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Research Article

Teachers' digital competence in the post COVID-19 era: The effects of digital nativeness, and digital leadership capital

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ABSTRACT

The COVID-19 pandemic, which posed challenges for accommodating student learning, also opened avenues for using digital resources in online learning. However, differences were observed in their use, effectiveness, and intensity across developed and least developed societies. This is referred to as "digital inequalities," caused by factors such as insufficient organizational-level support and teachers' digital competence (DC). This study was conducted to determine teachers' DC and reveal if their DC was explained by their digital nativeness and principals' digital instructional leadership capital. The study used a quantitative research method, whereby data were collected from 393 teachers. The researchers used SmartPLS 4 and SPSS 24 to analyze data. The findings complement the available literature and help pave ways to promote the integration of digital resources in teaching and learning.

Keywords: digital nativeness, digital competence, digital inclusion, digital instructional leadership, COVID-19 pandemic, teacher

INTRODUCTION

When it comes to student engagement in the learning process, the COVID-19 pandemic significantly raised the bar of uncertainty. Consequently, schools were pushed to integrate online teaching and learning simultaneously with face-to-face options. The integration of online teaching and learning needs digital savvy teachers (Sharpe et al., 2022). Jogezai et al. (2021) rightly suggest that schools help teachers build their capacity for digitizing learning to avoid students' exclusion from learning in an environment of uncertainties, where COVID-19 may further prevail or a new form of such lethal viruses may emerge (De Giusti, 2020; ECLAC-UNESCO, 2020).

The COVID-19 pandemic, declared on March 11, 2020, by the World Health Organization (Cucinotta & Vanelli, 2020), pushed teachers to be more vigilant and effective than ever while integrating digital resources into teaching and learning (OECD, 2020). As a result, there has been a digital transformation (Iivari et al., 2020; OECD, 2020), which has challenged teachers' digital competence (DC) (Cook et al., 2023), as frontline implementers (Jenkins, 2020). Research highlights a mix of responses from teachers during the pandemic. The results in developed and developing countries reveal successes and failures integral to teachers'

innovative DC to transform teaching and learning (Adnan & Anwar, 2020; Jogezai et al., 2021; Sangwan et al., 2021). Both success and failure exist at the structural, external, and internal levels. The external-level factors included the available support in the form of policies, infrastructure, the Internet connectivity, and a supportive school environment (Ismail et al., 2020), while their absence caused a failure to respond to the digitization of teaching and learning. Teachers' self-efficacy and their attitudes towards and interest in integrating digital tools in teaching and learning (Jogezai et al., 2021; Sangwan et al., 2021), as examples of internal-level factors, remained integral to their effective engagement in online learning. Teachers' DC was a key factor in international educational policies before the pandemic and will become even more prominent in its aftermath.

Teachers' belief in their capabilities to respond to online learning or their DC (Chen et al., 2021; Mannila et al., 2018) related to the digitization of learning remains a key determinant in making online learning successful (Quaicoe & Pata, 2020; Zhang et al., 2016) in the post-pandemic era. Teachers' DC depends on several key influences involving environmental, personal, behavioral, and contextual factors (Bandura, 2006). Similarly, the demographic and age differences (Borg & Smith, 2018; Khairani, 2017; Wang, 2013) have added to differences in DC between urban and rural (Khairani, 2017; Wang, 2013) and young and old. Prensky (2001) perceives these young ones as 'digital natives' (DN), as they have grown up with the technology. Self-efficacy beliefs in online teaching require both prior personal experience and institutional support (Gobel et al., 2023). School principals' leadership role in creating supportive environments for teachers is paramount (Liu & Hallinger, 2018) when they perform as digital instructional leaders (Berkovich & Hassan, 2022). This study remains unique in exploring teachers' DC in integrating digital resources in teaching and learning by explaining the predictability of their DN and principals' digital instructional leadership (DIL).

