European Journal of Education and Pedagogy
Vol 6 | Issue 2 | March 2025
ISSN 2736-4534

RESEARCH ARTICLE

Distributed Leadership, New Technologies and Teachers' Digital Competence in the Post-COVID Era

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ABSTRACT

The impact of new technologies on the educational context and more specifically on the microcosm of a school is a setting in the post-COVID-19 era. This study investigates the impact of new technologies on school leadership practices and the degree of development of teachers' digital skills by studying new trends in the contemporary school setting. The approach is organized on two central themes: (a) Distributed leadership and collaborative school leadership practices in the post-COVID-19 era and (b) digital investment in school organizations and digital teacher training. This is a quantitative study with a sample of 323 teachers and data were collected using an original online questionnaire constructed for the need of this study. The results of the study indicate a shift in school leadership practices towards more collaborative models and the existence of a digital strategy in the current educational setting, although digital investment is moderately implemented in schools. Also, teachers' digital skills appear to be well developed, but continuous training is seen as increasingly imperative, since shortcomings are still identified in the modern school setting.

Keywords: Digital skills, digital training, distributed leadership, new technologies.

Submitted: December 10, 2024

Published: March 15, 2025

10.24018/ejedu.2025.6.2.904

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1. Introduction

It is accurate to conclude that the challenge of digital transformation in education had already emerged several years prior to the advent of the coronavirus pandemic. However, the health crisis accelerated the process since it became essential that all members of an educational organization are able to collaborate and connect using new technologies (Norton *et al.*, 2020). The implementation of new technologies in the educational setting has been shown to facilitate innovation, while the very nature of these technologies serves as a primary means of establishing competitive advantages (Begicevic Redep *et al.*, 2020). The European Union is committed to the advancement of a European digital education system and the cultivation of citizens' competencies and skills for the digital transition. These are essential elements for ensuring that every individual has equal opportunities to achieve their goals, secure employment, and engage as active citizens.

The integration of new technologies into the educational context, particularly within a school, has consistently represented a significant challenge for school leaders (Raptis, 2022). Even prior to the advent of the pandemic, school leaders were tasked with a number of responsibilities and roles, primarily aimed at promoting and effectively utilizing new technologies (Raptis, 2023). Moreover, for several years, new technologies have been utilized in the administration of educational organizations as a valuable tool for administrative support (Seyal, 2012).

Furthermore, unified fourth-generation communications and emerging technologies, including shared workspaces, interactive videos, web conferencing, virtual worlds, artificial intelligence, the Internet of Things, 5G network speeds, and the full range of digital activities (virtual, augmented, and blended), underscores the imperative need for the digital transformation of schools, the investment in digital services within educational organizations, and the enhancement of teachers' digital competencies in the post-COVID-19 era.

The principal aim of this study is to investigate the impact of emerging technologies on school leadership practices and the extent to which teachers have acquired sufficient digital skills in the post-COVID-19 era. The study is structured around two sub-themes, which are as follows: (a) distributed leadership and collaborative school leadership practices in the post-COVID-19 era and (b) investment in digital services within schools, along with teacher training in digital tools. The following sections present a concise review of the existing literature oriented to the two above mentioned axes. Additionally, the research method is presented, followed by the findings, the discussion and suggestions for further research.

2. Literature Review

As society becomes increasingly dependent on technological innovations, it is imperative for school leaders to leverage the power of new technologies in order to foster a meaningful, inspiring, and engaging digital culture (Sheninger & Murray, 2017). In their study, Raptis *et al*. (2024) investigated the role of school leadership in the digital development of educational organisations. Their findings indicated that, in the post-COVID-19 era, school principals have incorporated new technologies both into their leadership practices and into their communication approaches with all parties involved.

Specifically, school leaders may not perceive themselves differently in the post-COVID-19 era, yet their behaviour and leadership practices have undergone a significant and potentially irreversible transformation (Harris & Jones, 2020). As Azorín (2020) specifically states, school leadership is evolving towards a collaborative and network-building pedagogical approach, exemplified by models of collaborative leadership, distributed leadership and teacher-based leadership. For educational organizations to resume their pre-crisis operational status, school leaders must acknowledge that new technologies have influenced teaching, learning and leadership school practices (Hargreaves, 2020).

