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Digital technologies and leadership practices in Greek elementary schools

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ABSTRACT

The rapid advancement and widespread adoption of digital technologies have significant implications for leadership theory and practice, which remain largely unexplored in the current literature. This study investigates how demographic characteristics influence the perceptions of elementary school principals and educational staff regarding the digital age and leadership practices. Employing a quantitative research approach, data were collected through a web survey based on the questionnaire for digital technologies and leadership practices (QDTLP) from 505 participants in 215 elementary schools of Peloponnese Region. Multivariate analysis of variance (MANOVA) and univariate analysis of variance (ANOVA) were employed to examine differences in perceptions based on gender, age, education level, subject specialization, years of teaching experience, years of work at the current school, role in the school, and the Directorate of Primary Education (DPE) the school belongs to. The findings indicate that age, education level, years of teaching experience, and role in the school significantly affect perceptions, while gender, subject specialization, and DPE the school belongs to, do not demonstrate a significant influence. The study provides valuable insights into how demographic characteristics shape perceptions about digital technologies and leadership within the elementary school context, contributing to the adaptation of leadership practice in the digital age.

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1. INTRODUCTION

In the contemporary landscape, where digital technologies have become deeply ingrained in every facet of our lives, discussions about any social context, including education, are now inseparable from references to advanced digital and internet technologies, reflecting their pervasive influence [1]–[3]. The continuous progress in the field of digital technologies over the past 15 years has fostered direct communication, interaction, collaborative action, and social networking, fundamentally reshaping the ways individuals learn, participate, collaborate, exchange ideas, provide mutual support, make choices and decisions, and engage in critical thinking [3], [4]. While digital technologies have reshaped educational practices, a significant gap remains in academic literature concerning their impact on leadership theory, practice, and development [5], [6]. Addressing this gap is crucial for transitioning from pre-digital to digital

leadership models and bridging the gap between digital natives and digital immigrants [7]. Furthermore, it is vital to promote a shift from traditional hierarchical approaches to more modern, distributed, and collaborative leadership practices in the digital age [8]–[10].

Moreover, the COVID-19 pandemic has dramatically altered perceptions of leadership and leadership practices in education, forcing to a rapid and widespread adoption of digital technologies [8]. School principals and those responsible for coordinating and supporting teaching and learning processes adopted leadership practices that were previously unimaginable [8]. This crisis fostered the emergence and utilization of extensive networks for communication, teaching, learning, and leadership, characterized by their collective, collaborative, and finally distributed nature [6], [11].

Within the European context, the European Union recognizes the vital role of digital technologies in education and training, advocating for a redefinition of education for the digital age and envisioning high-quality, inclusive, and accessible digital education across Europe [12]. Greece, as a European Union (EU) member state, has responded by implementing policies to strengthen technological infrastructure, connectivity, and digital equipment in schools. It has also undertaken a series of actions to promote the use of digital technologies in teaching and learning, develop digital skills among teachers and learners, and foster innovation, creativity, and change in schools and educational organizations [12].

However, although existing literature has started to explore the influence of digital technologies on educational leadership, there remains a need to understand how demographic characteristics shape the perceptions of school leaders and teachers regarding these digital-age leadership practices [5], [6], [13]. This study is part of a broader research project that included the validation of the questionnaire for digital technologies and leadership practices (QDTLP) [13]. Drawing on findings of the abovementioned research project, it seeks to examine how demographic attributes, such as gender, age, education level, years of teaching experience, years at the current school, role within the school, and the Directorate of Primary Education (DPE) the school belongs to, impact perceptions of digital age leadership practices.

This study seeks to provide insights for developing and implementing professional development programs that enable school leaders to effectively address the complexities of the digital age, with a focus on the varied demographic composition of the educational environment. By employing multivariate analysis of variance (MANOVA) and analysis of variance (ANOVA), this study examines the intricate relationship between demographic characteristics and the perceptions about the digital age and leadership practices within elementary schools [14]. The findings are anticipated to shed light on how demographic characteristics shape perspectives on digital technologies and leadership, thereby contributing to the adaptation of leadership practices for the digital age and providing more effective support to both teachers and learners in navigating this new reality.