LITERATURE REVIEW

Teachers' Digital Competence

To be effective in using digital resources in instruction, teachers need to believe in their competency in the instructional use of digital resources. Such competence has been differently connoted in the literature such as DC (Calvani et al., 2012). There are other terms that have been synonymously used, such as information and communication technology (ICT) literacy (Ainley et al., 2008), digital literacy (Erstad, 2006; Eshet-Alkalay, 2004), media literacy (Erstad, 2010), and digital skills (Zhong, 2011). DC is defined by Zhao et al. (2021) as a set of abilities necessary for participation in a particular setting or environment. DC, therefore, remains broader when considering the kinds of skills, understandings, and critical reflections of teachers (Hatlevik & Christophersen, 2013), and it also relates to one's capability to be innovative. This nexus of competency and innovativeness makes it more relevant in the context of rapid digital transformation (Scull et al., 2020) as it requires teachers to be more novel and unconventional in their responses. The uncertainties caused by the recent COVID-19 pandemic and its sustained effects (Steen & Brandsen, 2020) really require one to be innovative and possess the potential to be imaginative and predictive to make teaching and learning more effective (Xie, 2022).

According to Marusic and Viskovic (2018), DC mirrors one's capability of using technologies in a critical, collaborative, and creative manner; additionally, a person must possess the requisite knowledge, skills, and dispositions to be viewed as competent in a domain. Therefore, the DC of teachers continues to be fundamental to effective digital integration. Teachers' DC as frontline implementers (Jenkins, 2020) is vital in the post-COVID-19 crisis and similar circumstances (Tzafilkou et al., 2022) to possess critical thinking, problem-solving, and communication abilities (Saavedra & Opfer, 2012). The DigComp initiative identifies five areas of DC: information and data literacy, communication and cooperation, digital content production, safety, and problem solving (Carretero et al., 2017).

DC is described differently in the most recent and extensive research reviews. For example, Ilomäki et al. (2016) consider it a skill and knowledge that a citizen needs to take part in and contributes to a digitalized knowledge society. Pettersson (2017) says that teachers' digital content is not just a duty that each individual teacher is responsible for but should also be considered a component of the organization's digitization

process. Because of the nexus of the organizational digitization process, DC must be viewed from both the organizational and individual levels.

The literature suggests that there are several factors that may influence teachers' DC. These include their willingness and ability to learn (Papp, 1998), their perception of the ease of use of digital tools (Nair & Das, 2012), their attitudes towards technology (Jogezai et al., 2021), their beliefs and the organizational environment in which they operate (Chen et al., 2021), as well as their access to professional development programs and ICT resources (Ismail et al., 2020). Literature has classified these factors into two primary categories. These comprise the external and internal-level factors (Cattaneo et al., 2021). The external-level factors comprise the available ICT infrastructure at schools, teachers' professional development, and school management support (Ismail et al., 2020). The internal-level factors include teachers' attitudes, beliefs, job satisfaction (Chen et al., 2021), and their concerns (Jogezai et al., 2022).

The available research highly considers the effects of both internal and external factors, with the former playing a more critical role in influencing teachers' competence in the digitization of learning. For instance, the presence of these factors with a cascade effect and upfront has resulted in learners' hesitancy to participate in online learning. A slow response time from the teachers (Adnan & Anwar, 2020), and the lack of a supportive learning environment (Alberta Teachers' Association, 2020) were all integral to students' nonparticipation in online learning. This very issue existed despite teachers and students having access to ICT infrastructure. It reflects the lack of teachers' DC, which hinders the effective use of digital resources in online learning despite their availability.

As an internal-level factor, the social environment shapes value patterns and attitudes (Gardner et al., 1993). Gender differences, as a social construct, also account for differences in the attitude of teachers (Lateef & Alaba, 2013). Similarly, different authors have found that young teachers demonstrate higher levels of competence than their older colleagues (Cattaneo et al., 2021; Fraillon et al., 2014). Mentoring and DIL (Berkovich & Hassan, 2022) play a key role in creating supportive environments as they enable teachers to remain committed and help in both the structural and personal dimensions of DC. It is quite clear that even with the presence of external factors, the absence of internal factors such as teachers' DC or efficacy remains central to teachers' integration of digital resources in teaching and learning. Principals' role in making the conditions supportive for effective ICT integration depends on unleashing these issues (Yang Hansen et al., 2020) and enabling teachers to integrate digital technology in a meaningful way (Mariën & Prodnik, 2014). Principals' leadership has played a phenomenal role in this regard (Ismail et al., 2020), as it can influence both structural and personal-level factors towards teachers' DC because leadership has the potential to create an enabling environment for teachers. Cattaneo et al. (2021) state that DC is not a phenomenon that stands apart from its context. The context may include urban and rural divisions explaining access and attitudes towards technology (Borg & Smith, 2018; Khairani, 2017; Wang, 2013). According to Olofsson et al. (2020), adequate DC requires an exemplary digital organizational practices, and such practices could be characterized by adequate technological infrastructure, teachers with a high level of technological-pedagogical knowledge, ongoing professional development, and well-functioning technology-mediated communication and leadership. Both external and internal factors remain integral to school context and can either support or hinder the DC of teachers. Cattaneo et al. (2021) recommend an objective assessment of the school context in this regard.