In the context of challenging and crisis-related circumstances, it has been proposed that school leaders should endeavour to cultivate and sustain a culture of collaboration and participatory decision-making, which entails the utilisation of interconnected networks among individuals (Hooge & Pont, 2020). School leaders exert influence over all involved members and demonstrate leadership through a variety of platforms, including tele-conferencing, web fora, and networks. Consequently, this network-based practice, which has become a necessity in the context of a complex and changing environment, has become a prevalent and wide spread leadership practice. It can be described as a distributed, collaborative and participatory leadership approach (Harris & Jones, 2020). In practice, distributed leadership signifies a transition away from the conventional, formal leadership structures and roles, towards a more decentralised and network-based leadership culture (Harris, 2011, 2013, 2020). In particular, distributed leadership focuses on the interactions of the leaders, both within and outside the organisation, rather than their actions. This reflects the new setting that has emerged since the onset of the coronavirus pandemic for those who practice leadership (Denee & Thornton, 2021). Furthermore, as Azorín (2020) proposes, distributed leadership is founded upon the development of new skills rather than the exertion of central control by the leader. This concept relies on the mobilisation of members of an organisation to assume leadership roles through collective commitment and action. In essence, distributed leadership entails a shift in focus from the actions of individual leaders to shared activities and practices (Azorín, 2020). Three prospective developments have been identified with regard to the future of education and educational leadership in the post-COVID-19 era.

- Initially, Harris (2020) and Netolicky (2020) posit that one trend calls for a return to normality and the "old" model of operation, as it was experienced before the pandemic. This involves upgrading the educational practices employed during the current crisis back to the previous normality.
- Conversely, there is a public discourse surrounding the concept of establishing a "new normal," which entails a re-calibration and re-orientation of the existing models in order that they become aligned with the demands and urgent needs of potential crises.
- In conclusion, as Harris (2020) asserts, the majority of school leaders are situated between the two aforementioned trends, thereby introducing a novel perspective.

Furthermore, as Harris proposes in her study (2020), the necessity at this juncture is a model that incorporates the most efficacious elements of distance education and face-to-face learning, thus a new, hybrid model. In particular, this new hybrid model should be digitally oriented, empowering and creating connections with digital learning for both students and teachers, and, through this, accelerating the digital transformation of schools (Harris, 2020).

As Psifidou *et al*. (2020) have observed, the challenges faced by teachers in implementing distance education can be attributed to a number of factors, including deficiencies in basic digital skills and competencies, difficulties in effectively utilising e-education platforms, limited access to digital equipment and internet connectivity, concerns about data privacy and copyright, as well as a lack of experience in digital material production and effective pedagogical practices in distance education. Consequently, the current pandemic has served to accentuate the digital chasm, the deficit of digital competencies among teachers, and the insufficient technological infrastructure of educational institutions.

In the echo of the post pandemic era, it is imperative to underscore the vital necessity of systematic digital investment in teachers, students, and parents (Suphakicco, 2022). It is also imperative that teachers develop the necessary digital skills for constructively utilising new technologies in order to create an engaging learning environment for all participants, and to provide quality education. The effective digital literacy of the teaching staff, combined with concerted efforts to strengthen and

update the technological equipment of each school, represents a key aspect for the digital empowerment of schools in times of crisis.

Furthermore, the European Action Plan for the years 2021 to 2027 (Binder, 2023) sets out a long-term strategic vision by promoting the development of a high-performance digital training ecosystem and strengthening digital skills and competences for digital transformation. The purpose of this policy is to promote excellence in preparing educational staff to work with digital environments (e.g., virtual setting, artificial intelligence, emerging technologies, etc.) combined with the use of digital developments in teaching, learning and assessment processes.

A recent World Economic Forum report (Sart & Yildiz, 2022) indicates that approximately half of the workforce will be required to enhance their skills by 2025, a period during which the technology sector is anticipated to experience a significant expansion. It can be therefore extrapolated that work automation will result in the abolition of over 80 million job positions, simultaneously with the creation of nearly 100 million new ones, compatible with the ever evolving landscape. Consequently, there will be a heightened necessity for proficiency in digital skills and updated training in approximately half of the basic skills that is expected from an employee to evolve, in addition to the cultivation of management of individual skills, such as stress management, resilience, adaptability, and active learning.