Based on this analysis, the study aims to address two key research questions: i) It will explore how demographic characteristics influence perceptions about digital technologies and leadership practices in the digital age; and ii) The study will examine what differences emerge among various demographic groups regarding the acceptance and application of digital technologies in leadership practices. The study is particularly significant as it is expected to fill a gap in the literature concerning leadership and its practices in the digital age. The research findings will contribute not only to the theoretical understanding of the topic but also to the practical implementation of effective leadership strategies in elementary schools. Specifically, focusing on demographic characteristics may lead to more tailored professional development programs and the development of leadership skills.

With the rapid evolution of digital technologies and the acceleration of digitalization, especially due to the COVID-19 pandemic, have created new challenges for educational leaders. To navigate these changes effectively, leaders must develop new skills and strategies that address the evolving needs of their school communities. Additionally, understanding how demographic attributes influence the perception and application of digital technologies is crucial for effectively guiding school communities through the era of digital reform.

2. METHOD

This study employs a quantitative research approach [15], utilizing data collected through a web survey based on the QDTLP research instrument from 505 participants. Building on a prior research phase that established the validity and reliability [14], [16], [17] of the QDTLP research instrument [13], this study investigates the perceptions of school principals, vice-principals, teachers, and special education staff regarding digital technologies and leadership practices in the digital age. The analysis focuses on examining differences in perceptions related to the four factors derived from the QDTLP: digital skills, leadership practices, digital age, and teacher leadership. The independent variables considered in this study include gender, age, education level, subject specialization, years of teaching experience, years at the current school,

role within the school, and the DPE the school belongs to. The research project received approval from the Research Ethics Committee of the University of Peloponnese (protocol number: 7636/29-03-2022). Subsequently, the Regional Directorate of Primary and Secondary Education of Peloponnese granted written permission to conduct this study within the Peloponnese Region (protocol number: 756/02-02-2023) [13]. Data collection was carried out from April to June 2023.

The study population comprised 3,199 principals, vice-principals, teachers, and special education staff employed in 215 elementary schools of the Peloponnese region in Greece during the 2022-2023 school year. A sample size of 505 participants was determined based on recommendations for an appropriate sample-to-item ratio and considerations of population complexity and research goals [16], [18]. This sample size ensures a high level of confidence (98.56%) and a low margin of error (5%). Stratified sampling was employed to select participants, ensuring proportional representation of each regional unit of Peloponnese [13]. Detailed demographic information about the participants for the four factors derived from the QDTLP (digital skills, leadership practices, digital age, teacher leadership) is presented in Table 1.

Table 1. Means and standard deviations (±) of demographic characteristics for digital skills, leadership practices, digital age and teacher leadership (N=505)