Teachers' Digital Nativeness

The rapid development of digital technologies, according to Huang et al. (2021), has influenced education equally as other sectors and has consequences for teachers who adopt those digital technologies in teaching and learning. Prensky (2001) referred to DN as those who have grown up in the technology age and digital immigrants (DI) as those who have grown up in the technology age, but are not initially well-prepared to integrate technology into teaching. In a learning situation, as Oblinger and Oblinger (2005) argued, natives are active, experiential learners, proficient in multi-tasking, and dependent on communications technologies (e.g., the Internet) for accessing information and interacting with others.

Teachers in developing countries have fewer experiences with digital capital as a result of little or no interaction with digital tools. They are found to have issues with access to digital resources and lack the capacity of using them in their instructions in the absence of school-level support (Ismail et al., 2020). So,

teachers could be identified as DI (Prensky, 2001). Huang et al. (2021) indicate that in educational settings, where technology is widely used for various purposes, veteran teachers exhibit distinct traits of digital nativity that are akin to those of DN teachers. This may be true in high-income and developed countries, but there is no empirical evidence in developing countries.

A recent literature review by Chadwick et al. (2022) informs us that individuals who possessed previous familiarity with digital tools were found to have an advantageous position in adapting to the swift transition to online platforms. It would be viable to investigate the relationship between teachers' DN, as frequent users of digital resources, and their DC. DN have been raised in a technological milieu that has influenced their cognitive processes, behavioral patterns, and actions. As a result, Gu et al. (2013) asserted that the nature of technology usage and acceptance differ significantly between DN and DI. In this regard, Hürsen (2012) also found that young teachers with less teaching experience remained more positive about the digitization of learning. We believe that the difference between technology usage and acceptance among the DN, the young teachers, and the DI may influence their digital capital. The researchers have hypothesized following:

H1. Teachers' digital nativeness has a significant influence on their DC.

Digital Instructional Leadership

The role of the organizational environment (Chen et al., 2021) and leadership support from principals (Ismail et al., 2020; Jogezai et al., 2021; Yang Hansen et al., 2020) is critical in enhancing teachers' capacity to integrate digital resources. Leadership is expected to initiate changes, such as online learning, and teachers are expected to enact agency (Jenkins, 2020). As a result, principals' digital instructional leadership (DIL) (Berkovich & Hassan, 2022) receives priority consideration for demonstrating an interest in and knowledge of digital use in instruction, as well as assisting teachers by creating supportive environments (Ismail et al., 2020). Olofsson et al. (2020) found the organizational context critical for DC and the role of administration very important. Leaders create support and an interactive environment. Liu and Hallinger (2018) found the leadership role prominent in managing instructional programs, which involves supervision and evaluation of instruction, coordinating the curriculum, and cultivating a supportive organizational climate whereby teachers are supported in their professional evolution. As a result, this could be an indication that collaboration between teachers and mentor teachers, or digital leaders, would be very beneficial. According to Blau and Presser (2013), effective digital educational leadership by principals necessitates proficiency in information technology and its associated practices, comprehension of the intricacies of organizational transformation, advocacy for a perspective on the significance of technology integration and its functions in educational institutions, and the establishment of avenues for the professional development of teachers in the realm of technology incorporation. Their DIL can help teachers with real-time knowledge sharing and facilitate access to timely support. Pireddu (2014) also contends that the evolution of the Internet and web demonstrates an innovative approach to knowledge exchange, learning, and the promotion of creativity. Principals' DIL has to be responsible for the growth and development of their teachers (Instefjord & Munthe, 2017). However, their own DIL capacity is also very important (Oberer & Erkollar, 2018) and may remain relatively significant for increasing teachers' DC.

Although the pandemic increased the possibility of using DIL, there are no conclusive signs that it has been widely used or successful (Pollock, 2020). More significantly, the need for DIL increases since it is predicted that, at the very least, hybrid remote learning will continue in mainstream teaching and learning (Cook et al., 2023; Steen & Brandsen, 2020). Regarding the impact of DIL on teachers' DC, the following hypothesis has been developed:

H2. The principal's DIL capital influences teachers' DC.