3. Method

The present study employs a qualitative methodology to investigate, analyse and interpret the statements of primary education teachers in the Larissa prefecture (Greece) regarding the impact of new technologies on school leadership practices and the extent of teachers' digital skills. The aforementioned main objective is examined and analysed with reference to two principal thematic axes:

1. Digital leadership and collaborative school leadership practices in the post-COVID-19 era,
2. Digital investment in school organisations and teachers' digital training.

The research objectives also constitute the primary research questions, which are the following:

a) To what extent are collaborative school leadership practices being implemented in contemporary educational institutions in the post-COVID-19 era?
b) What are the teachers' perspectives on the extent of digital investment in contemporary educational institutions?
c) What is the extent of teachers' digital training?
d) Is there a difference among teachers' perspectives on collaborative school leadership practices, the level of digital investment in schools, and the level of their digital training, based on their employment status?
e) Is there a difference among teachers' perspectives on the level of their digital training, based on the number of working years?

For this study, the questionnaire was used as a data collection tool. This research questionnaire consists of an introduction and two distinct parts. In the introduction, the main purpose of the research is clearly stated and privacy is emphasized. At the end of the introduction, the names of the researchers and their gratitude to the participant(s) are expressed.

The first part of the questionnaire contains six demographic variables and the second and main part contains 26 items in direct correspondence with the research objectives, and answerable with a five-point Likert scale.

The sample of the study consisted of Primary Education teachers of the prefecture of Larissa (Greece), a population accessible to the researchers. Thus, this was a non-probability sampling or convenience sampling (Babbie, 2018; Bryman, 2017). The research instrument was originally developed based on the relevant literature review, uploaded to Google Forms and distributed through the school principals to the participants' email addresses. There were 323 teachers who responded. Table I shows the composition of the sample according to the demographic variables.

Of the 323 teachers sampled in this study, 95 are male (29.4%) and 228 are female (70.6%). Also, the distribution of the sample teachers by age groups revealed that 24 teachers (or 7.4%) belong to the group up to 29 years old, 140 teachers (or 43.3%) to the group from 30 to 39 years old, 53 teachers (or 16.4%) to the group from 40 to 49 years old and finally 106 teachers (or 32.8%) to the age group of 50 years old and above. The median age of the sampled teachers was 39.8 years.

Observation of the structure of the sample by level of studies revealed that 173 teachers (53.6%) have a master's degree as their higher degree, 133 teachers (41.2%) have a bachelor's degree in higher education, 12 teachers (3.7%) have a second bachelor's degree and 5 teachers (1.5%) have a Ph.D. In addition, of the total 323 respective principals of the schools where the teachers in the study sample serve, 166 (or 51.4%) were male, while 157 (48.6%) were female.

When asked about their employment status, 249 teachers in the sample (77.1%) responded that they were permanent, while the remaining 74 teachers (22.9%) responded that they were substitute teachers. Finally, from the observation of the structure of the sample by groups of working years as teachers, it was found that 66 teachers (0.4%) had up to 5 years of service, 54 teachers (6.7%) had 6 to 10 years of service, 70 teachers (21.7%) had 11 to 15 years of service, 34 teachers (10.5%) had 16 to 20 years of service and finally 99 teachers (30.7%) had 21 years of service and above. The median number of years of service of the sample teachers was 14 years.

3.1. Reliability and Validity of the Questionnaire and the Test of the Assumption of Normality

Initially, Cronbach's Alpha reliability test was conducted for the factors of collaborative school leadership practices in the post-COVID-19 era, digital investment in contemporary schools and teachers' digital training. For all above factors, the Cronbach's Alpha reliability test values were above 0.700 (Table II) revealing a high degree of reliability.

TABLE I: Descriptive Statistics of the Sample

Demographic variables		N	%
Gender	Male	95	29.4
	Female	228	70.6
Age group	<29 years old	24	7.4
	30–39	140	43.3
	40–49	53	16.4
	>50	106	32.8
Level of studies	Bachelor	133	41.2
	Second bachelor	12	3.7
	Master	173	53.6
	Ph.D	5	1.5
School Principal's gender	Male	166	51.4
	Female	157	48.6
Working status	Permanent	249	77.1
	Substitute	74	22.9
Working years	<5 years	66	20.4
	6–10	54	16.7
	11–15	70	21.7
	16–20	34	10.5
	>21	99	30.7