Demographic characteristics	Category (n)	Factors			
		Digital skills	Leadership practices	Digital age	Teacher leadership
Gender	Female (331)	4.67±.91	4.16±.99	5.08±.58	4.39±.94
	Male (174)	4.73±.84	4.24±.97	5.01±.60	4.38±1.03
Age	≤34 (87)	4.29±1.01	4.07±1.03	5.03±.53	4.46±.99
	35-44 (129)	4.58±.89	4.12±.95	5.08±.58	4.40±.92
	45-54 (147)	4.85±.84	4.21±1.03	5.06±.63	4.32±.98
	≥55 (142)	4.86±.74	4.29±.93	5.04±.59	4.41±.99
Education level	Bachelor's degree (251)	4.69±.85	4.14±.98	5.03±.59	4.27±.97
	Postgraduate degree (254)	4.69±.92	4.23±.98	5.08±.58	4.50±.95
Subject specialization	Teacher (403)	4.69±.90	4.19±.98	5.04±.58	4.39±.97
	Other (102)	4.68±.82	4.16±1.00	5.12±.58	4.37±.95
Years of teaching experience	Up to three years (25)	4.59±1.07	4.29±.89	5.08±.48	4.63±.87
	Four to nine years (85)	4.26±.89	4.00±1.00	5.06±.57	4.35±1.00
	Ten and more (395)	4.79±.84	4.22±.98	5.05±.60	4.38±.97
Years of work at the current school	Up to three years (195)	4.46±.94	4.00±1.06	5.03±.59	4.28±1.04
	Four to nine years (122)	4.81±.86	4.31±.99	5.09±.60	4.49±.84
	Ten and more (188)	4.85±.79	4.30±.87	5.06±.57	4.43±.96
Role within the school	Educational staff (359)	4.54±.91	4.12±1.01	5.04±.58	4.37±.96
	Principal, vice-principal (146)	5.05±.70	4.34±.91	5.08±.59	4.43±.98
DPE the school belongs to	DPE of Argolida (146)	4.50±1.00	3.99±1.01	5.09±.60	4.18±.99
	DPE of Arcadia (62)	4.74±.78	4.08±.95	5.01±.59	4.34±.96
	DPE of Korinthia (134)	4.69±.88	4.23±.96	5.04±.59	4.46±.99
	DPE of Lakonia (82)	4.72±.81	4.29±.97	5.05±.52	4.46±.98
	DPE of Messinia (136)	4.77±.88	4.26±1.00	5.07±.62	4.43±.92

The 22-item QDTLP research instrument based on a 6-point Likert scale, was employed in this study. The QDTLP was developed through a systematic literature review and expert input, with the aim of investigating the influence of digital technologies on leadership practices in Greek elementary schools. The questionnaire's content validity was ensured through a rigorous process of item selection, adaptation, and translation, guaranteeing conceptual and measurement equivalence across languages, as described in detail by Kokkonos *et al.* [13].

Data analysis was performed using JASP and Jamovi for macOS [19]–[22]. To investigate the abovementioned research questions, a series of statistical analyses were conducted. First, one-way MANOVAs were performed [14], [23] to examine the overall effect of the demographic characteristics–gender, age, subject specialization, years of teaching experience, years of work at the current school, education level, role within the school, and DPE the school belongs to–on the four dependent variables/the standardized factors: digital skills, leadership practices, digital age, and teacher leadership. Univariate ANOVAs were conducted to further explore the relationship between each demographic characteristic and the dependent variables. This approach provided a more nuanced understanding of how specific demographic attributes influence perceptions of leadership practices in the digital age. The Bonferroni correction was applied to statistically significant analyses to adjust p-values and control the family-wise error rate, ensuring the statistical rigor of the findings [14], [23]. A significance level of $p \leq .05$ was applied to all statistical tests.

3. RESULTS AND DISCUSSION

3.1. Results

The one-way MANOVAs revealed several significant findings regarding the demographic characteristics influencing participants' perceptions of digital technologies and leadership practices in the digital age. The results indicate that independent variables such as age (Wilks's λ=.901, $F_{(12, 1318)}$=4.412, p<.001), education level (Wilks's λ=.979, $F_{(4, 500)}$=2.692, p=.030), years of teaching experience (Wilks's λ=.926, $F_{(8, 998)}$=4.872, p<.001), *years at the current school* (Wilks's λ=.950, $F_{(8, 998)}$=3.724, p=.001), and role within the school (Wilks's λ=.918, $F_{(4, 500)}$=11.188, p<.001) significantly affected the aforementioned dependent variables (digital skills, leadership practices, digital age, and teacher leadership). In contrast, independent variables like gender, subject specialization, and the DPE to which the school belongs to, did not show a significant influence on digital skills, leadership practices, digital age, and teacher leadership (Wilks's λ=.988, $F_{(4, 500)}$=1.569, p=.181, Wilks's λ=.994, $F_{(4, 500)}$=.701, p=.591, Wilks's λ=.969, $F_{(16, 1519)}$=.989, p=.466, respectively).