THEORETICAL FRAMEWORK

The use of digital resources through understanding teachers' capital is quite prominent in research (e.g., Göbel et al., 2023; Gu et al., 2013). Teachers' DC is their belief (Chen et al., 2021) that they can instill their ability to use digital resources for instructional purposes (Marusic & Viskovic, 2018). There are several factors that affect teachers' behavior toward DC. Their prior knowledge and personal experience remain prominent in this regard. We refer to prior experience as DN with frequent and prior interaction with technological tools

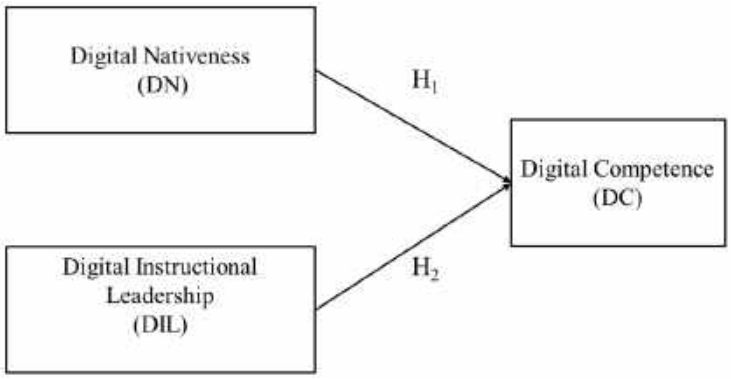

Figure 1. Conceptual framework of the study (Source: Authors)

Table 1. Participants' description

Participants	Variables		Frequency	Percentage
Teachers	Gender	Male	216	55.40
		Female	174	44.60
	Age group	Born before 1980	114	29.20
		Born on or after 1980	276	70.80
	Teaching experience	1-10 years	133	34.10
		11-20 years	140	35.90
		21-30 years	76	19.49
		Above 30 years	41	10.51
Principals	Gender	Male	105	63.25
		Female	61	36.75
	Age group	Born before 1980	95	57.23
		Born on or after 1980	71	42.77
	Experience	1-10 years	32	19.28
		11-20 years	45	27.11
		21-30 years	67	40.36
		Above 30 years	22	13.25
	School context	Metropolitan	18	4.60
		Urban	288	58.50
		Semi Urban	54	13.80
		Rural	90	23.10

(Prensky, 2001). Also, their working environment, including relevant digital infrastructure and support (Ismail et al., 2020), plays an important role in developing their DC. The supportive role of principals' as DIL (Berkovich & Hassanas, 2022) remains integral to teachers' DC (Göbel et al., 2023) by cultivating instructional support (Liu & Hallinger, 2018). Teachers' DN and principals' DIL serve as their personal agency or capital, or the ability to influence teachers to perform a specific behavior or task (Cassidy & Eachus, 2002). Research denotes and informs about the malleability of such agency or capital in predicting teachers' capability (Thoonen et al., 2010). Teachers' behavior toward DC, as reflected in this study's theoretical framework, is influenced by their previous experiences as DN and the school-level supportive role of the principal's DIL (**Figure 1**).

Method

This was a quantitative study aiming to explain the influence of DN and principals' DIL on teachers' DC. Shank and Brown (2013) posit that the primary objective of a quantitative study is to test hypotheses. This study tested hypotheses to explain the influence of teachers' DN and their principals' DIL on their DC. Data was collected from schoolteachers using a survey questionnaire.

Sampling

The purpose was to identify teachers' DC in relation to the effect of their DN and their principals' DIL. In this quantitative research, data was collected from teachers and principals using convenient sampling.

The data was then retrieved from Google Docs for analysis. A total of 390 teachers and 116 principals responded to the survey. **Table 1** depicts the key characteristics of the participants in terms of their gender, designation, age group, and teaching experiences. Initially, data was collected from school principals, and

Table 2. Reliability statistics of DC, DN, & DILS instruments

Instrument	Cronbach's alpha
Digital competence scale	.960
Digital nativeness scale	.949
Digital Instructional leadership scale	.951