TABLE II: Reliability Test Results

Factors	Cronbach's alpha
School leadership collaborative practices	0.833
Digital investment in schools	0.811
Teachers' digital training	0.878

Then, the normality of the factors under consideration was tested using the Kolmogorov-Smirnov test of normality due to the big sample size (sample size >50). The normality test indicated that factors did not follow a normal distribution, since the result was statistically significant ($p < 0.05$). For this reason, the non-parametric Mann-Whitney test for independent samples was used for factors with two subgroups. To investigate possible differences between subgroups of demographic variables with three or more subcategories (e.g., years of service), the non-parametric Kruskal-Wallis test for independent samples was used. This test determined whether these subgroups had statistically significant differences between them.

4. Results

4.1. Collaborative Leadership Practices

In order to address the initial research question, the mean values of the four items that was measuring the collaborative practices of school leadership were examined. As illustrated in Fig. 1, it was determined that the mean values for all four items were above the middle point of the scale, which is 3. Specifically, the highest mean value (M = 4.27) was observed in the item, "The principal involves you in the decision-making process at faculty meetings." The second-highest mean value (M = 4.15) corresponded to the item, "The principal encourages the taking of initiatives by members of the teaching staff in the process of solving problems." The mean value that ranked third (M = 4.01), corresponded to the item, "There is a tendency for actions to be promoted by the principal of your school in cooperation with the teaching staff." The mean value that ranked last (M = 3.57) corresponds to the item, "the principal works with you to develop the school's digital strategy."

4.2. Digital Investment

For the second research question, the mean values of the four items referring to the degree of digital investment in schools were examined. As illustrated in Fig. 2, it was found that in two of the four items the mean values were above the middle point of the scale (which is 3), while for the other two items the mean was below the middle point of the scale. More specifically, it was found that the highest mean (M = 3.33) was found for the responses to the item, "The principal encourages you to participate in training programs for digital training." The second highest mean (M = 3.03) refers to the item, "There are digital devices available in your school that students can use." The third mean in a descending order (M = 2.53) refers to the item, "Your school participates in European and national programs that allow networking with other schools using New Technologies (Erasmus+, eTwinning, etc.)." Finally, the last ranked means (M = 2.08), refers to the item, "There are portable devices available in your school, which students can borrow for home use."

4.3. Digital Training

For the third research question, the mean values of the six items referring to the digital training of teachers were examined. As shown in Fig. 3, it was found that in all six items the mean values were above the middle point of the scale. The highest mean value (M = 4.17) referred to the item, "To what extent do you use digital media daily for your communication?" The second highest mean (M = 3.83) corresponds to the item, "To what extent do you have the ability to filter the data you search on line?" while the third best mean (M = 3.68) corresponds to the item, "To what extent do you look for opportunities to improve any weakness in your digital skills?" The item with the