More specifically, univariate ANOVAs for age indicated a statistically significant effect in digital skills ($F_{(3, 501)}$=10.572, p<.001, η^2_p=.060). Post-hoc analyses with Bonferroni correction showed that participants aged ≤34 reported significantly lower scores (M=4.29±1.01) in digital skills compared to those aged 45-54 (M=4.85±.84) and ≥55 (M=4.86±.74). Additionally, the 35-44 age group had significantly lower scores (M=4.58±.89) than the ≥55 age group. Also, ANOVAs for education level demonstrated a statistically significant effect in teacher leadership ($F_{(1, 503)}$=7.494, p=.006, η^2_p=.015), where participants holding a postgraduate degree reporting significantly higher scores (M=4.27±.97) than those with a bachelor's degree (M=4.50±.95). Significant differences in digital skills were found across years of teaching experience, as indicated by univariate ANOVAs ($F_{(2, 502)}$=13.396, p<.001, η^2_p=.051). Bonferroni post-hoc tests revealed that teachers with four to nine years of experience scored significantly lower (M=4.26±.89) in digital skills compared to those with at least 10 years (M=4.79±.84). Moreover, significant differences in digital skills and leadership practices were found among years at the current school, as indicated by univariate ANOVAs ($F_{(2, 502)}$=10.725, p<.001, η^2_p=.041; $F_{(2, 502)}$=6.021, p=.003, η^2_p=.023, respectively). Bonferroni post-hoc analysis showed that participants with ≤3 years at the current school reported significantly lower scores on both digital skills (M=4.46±.94) and leadership practices (M=4.00±1.06) compared to those with 4-9 years (M=4.81±.86; M=4.31±.99, respectively), and ≥10 years of work at the current school (M=4.85±.79; M=4.30±.87, respectively). Finally, the univariate ANOVA identified significant differences in digital skills ($F_{(1, 503)}$=36.142, p<.001, η^2_p=.068) and leadership practices ($F_{(1, 503)}$=5.295, p=.022, η^2_p=.010) with respect to the role within the school. These statistically significant differences were attributed to that educational staff reported significantly lower scores in digital skills (M=4.54±.91) and leadership practices (M=4.12±1.01) compared to principals and vice-principals (M=5.05±.70; M=4.34±.91, respectively). The rest of the univariate ANOVAs and pairwise comparisons did not reach statistical significance (p>.05).

3.2. Discussion

The results of this study provide valuable insights into the complex interplay between demographic characteristics and perceptions of digital technologies and leadership practices in the context of Greek elementary schools, and especially in elementary schools of Peloponnese Region. The findings highlight that age, education level, years of teaching experience, years of work at the current school, and role within the school significantly influence these perceptions. In contrast, gender, subject specialization, and the DPE the school belongs to, did not demonstrate a statistically significant impact.

The observed differences in perceptions based on age, with older participants demonstrating a greater appreciation for digital skills, underscore the evolving nature of education in the digital age. As technology continues to advance and become more integrated into teaching and learning, experienced educators recognize the need to adapt and enhance their digital skills to remain effective. This aligns with the observations of several researchers [1]–[3], who emphasize the necessity for continuous adaptation and improvement in the face of technological advancements. Moreover, this finding also aligns with distinction between 'digital natives' and 'digital immigrants' [7], suggesting that older educators, who may have initially been hesitant to embrace technology, are now recognizing its potential to enhance teaching practices and improve student learning outcomes [8].