Table 3. Accumulative mean scores of teachers' DC

Variable		Scores (dimension wise)					Total score
		Communication & collaboration	Information & digital literacy	Digital content creation	Safety & security	Problem-solving	
		42.00	21.00	28.00	28.00	28.00	147.00
Gender	Female	32.02	15.75	18.08	19.02	18.27	103.14
	Male	32.02	15.62	16.79	17.75	17.95	100.13
School context	Metropolitan	35.00	17.00	24.66	25.33	17.63	119.62
	Urban	31.42	15.47	17.28	17.76	17.66	99.59
	Semi urban	33.88	16.77	17.11	20.44	19.66	107.86
	Rural	29.60	15.33	16.85	17.66	17.53	96.97
Date of birth	Born on or after 1980	33.16	23.50	19.30	18.56	18.39	112.91

later, teachers from the same schools were selected through convenient sampling. The data collection instrument was sent through Google Docs to their email addresses and WhatsApp numbers. The researchers obtained ethical approval from the Balochistan University of Information Technology and Management Sciences prior to data collection, and the participants were informed about the purpose of the study and their rights as research participants. Access to the survey was granted only after the respondents agreed to participate and indicated that they had read and understood the purpose of the study and their rights as participants. The study participants were 55.40% male and 44.60% female teachers, and 36.75% female and 63.25% male principals. The majority of the teachers (35.90%) fall in the experience group of 11-20, followed by the 1-10-year group (34.10%). They also marginally differed in terms of their date of birth as of before (29.2%) and after 1980 (70.80%). This means the majority of the teachers are non-digital natives. The group of principals with experience between 21 and 30 makes up the majority (40.36%), with the 11 to 20-year group coming in second (27.11%). They also marginally differed in terms of their date of birth as of before (57.23%) and after 1980 (42.77%). These results show that the majority of the principals are non-digital natives.

Measures and Instrument Design

An instrument in a quantitative study is used to measure the behavior or characteristics of a variable (Collins, 2003). The study used three different instruments to measure the participants on the variables DC, DN, and DIL, which were then compiled into a single instrument for the participants. These instruments included the teachers' digital competency scale (DCS) (Carretero et al., 2017), the digital nativeness assessment scale (DNAS) (Teo, 2013), and the digital instructional leadership scale (DILS) (Berkovich & Hassan, 2022). DCS and DNAS were used to collect data from teachers, and DILS from principals. All these tools have been used with established validity and reliability. DNAS is composed of 21 items (DN1-DN21) and measured on a 7-point Likert scale from (1) "very uncertain" to (7) "very confident". The DCS consisted of 21 items (DC1-DC21) and DILS on nine items (DIL1-DIL9). Both DCS and DILS responses were measured using a 5-point Likert scale from (1) "strongly disagree" to (5) "strongly agree." The instruments met the reliability measures with a Cronbach's alpha in the range of.951 to.960 (**Table 2**).

Participants' DC and DN Profiles

Participants digital competence profile

Teachers' DC profiles provide an overview of their digital capability in each dimension (**Table 3**). The scores for each dimension are shown next to the total, as are the total scores for each variable (gender, context, and birth date). Coordination and communication stand out across all genders, dates of birth, and school contexts (in the range of 31.42-35.00), but rural areas score very low in comparison (29.60). All the other dimensions almost reflect the same trend, excluding teachers from the metropolitan context scoring higher on the digital

Table 4. Teacher' DN profile

Variables		Digital nativeness (mean scores)
Gender	Female	80.45
	Male	78.58
School context	Metropolitan	85.66
	Urban	79.78
	Semi Urban	82.77
	Rural	77.66

content creation dimension (24.66), and safety and security (25.33). A marginal difference in the mean score of a semi-urban context (19.66) on the problem-solving dimension is observed. Looking at the aggregate scores for each variable, teachers from metropolitan and semi-urban contexts, females, and those born on or after 1980 scored 119.62, 107.86, and 112.91, respectively. Teachers who teach in a rural area have lower scores (96.97) than other teachers.

Participants' digital nativeness profile

The measurement of DNAS items is conducted through a 7-point scale, which allows for a potential total score range of 21 to 147. A score that is tilted towards either end of the spectrum indicates the degree to which a participant is either non-DN or DN. **Table 4** shows that teachers have moderate DC, with minimum DN scores of 21 and maximum scores of 147. In relation to participants' antecedents, such as gender, school context, and the date of birth, there is no major difference in their DN scores. However, those from metropolitan areas have higher mean scores (M=85.66) than the teachers from rural areas (M=77.66).

Data Analysis

Measurement model assessment

The measurement model aimed to evaluate convergent validity, reliability, and discriminant validity. The overall item loadings remained in the range above 0.50, as suggested by Hair et al. (2017) (**Table 5**).