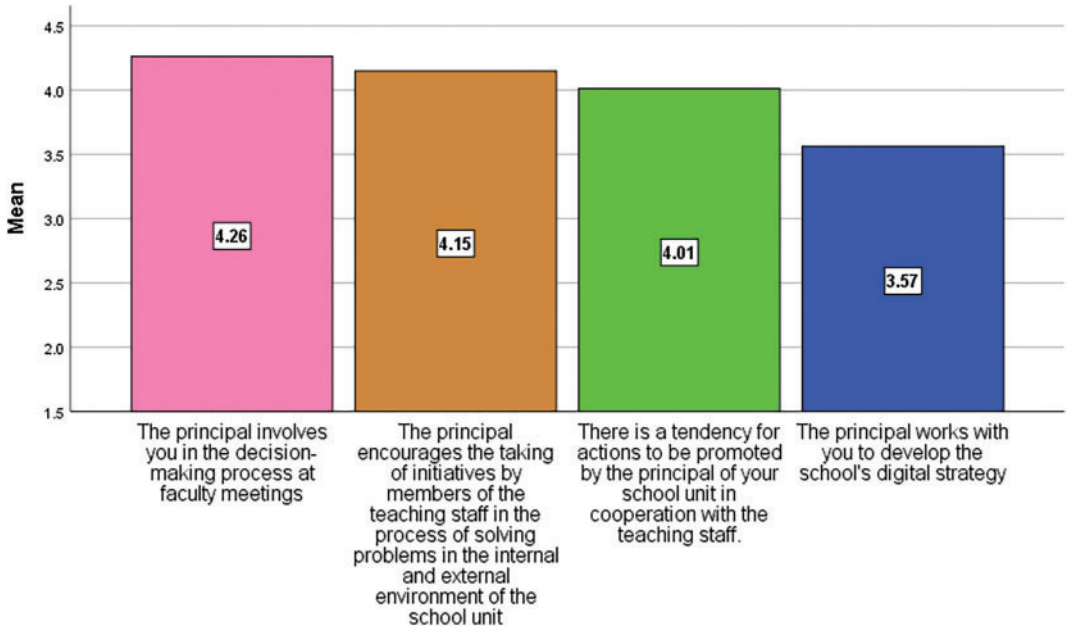

Fig. 1. Mean values of the items regarding school leadership collaborative practices.

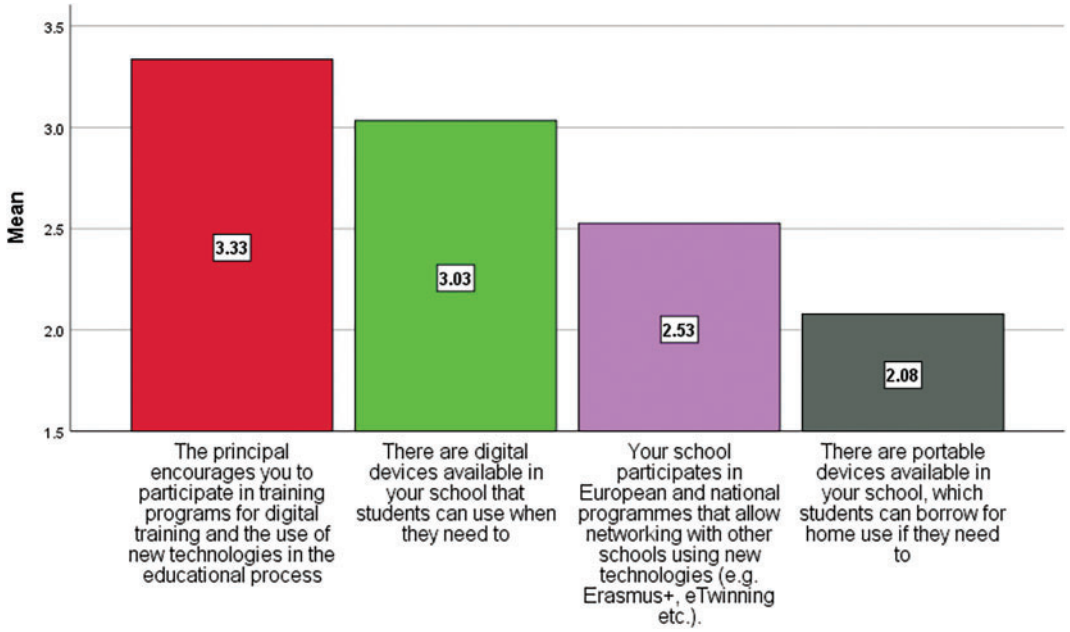

Fig. 2. Mean values of the items regarding the digital investment in schools.

next best mean (M = 3.65) was: "To what extent do you have the ability to create digital materials for your students in various formats (video, image, audio, text, etc.)?" The items with the lowest means correspond to the items, "To what extent do you provide protection for your digital devices?" and "To what extent do you have the ability to understand and solve a technical problem on your device?" In the last question, the mean value is approximately equal to the middle point of the scale.

4.4. Employment Status

For the fourth research question, it was examined whether collaborative leadership practices, digital investment in schools and teachers' digital training produced statistically significant differences based on the teachers' employment status (permanent/substitute).

The corresponding research hypotheses follow:

- Research Hypothesis H0: There is no statistically significant difference between the teachers based on their working status regarding their beliefs on collaborative leadership practices, digital investment in schools and teachers' digital training.
- Research Hypothesis H1 (alternative): There is a statistically significant difference between the teachers based on their working status regarding their beliefs on collaborative leadership practices, digital investment in schools and teachers digital training.

The non-parametric Mann-Whitney test was used to determine whether there are statistically significant differences, as shown in Table III.