Additionally, the finding that teachers and principals with more years of work at the current school assign greater importance to digital skills and leadership practices further supports the idea that sustained experience within a specific educational context fosters a deeper understanding of technology's potential in education [10], [24]. This long-term presence within the same school environment further reinforces their sense of belonging and collective responsibility, making it more likely to adopt a leadership approach that emphasizes a distributed perspective, where experienced members of the school community actively contribute to decision-making, implementation of changes, and development of digital skills [9]. This approach not only leverages their deep institutional knowledge but also aligns with contemporary educational

leadership principles, which emphasize collaborative, collective, networked, and distributed leadership practices [8], [11]. These insights suggest that schools should actively encourage and support the professional development of educators with more years of work at the current school in digital technologies. By acknowledging their valuable experience and growing appreciation for digital skills and leadership practices, schools can empower these educators to become leaders in technology integration and organizational development [3], [11].

Moreover, participants with a bachelor's degree demonstrated a higher appreciation for teacher leadership compared to those with postgraduate qualifications. This result suggests the need for further investigation to understand the underlying factors influencing these perceptions. It is possible that teachers with bachelor's degrees, having had less exposure to formal leadership training, place greater emphasis on the practical aspects of teacher leadership within the classroom. In contrast, those with postgraduate qualifications, who might have received more theoretical training in leadership, could possess a broader perspective that encompasses both instructional and administrative aspects of leadership. By revealing these contrasting viewpoints, these finding challenges traditional assumptions about the relationship between educational attainment and leadership perceptions [5], [9]. It also highlights the need for a more nuanced understanding of how different educational pathways shape individuals' views on leadership.

The role within the school also significantly shaped participants' perspectives. Principals and vice-principals, who often bear greater responsibility for implementing and evaluating digital initiatives, tend to have a deeper understanding of the importance of digital skills and leadership practices in the digital age. This heightened awareness likely stems from their engagement with senior educational leaders and policymakers, as well as their involvement in professional development opportunities. Such engagement allows them to remain informed about current trends in educational policy and technological advancements [25]. While this ongoing professional learning likely contributes to their understanding of the significance of digital skills, further research is needed to explore this relationship in depth. This observation aligns with the concept of distributed leadership, which emphasizes shared leadership responsibilities across the school community [8], [9], [11]. Distributed leadership becomes even more critical in the context of digital transformation, as it requires collaboration and shared expertise to navigate the complexities of technology integration. This need for collaboration is supported by several researchers [8], [26], who highlight the effectiveness of combining distributed leadership with digital technologies.

Furthermore, the COVID-19 pandemic has underscored the importance of such collaborative, networked and distributed leadership practices, as schools rapidly adapted to remote learning and leveraged technology in unprecedented ways [11], [27]. Therefore, it is imperative that schools foster a culture of distributed leadership, where all members of the school community, regardless of their formal position, feel empowered to contribute to technology integration and innovation [9]. Embracing this approach allows schools to tap into the collective expertise of their staff, promote collaborative problem-solving, and ensure more effective and inclusive implementation of digital technologies.

The absence of significant differences based on gender, subject specialization, and DPE the school belongs to, suggests that the perceived importance of digital technologies and leadership practices transcends these demographic categories. This shared understanding across the educational landscape underscores the universality of these perceptions, emphasizing that digital technologies and leadership practices are recognized as crucial regardless of regional, gender, and subject specialization differences. This finding carries important implications for policymakers and educational leaders. It suggests that initiatives aimed at promoting digital literacy and leadership development should be inclusive and accessible to all members of the school community, irrespective of their background or individual characteristics [8], [9]. By ensuring equitable access to digital technologies and leadership opportunities, schools can foster a more equitable learning environment and empower all students to thrive in the digital age [24].

Building on the findings, it is crucial to emphasize the need for continuous professional development that accommodate the diverse demographic characteristics of every school community member [10]. By understanding how these characteristics shape perceptions and practices, educational leaders can develop the appropriate strategies to foster a culture of digital literacy and innovation within schools [4], [8]. Highlighting the specific demographic attributes that influence perceptions of digital technologies and leadership practices provides a valuable roadmap for educational leaders and policymakers to navigate the complexities of technology integration and leadership development in the 21st century [8], [11]. The findings underscore the importance of adopting a multifaceted approach that recognizes the diverse needs and experiences of educators, fosters a culture of leadership distribution, and promotes equitable access to digital technologies and learning opportunities for all [4].

