primary School	79	20,2
	Kindergarten (Preschool)	27	6,9
	Other Educational Institutions	24	6,1
	Total	391	100

participants (30.9%), and the 25–35 age group, with 77 participants (19.7%). The lowest participation was observed among administrators aged 57 and above, with only eight individuals in this category. In terms of school type, the highest participation was observed among administrators working in upper secondary schools, with 153 participants (39%). This was followed by primary schools, secondary schools, and nursery schools. The lowest participation came from other educational institutions—such as guidance and research centers, public education directorates, and special education schools—with only 24 participants (6.1%).

Validity and reliability

EFA was conducted to examine the construct validity of the digital competence scale and to identify its underlying factor structure. Principal component analysis and Varimax rotation, a type of orthogonal rotation method, were employed for this purpose. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.978, indicating that the sample size was sufficient for conducting EFA. In the KMO values calculated for each item, the lowest value was found to be 0.741, confirming that the sample was sufficient. In addition, as a result of the Barlett's test, $x^2(703) = 24.124$; $p < 0.05$ and this result showed that the correlation between the items was large enough for EFA. Following EFA, it was determined that the Digital Competence Test comprises 38 items which are organized into four sub-dimensions resulting in a four-factor structure. These four factors collectively account for 84.617% of the total variance, thereby endorsing the validity of the Digital Competence Scale (DCS). The first sub-dimensions explains 72.49% of the variance, second sub-dimension 78.33% of the variance, third sub-dimension 82.06% of variance and fourth sub-dimension explains 84.61% of the variance, respectively. The digital competence scale was refined into a four-dimensional structure, encompassing the following dimensions: information and data literacy–problem solving, security, digital content creation–communication and collaboration, and ethics. The DigComp 2.0 framework by Vuorikari et al. (2022), which served as the basis for Gümüş (2021) scale development, notes that due to the artificial separation of areas and competencies within the digital competence framework, considerable overlaps and intersections may exist between different fields and competencies.

EFA was performed to evaluate the structural validity of the Transformational Leadership Scale (TLS). The sampling adequacy value for KMO and Barlett's test (KMO) is 0.958, indicating a sufficient sample size for exploratory factor analysis (EFA). Furthermore, the examination of the KMO values for each item confirmed the suitability of the sampling, with the lowest value being 0.918. Moreover, the results of Barlett's test demonstrated a significant correlation between the items ($x^2(28) = 4.832$, $p < 0.05$) and supported the appropriateness of EFA. After EFA, it was found that the 8-item TLS was grouped under a single dimension and explained 88.158% of the total variation. This confirms the validity of the TLS.

Cevahir (2020) indicates that a Cronbach's alpha coefficient of 0.80 or higher is generally considered indicative of satisfactory internal consistency. To assess the reliability of the Digital Competence Scale ($\alpha = 0.990$) and the Transformational Leadership Scale ($\alpha = 0.981$), Cronbach's alpha reliability analyses were performed. Both scales demonstrated high reliability coefficients, confirming their internal consistency and overall reliability. This result indicates excellent internal consistency; such extremely high reliability values may also suggest the possibility of item redundancy or narrow construct coverage. Therefore, it was decided to evaluate both discriminant and convergent validity. The Average Variance Extracted (AVE) values were ≥ 0.50 for all dimensions (The values are 0.839, 0.831, 0.822, and 0.936, respectively). Discriminant validity was examined using the Fornell-Larcker criterion. It was observed that the square root of the AVE values for each factor (The values are 0.916, 0.912, 0.907, and 0.968, respectively) was higher than the correlation coefficients with other factors.