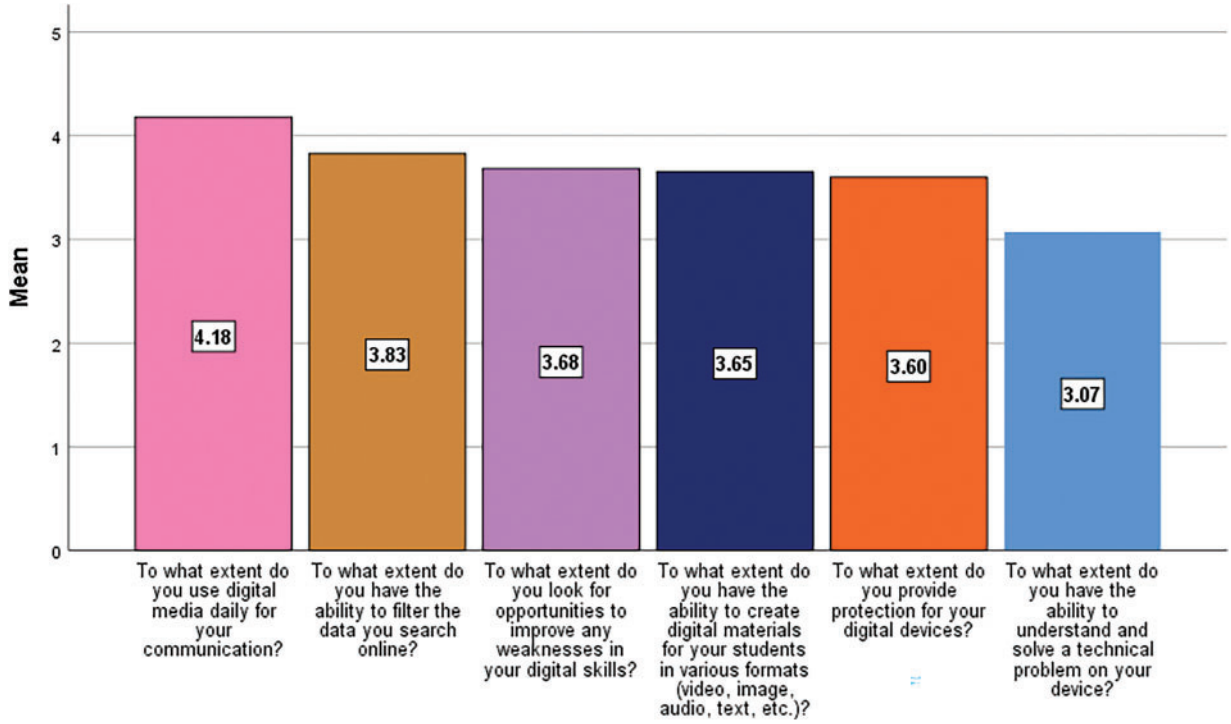

Fig. 3. Mean values of the items regarding teachers' digital training.

TABLE III: Differences Based on Teachers' Working Status

Variables	Permanent teachers (n = 249)		Substitute teachers (n = 74)		U	p
	Median (I.R)		Median (I.R)			
Collaborative leadership practices	4.00	(1.00)	4.00	(1.50)	7032.500	0.002
Digital investment in schools	2.75	(1.00)	2.50	(1.00)	7967.000	0.076
Teachers digital training	3.67	(1.00)	4.00	(.83)	7192.000	0.004

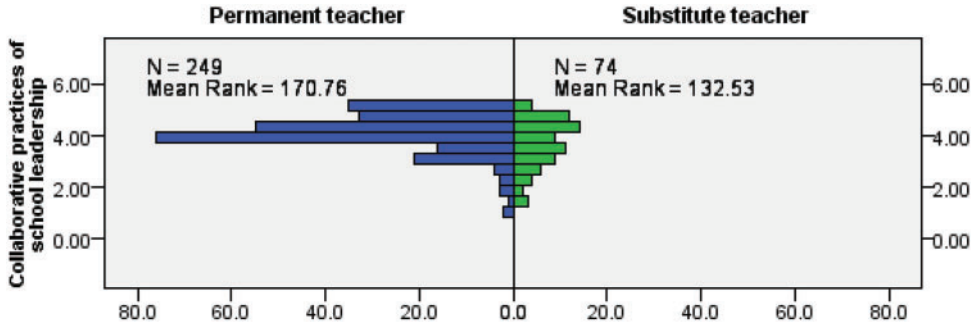

Fig. 4. Teachers' views on collaborative leadership practices based on their working status.