Table 5. Convergent validity

Construct	Items	Loadings	CR	AVE	P
Digital competence	DC-1	0.650	0.966	0.563	0.000
	DC-2	0.769			
	DC-3	0.775			
	DC-4	0.734			
	DC-5	0.699			
	DC-6	0.689			
	DC-7	0.824			
	DC-8	0.768			
	DC-9	0.753			
	DC-10	0.766			
	DC-11	0.885			
	DC-12	0.746			
	DC-13	0.633			
	DC-14	0.775			
	DC-15	0.759			
	DC-16	0.679			
	DC-17	0.756			
	DC-18	0.727			
	DC-19	0.793			
	DC-20	0.789			
	DC-21	0.745			
Digital nativeness	DN-1	0.890	0.989	0.709	0.000
	DN-2	0.887			
	DN-3	0.500			
	DN-4	0.882			
	DN-5	0.877			
	DN-6	0.603			
	DN-7	0.696			
	DN-8	0.543			

Table 5 (Continued). Convergent validity

Construct	Items	Loadings	CR	AVE	P
	DN-9	0.627			
	DN-10	0.898			
	DN-11	0.764			
	DN-12	0.704			
	DN-13	0.679			
	DN-14	0.511			
	DN-15	0.623			
	DN-16	0.849			
	DN-17	0.537			
	DN-18	0.827			
	DN-19	0.618			
	DN-20	0.640			
	DN-21	0.550			
Digital instructional leadership	DIL-1	0.760	0.958	0.509	0.000
	DIL-2	0.887			
	DIL-3	0.807			
	DIL-4	0.887			
	DIL-5	0.879			
	DIL-6	0.915			
	DIL-7	0.798			
	DIL-8	0.793			
	DIL-9	0.837			

Table 6. Discriminant validity using HTMT

	DC	DIL	DN
Digital competence-DC			
Digital instructional leadership-DIL	0.277		
Digital nativeness-DN	0.511	0.181	

Table 7. Path coefficient & hypothesis testing

Hypothesis	Path	Beta coefficient	Standard deviation	T statistics	p-value	Decision
H1	DN->DC	0.502	0.042	11.95	0.00	Supported
H2	DIL->DC	0.217	0.042	5.177	0.00	Supported

The values for composite reliability (CR) and average variance extracted (AVE) were observed to be above the threshold of 0.8 and 0.5, respectively. The study found that CR value fell within the range of 0.958 to 0.989, while AVE ranged from 0.509 to 0.709. These values met the recommended threshold, indicating that the model's measurement reliability was established.

The measurement of discriminant validity is critical in research that involves latent variables as well as the use of many items or indicators to represent the construct. As a result, the researcher must first establish discriminant validity (Henseler et al., 2015). This ensures that the latent variables utilized to measure the causal links under investigation are actually unique from one another. In other words, they are not measuring the same thing, which raises the issue of multicollinearity. Henseler et al. (2015) recommend a threshold value of 0.90 for the heterotrait-monotrait (HTMT) ratio criterion, which was used to check the discriminant validity. **Table 6** shows that all of HTMT values were lower than the criterion of 0.90. These results indicate confirmation of both the convergent and discriminant validity of the measurement model.

Structural model assessment

The statistical significance of the propositions was evaluated through the utilization of boot-strap resampling, as described by Henseler et al. (2009). The determination of the relationship of the structural model is contingent upon the path coefficient that exists among the constructs under investigation, as posited by Hair et al. (2017). Hypothesis testing (**Table 7**) supported **H1** and **H2** with a significant impact. The findings of **H1** indicate that DN has a significant impact on DC (β=0.502, t=11.95, p<.05). **H2** evaluated whether there was an influence of principals' DIL on teachers DC. The findings support the hypothesis by showing that DIL has a significant positive impact in this regard (β=0.217, t=5.17, p<.05).

DISCUSSION

The pandemic preference for online learning has influenced this study's eventual realization of digital integration in learning, which is of utmost significance. This study examined teachers' DC as the frontline implementers, while also considering the leadership capital of school principals, who were crucial in spontaneous response and decision-making in the face of the pandemic's uncertainty. Initially, the study reported DC and DN profiles of teachers, followed by an analysis for hypothesis testing.