Normality results

A normality test was conducted to determine whether parametric or nonparametric analysis methods should be applied. In the literature, it is commonly recommended that the Shapiro–Wilk test be used for sample sizes less than 50 ($n < 50$), while the Kolmogorov–Smirnov (K-S) test is preferred for sample sizes greater than 50 ($n > 50$; Büyüköztürk et al., 2018; George and Mallery, 2016). In the present study, the K-S test was employed, as the sample size was 391 ($n > 50$). The total items of the Digital Competence Scale and its four subdimensions, as well as the Transformational Leadership Scale, were analyzed using this test. The results indicated that the p-value for the Digital Competence Scale and its subdimensions was $p < 0.001$. The Kolmogorov–Smirnov test conducted for the Transformational Leadership Scale yielded a result of $p < 0.001$, indicating a statistically significant deviation from normality at the conventional alpha level of 0.05. K-S test can be overly sensitive in large sample sizes, often detecting trivial deviations from normality as statistically significant. Therefore, decisions regarding the distribution of the data should not rely solely on the results of the K-S test. Especially the skewness values of the first and fourth sub-dimensions exceed the ±1 threshold, indicating that the distribution deviates significantly from symmetry. Although the other sub-dimensions are closer to normality, there is sufficient evidence to conclude that the overall data set does not follow a normal distribution. Thus, it was determined that the assumptions of parametric tests were not fully met. In conclusion, the data is not normally distributed. These findings necessitate the use of nonparametric tests for further analysis.

Results on digital competence in relation to gender and age

Based on the results of the K-S tests, Mann–Whitney U tests were conducted to examine differences in the gender variable. The Mann–Whitney U test revealed that male administrators had lower levels of digital competence compared to their female counterparts (Mean $\text{Rank}_{\text{male}} = 193.68$, $n = 281$; Mean $\text{Rank}_{\text{female}} = 202.07$, $n = 110$), with a negligible effect size ($r = 0.036$), calculated using the formula $r = Z/\sqrt{n} = 0.719/\sqrt{391} = 0.036$.

The results of the Digital Competence test indicate that there is no statistically significant difference between male and female administrators ($p > 0.05$; $p = 0.472$; Table 2).

The Kruskal-Wallis tests were conducted to examine differences in the age variable. Table 3 shows the results. When analyzing the digital competence scores of administrators by age, a statistically significant difference was observed in the total scale ($p < 0.05$; $p = 0.00$). The analysis revealed similar results for the Safety, Information and Data Literacy–Problem Solving (IDL–PS), and Digital Content Creation–Communication and Collaboration (DCC–CC) subdimensions.

As shown in Table 3, school administrators in the 36–42 age group had the highest mean rank (Mean Rank = 222.65, $n = 121$). To determine the proportion of variance in the Digital Competence dependent variable explained by age, the formula $\eta^2 = \chi^2 / (N - 1$; Cevahir, 2020) was used. The resulting Eta-squared value was 0.045, indicating that age accounts for 4.5% of the variance. These findings suggest that age explains only a small portion of the total variance. The observed differences were primarily driven by the mean ranks of the 25–35 and 43–57 age groups, as well as the 36–42 and 43–57 age groups ($p < 0.01$).

Results of digital competence and transformational leadership

Simple correlation tests are used to examine whether a linear relationship exists between two quantitative variables from the same source and, if so, to provide numerical information regarding the direction and strength of that relationship. The correlation coefficient (r) ranges from −1 to +1, with the sign indicating the direction of the relationship. Regardless of the sign, the magnitude of the coefficient can be interpreted using Cohen's widely cited classification: 0.10–0.29 indicates a small effect, 0.30–0.49 a medium effect, and 0.50 or above a large effect. The Pearson correlation coefficient is applied when the data are normally distributed, whereas the Spearman correlation coefficient is used for non-normally distributed data (Cevahir, 2020). Thus, the Spearman correlation test was employed to examine the relationship between digital competencies and transformational leadership.

A moderate positive correlation ($r = 0.489$) that was statistically significant ($p < 0.05$; $p = 0.00$) was observed between digital competence and administrators' transformational leadership scores (Table 4).