4.5. *Collaborative Leadership Practices*

According to the data in Table III and Fig. 4, permanent teachers (Md = 4.00) appear to have significantly higher values than substitute teachers (Md = 4.00), U = 7032.50, p = 0.002, with effect size, r = −0.17, as far as views on collaborative leadership practices are concerned.

4.6. *Degree of Digital Investment*

As can be seen from Table III, the permanent teachers of the sample (Mn = 2.75) do not have significant different values compared to their substitute colleagues (Mn = 2.50), U = 7967.00, p = 0.076, with effect size, r = −0.10, as far as views on digital investment are concerned.

4.7. *Teachers' Digital Training*

According to the data in Table III and Fig. 5, permanent teachers (Mn = 3.67) have significant lower means compared to their substitute colleagues (Mn = 4.00), U = 7192.00, p = 0.004 with effect size, r = −0.16, as far as views on digital training are concerned.

4.8. *Years of Service*

For the fifth research question, it was examined whether teachers presented significant differences on their views regarding their digital training based on years of service. The following are the research hypotheses:

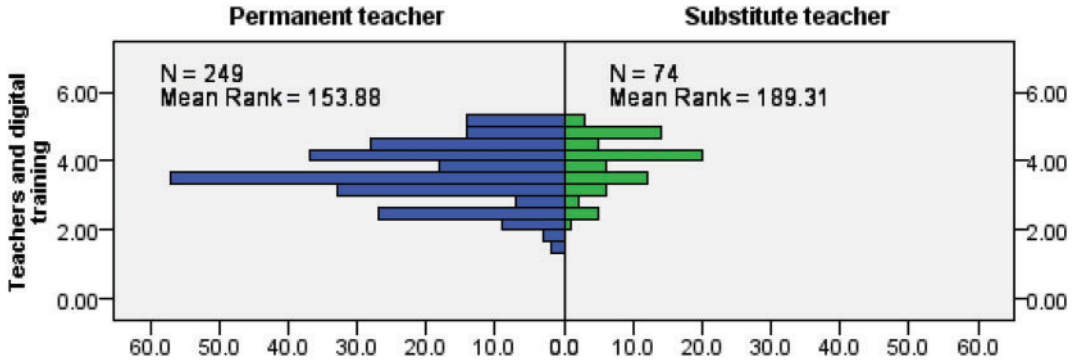

Fig. 5. Teachers' perceptions on their digital training based on their work status.

TABLE IV: Teachers' Digital Training Based on their Years of Service

Variables	<5 years		6–10 years		11–15 years		16–20 years		>21 years		U	p
Teachers' digital training	(n = 66)		(n = 54)		(n = 70)		(n = 34)		(n = 99)			
	Median	(I.R.)	Median	(I.R.)	Median	(I.R.)	Median	(I.R.)	Median	(I.R.)		
	3.92*	(0.66)	3.75*	(0.84)	3.92*	(1.17)	3.83*	(1.00)	3.17*	(1.16)	36.090	<0.001

Note: I.R. = interquartile range; *p < 0.001.

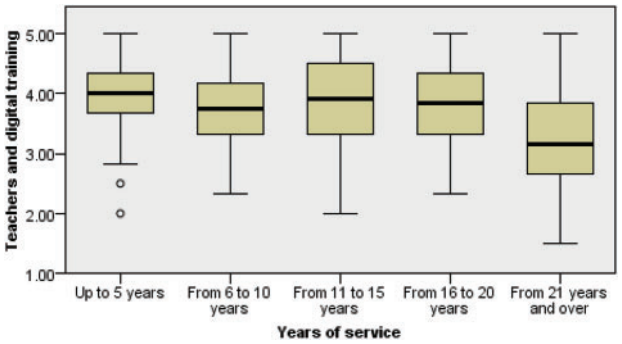

Fig. 6. Teachers' perceptions on their digital skills based on their years of service.

- Research Hypothesis H0: There is no statistically significant difference between the subgroups of teachers regarding their digital training and based on their years of service.
- Research Hypothesis H1 (alternative): There is a statistically significant difference between the subgroups of teachers regarding their digital training and based on their years of service.