In addition to tailored professional development, this study also highlights the importance of leveraging the expertise of experienced teachers in promoting digital literacy and innovation within schools. The significant differences in the perceived importance of digital skills across years of teaching experience, suggests that educators accumulate a deeper understanding of technology's potential in education as they

gain more experience. This highlights the need for professional development that addresses the specific needs and challenges faced by teachers at different career stages [10]. Creating opportunities for mentorship and knowledge sharing between experienced and novice teachers could be a valuable strategy for promoting technology integration and innovation. Additionally, fostering professional networks and collaboration, both within and across schools, can facilitate the sharing of knowledge and best practices, contributing to the collective growth and development of the involved school communities [24], [28]–[33]. Digital technologies can play a crucial role in enabling and enhancing such collaborative efforts.

As digital technologies continue to evolve and reshape the educational landscape [9], [13], it is imperative for educational leaders to adapt their practices to meet the needs of a diverse and digitally connected school community, fostering an environment where continuous learning and adaptation are valued and encouraged [8], [11]. Furthermore, the findings regarding varying perceptions based on role within the school emphasize the need for tailored professional development opportunities [3], [10]. School leaders should consider the specific needs and challenges faced by teachers, principals, and vice-principals when designing training programs and initiatives.

While this study offers valuable insights, it is important to acknowledge its scope was limited to elementary schools. Future research could broaden this perspective by including diverse educational levels–middle schools, high schools and post-secondary education institutions–across Greece and incorporating qualitative methods to gain a richer understanding of individual experiences. This could include investigating the specific mechanisms through which demographic attributes influence perceptions of digital technologies and leadership practices, as well as examining the long-term impact of these perceptions on technology integration and leadership practices, and how they may evolve over time.

Finally, this study has provided valuable insights into the complex dynamics between demographic attributes and perceptions of digital technologies and leadership practices in Greek elementary schools. The findings highlight the importance of considering these attributes when designing professional development programs, implementing leadership strategies, and fostering a culture of digital literacy and innovation. By embracing a holistic and inclusive approach, educational leaders can empower all members of the school community to navigate the complexities of the digital age and contribute to the ongoing transformation of education. This holistic and inclusive approach aligns with the Organization for Economic Cooperation and Development's (OECD) emphasis on schools as learning organizations and the importance of collaboration and organizational learning [34], [35]. Moreover, emphasizing digital innovation as a key driver of growth and development further underscores the need for schools to embrace a culture of continuous learning and adaptation, where experimentation and risk-taking are encouraged [2].

4. CONCLUSION

This study investigated the impact of demographic characteristics on the perceptions of digital technologies and leadership practices among Greek elementary school educators. The findings reveal that age, education level, years of teaching experience, years at the current school, and role within the school significantly influence these perceptions, as evaluated by the four factors of QDTLP (digital skills, leadership practices, digital age, and teacher leadership), underscoring the diverse perspectives within the educational community. The study emphasizes the need for tailored professional development programs that cater to the specific needs of educators at different career stages and roles, promoting continuous learning and adaptation in the face of evolving digital technologies. The significant differences in the perceived importance of digital skills across years of teaching experience, highlights the value of leveraging the expertise of experienced teachers in promoting digital literacy and innovation within schools. By understanding and addressing the nuanced relationship between demographic characteristics and perceptions of digital technologies and leadership practices, educational leaders can foster a culture of digital literacy, innovation, and shared responsibility. This approach will not only empower teachers and school principals to navigate the challenges of the digital age but also create a more inclusive and supportive learning environment for students, ultimately preparing them to thrive in an increasingly digital world. Ultimately, this study demonstrates the importance of recognizing the diverse needs and perspectives within the school community when implementing digital technologies and promoting effective leadership practices. These findings contribute valuable insights to the ongoing efforts to integrate digital technologies and promote innovative leadership practices within the Greek educational system.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author [AK], upon reasonable request.

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