Conclusion and discussion

The purpose of this study was to examine the digital competence and transformational leadership of school administrators. In this context, the study utilized the Teacher Digital Competence Scale developed by Gümüş (2021) and the Short Transformational Leadership Scale developed by Berger et al. (2012). The sample consisted of 391 school administrators working at various educational levels in the province of Adana during the 2022–2023 academic year. Validity and reliability analyses were performed for both instruments, and the results indicated that the scales demonstrated strong validity and high reliability. The Kolmogorov–Smirnov normality test was applied to the scales, and the results indicated that the data did not follow a normal distribution. Therefore, non-parametric tests were employed in the subsequent analyses. Mann–Whitney U tests were conducted to examine gender-based differences in digital competence. Kruskal-Wallis tests were conducted to examine age-related differences in digital competence. The Spearman correlation test was employed to examine the relationship between digital competence and transformational leadership. The results revealed no statistically significant difference in digital competence based on gender. Additionally, the findings indicated that school administrators' digital competence levels differed significantly across age groups. The analysis revealed a moderate, positive, and statistically significant relationship between school administrators' transformational leadership traits and their digital competence levels.

The existing literature has revealed different results in line with the scope of this study. Supporting our result, Özalp (2022) reported no significant difference in teachers' digital competence scores based on gender. Similarly, Vural et al. (2023) found no gender-based differences in teachers' perceptions of digital leadership. However, studies conducted by Gümüş (2021) revealed that the digital competence characteristics of teachers and school administrators differed significantly according to gender. This discrepancy may be attributed to contextual factors such as variations in sample composition, geographical location, access to digital technologies, and differences in professional development opportunities and cultural contexts across gender groups. Similar to the results of the present study, Gümüş (2021) found that teachers' digital competence scores differed by age, with teachers aged 21–40 demonstrating higher levels of digital competence compared to those over 40 years

TABLE 2 Indicators of difference between school administrators' gender and the level of digital competence.

	Gender	N	Mean rank	U	p	Z
Digital competence	Male	281	193.62	14,787	0.472	−0.719
	Female	110	202.07			
Safety	Male	281	196.11	15,425	0.975	−0.032
	Female	110	195.73			
IDL-PS*	Male	281	192.13	1,468,5	0.240	−1.174
	Female	110	205.88			
DCC-CC**	Male	281	192.52	1,478	0.313	−1.008
	Female	110	204.88			
Ethics	Male	281	190.79	13,991	0.122	−1.546
	Female	110	209.31			

IDL-PS*, Information and Data Literacy-Problem Solving. DCC-CC**, Digital Content Creation-Communication & Collaboration.

TABLE 3 Indicators of difference between school administrators' digital competence levels and age variable.

Age	25–35		36–42		43–57		57 and older		Chi Square (X^2)	*p*
	N	Mean rank	N	Mean rank	N	Mean rank	N	Mean rank		
Digital Competence	77	209.37	121	222.65	185	173.50	8	184.56	17.790	0.00*
Safety	77	210.84	121	217.20	185	177.46	8	161.06	12.713	0.005*
IDL-PS	77	214.12	121	217.80	185	174.11	8	198.13	15.839	0.001*
DCC-CC	77	210.03	121	220.62	185	174.11	8	194.75	14.912	0.002*
Ethics	77	201.65	121	213.16	185	182.12	8	202.94	6.529	0.089

*Correlation is significant at the 0.05 level (2-tailed).

TABLE 4 Relationship between school administrators' digital competence and transformational leadership scores.

		Transformational leadership
Digital competence	Spearman r	0.489
	P	0.000*
	N	391

*Correlation is significant at the 0.01 level (2-tailed).

old. Consistent with the findings of this study, Özalp (2022) and Vural et al. (2023) reported that teachers' digital competence levels vary significantly across age groups. The finding that the difference favors the 36–43 age group may be attributed to the fact that individuals in this developmental period typically possess a balance of professional experience and adaptability to change. They are often more confident in using technology than younger, less experienced colleagues, yet remain more open to innovation and learning than older groups. This combination of professional maturity, motivation for continuous improvement, and familiarity with evolving educational technologies may contribute to their higher levels of digital competence.