For testing the above hypotheses, the non-parametric Kruskal-Wallis test was used.

4.9. Digital Teacher Training

According to the data in Table IV and Fig. 6, there was a statistically significant difference among subgroups based on years of service as far as digital training is concerned (U = 36.090, p < 0.001). The posthoc test found that teachers who had 21 years of experience and above had statistically significantly lower median values (Md = 3.17, n = 99) compared to all other subgroups. More specifically, compared with the subgroups:

– Up to 5years of service (Md = 3.92, n = 66), p < 0.001, r = −0.40.
– From 6 to 10 years of service (Md = 3.75, n = 54), p = 0.007, r = −0.27.
– From 11 to 15 years of service (Md = 3.92, n = 70), p < 0.001, r = −0.36.
– From 16 to 20 years of service (Md = 3.83, n = 34), p = 0.012, r = −0.28.

5. Discussion and Conclusion

The findings related to the first research question confirm the research of Harris (2020), Netolicky (2020), and Harris and Jones (2020), regarding the change in school leadership practices in the post-COVID-19 era and the shift towards more collaborative, network based and flexible leadership models. Also in our study, collaborative leadership practices were found to be applied to a big extent in contemporary schools since in all items the mean of teachers' relevant perceptions was above the middle point of the scale. The tendency for collaboration by principals is a growing reality after the current health and economic crisis. New hybrid models of leadership practice oriented towards digital technology have come to the fore in the post-COVID-19 era, combining the most effective elements of distance and face-to-face education. Undoubtedly, the shift in school leadership practices towards more collaborative models can also been attributed to the distributed leadership model, which has been implemented to a certain degree by school leaders and has been defined by various scholars as a positive sign of change (Chaudhary *et al.*, 2020). Besides, as Tam (2019) emphasizes in her research, one of the key dimensions of distributed leadership is the development of collaborative skills and team culture and its replication through vision and shared purpose to all members of a school.

Regarding the second research question, teachers stated that the degree of digital investment in schools is not high, since in three of the four relevant items, the mean values are equal to or lower than the middle point of the scale. Specifically, only the item, "The principal encourages you to participate in training programs for digital training"

has a mean slightly above the middle point of the scale. Also this item refers to the principal and not to school infrastructure, equipment, etc. As typically highlighted in Suphakicco's (2022) study, what needs to be strengthened in the educational field after the covid-19 pandemic is the need to increase investment in teachers', students' and parents' digital skills in a systematic way, along with the simultaneous strengthening of educational institutions with efficient and updated technological infrastructure and services.

The findings related to the third research question showed that teachers perceive their own digital skills as above average to very good. It appears that teachers have developed their digital skills to a fairly good level and are largely familiar with the use of New Technologies, both as communication and teaching tools. However, there is still a lot of room for improvement and further development. After all, following the unexpected disruption of schools due to the covid pandemic, the Council of the European Union decided to emphasize and support the development of educational digital services in EU (Psifidou & Grm, 2022). Moreover, New Technologies' implementation in teaching can act as an effective force, which constantly motivates and inspires teachers to make new efforts to further improve their digital skills.

Regarding the fourth research question, it was found that there are statistically significant differences regarding teachers' perceptions on collaborative leadership practices and digital training, based on teachers' employment status (permanent, substitute). On the contrary, regarding teachers' perceptions on digital investment in school, no statistically significant differences were found. More specifically, permanent teachers evaluated collaborative leadership practices more positively than substitute teachers. On the other hand, regarding digital training, substitute teachers were found to evaluate themselves more positively than permanent teachers.

Last, in relation with the fifth research question it was found that years of service significantly differentiated teachers regarding their self reported digital skills. More specifically, teachers belonging to the subgroup of 21 years of service and above were found to declare significantly lower digital skills compared to all other sub groups. This indicates that teachers with more years of service have a lower familiarization with digital skills and therefore they are the group which should be prioritized for focused strengthening and updating of digital dexterities.

Finally, some suggestions for further research on this topic are made:

- To carry out a similar study with a representative sample of secondary school teachers.
- To carry out a comparative study comparing the perceptions of primary and secondary education teachers.
- To carry out a similar study measuring the perceptions of primary and secondary education school principals in order to identify possible differences among them.
- To carry out a similar study measuring the perceptions of teachers and school principals in order to identify possible differences among them.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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