The analysis revealed a moderate, positive, and statistically significant correlation between school administrators' transformational leadership characteristics and their digital competence. This finding underscores the pivotal role of leadership orientation in shaping administrators' ability to adapt to digital transformation processes within educational contexts. From a broader perspective, transformational leadership inherently fosters openness to innovation, a proactive attitude toward change, and a vision-oriented mindset, all of which are essential components of digital competence. It can be inferred that leaders who inspire, motivate, and intellectually stimulate their teams are also more likely to embrace and model digital literacy, thereby creating a culture that values technological advancement. In this sense, transformational leadership does not merely coexist with digital competence; rather, it serves as a strategic catalyst that propels digital adaptation and fosters the systematic integration of technology within educational institutions.

The lack of adequate digital skills may lead to operational errors, increased workloads, elevated stress levels, and ultimately diminished organizational performance (Korte et al., 2025). However, despite the growing recognition of digital competence as a critical capability, there remains a limited body of research examining its relationship with transformational leadership (Antonopoulou et al., 2021; Madrid et al., 2024; Korte et al., 2025). In this perspective, this study makes several noteworthy contributions to the growing body of research on digital competence and leadership in educational settings. Supporting our findings, Madrid et al. (2024) reported a significant relationship between transformational leadership and digital competence in higher education settings. The findings provide empirical evidence on the digital competence levels and transformational leadership characteristics of school administrators—an understudied group in comparison with teachers—thus addressing a critical gap in the literature. Furthermore, the identification of a moderate and positive relationship between transformational leadership and digital competence advances theoretical understanding by highlighting transformational leadership as a key driver of digital adaptability and innovation-oriented behavior in schools. Practically, the study provides valuable implications for policymakers and educational leaders seeking to design targeted professional development initiatives that integrate both leadership development and digital skill enhancement, thus supporting the digital transformation of educational institutions in a more systematic and sustainable manner.

Limitation and further research

This study was conducted in the province of Adana, Turkey, focusing exclusively on school administrators' digital competencies and transformational leadership characteristics. Therefore, its findings are limited to public school administrators employed in Adana during the 2022–2023 academic year. The results may not be fully generalizable to private schools or other regions with different demographic and institutional characteristics. In addition, the study relied on self-reported data, which may be subject to response bias. The cross-sectional research design also limits the ability to infer causal relationships between digital competence and transformational leadership. Future studies could address these limitations by incorporating longitudinal designs, qualitative methods, or larger and more diverse samples to enhance the generalizability and depth of the findings. The study employed a scale originally developed for teachers, considering that, in Türkiye, school administrators are selected from among teachers and continue to carry out teaching duties. Moreover, due to the limited availability of validated digital competence scales specifically designed for administrators, the use of a teacher-oriented scale was deemed a practical and contextually relevant choice. Future research could focus on developing a digital competence scale specifically tailored for school administrators, considering their unique leadership responsibilities, managerial tasks, and strategic roles within educational institutions.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Adana Alparslan Türkeş Science and Technology University Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because the questionnaire was conducted online. Participants were fully informed about the purpose and procedures of the study, and written voluntary participation consent was presented at the beginning of the survey. Ethics approval was obtained from the Scientific Research and Publication Ethics Committee of Adana Alparslan Türkeş Science and Technology University on June 29, 2022, with Decision No. 9 from the 6th Meeting. Participants were fully informed about the purpose and procedures of the study, and written voluntary participation consent was presented at the beginning of the survey. Additionally, permission for the use of the scale was obtained by contacting Gümüş, M. M. via e-mail.

Author contributions

AE: Conceptualization, Methodology, Visualization, Writing – original draft. DP: Conceptualization, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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