DC profile of teachers reveals that they have a moderate level of DC, albeit with variations in certain dimensions of DC. They are more inclined toward coordination and communication competency as compared to information and digital literacy, digital content creation, safety and security, and problem solving. However, teachers from metropolitan contexts showed higher scores on digital content creation and safety and security. Khairani (2017) found no difference in teachers' DC in rural and urban settings, which contradicts our findings. According to the overall findings, when using digital resources, teachers are more capable of collaboration and coordination. These results are consistent with Marusic and Viskovic's (2018) results, which complement teachers' collaboration with their creative use of digital technologies. Teachers with greater coordination and communication capabilities could be more so due to frequent use of social networking (Jogezai et al., 2021) or Internet addiction, which is a paramount feature of the digitization age. It will enable teachers to facilitate learners in real-time by guiding, providing feedback, and adjusting instruction instantaneously (Zhang et al., 2016).

On the problem-solving dimension, there was a slight difference between the scores of semi-urban and urban settings; however, females (18.27) and teachers born in or after 1980 (18.39) comparatively scored higher. However, the uncertainty caused by the recent COVID-19 pandemic and its lingering impact (Steen & Brandsen, 2020) requires teachers to be better problem solvers and critical thinkers (Saavedra & Opfer, 2012) to make teaching and learning more effective (Xie, 2022). Problem-solving as a central component of teachers' PD serves as an important predictor of online teaching behavior (Li et al., 2021).

The DN profiles of the participants differed depending on whether they were born before or after 1980. The former scored comparatively high on all dimensions of DN. The higher scores of those born in or after the 1980s support Prensky's (2001) concept of DN as well as Chadwick et al.'s (2022) view of younger people having more prior personal experience than their peers. The results also support Gu et al.'s (2013) stance that the nature of technology usage and the acceptance of technology among DN and digital DI are radically different. The findings, however, did not corroborate the hypothesis that every young person possesses an inherent aptitude for utilizing technology, a claim that is subject to debate (Kirschner & De Bruyckere, 2017).

The impact of DN on DC provides information about their significant predictive capability for the digitization of teaching. The results of the DC impact on DC support the findings of Hürsen (2012), who also discovered that young teachers with less experience demonstrated more positive behavior. The results confirm our hypothesis that the difference in technology usage and acceptance between DN, the young teachers, and DI, the older ones, influences their DC.

The DIL of school principals also portrayed a significant predictive capability for teachers' DC. It implies that principals' role in realizing and pursuing digitization of learning can be achieved most effectively by influencing teachers' DC. This is in addition to what Baloch et al. (2022) found: leadership orientation in education had more persuasive ability and structural orientation. Structural orientation refers to making the necessary digital resource available as informed by previous research (e.g., Ismail et al., 2020; Jogezai et al., 2022). The results also support Liu and Hallinger (2018), who found the leadership role prominent in managing instructional programs, which involves supervision and evaluation of instructions, coordinating the curriculum, and cultivating a supportive organizational climate whereby teachers are supported in their professional enhancement, including DC.

One important aspect would be a sense of empowerment for teachers by school principals, which Quaicoe and Pata (2020) refer to as coordinated school-based management, whereby teachers and school leaders equally contribute to addressing school-wide DCs. The effectiveness of leadership effects and teachers' greater inclination toward collaboration and coordination can be an indication of one area, where collaboration between teachers and principals as DIL would be highly relevant. Pireddu (2014) also contends

that the evolution of the Internet demonstrates an innovative approach to knowledge exchange, learning, and the promotion of creativity. DIL has to be responsible for the growth and development of their teachers (Instefjord & Munthe, 2017). However, their own digital leadership capacity is very important (Oberer & Erkollar, 2018) and may remain relatively significant for increasing teachers' DC. The dimension of the principal's own DC could be a relevant future research agenda.

CONCLUSIONS

This study examined teachers' DC as frontline implementers, looking at the influence of their DN on their DC and school principals' DIL in spontaneous pandemic response and decision-making. Before hypothesis testing, the DC and DN profiles of teachers were identified and found to be moderate. DC profiles of teachers emphasize coordination and communication, which may improve collaboration and communication when addressing their DC. However, the meaningfulness of such coordination must be established. The participants born after 1980 scored higher on all DNS scales, corroborating earlier findings (Chadwick et al., 2022; Gu et al., 2013). The disparities in technology usage and acceptance between DN, young teachers, and DI hinder DC and the effective use of digital resources in teaching and learning. Principals predicted teachers' digital competency, making it crucial for managing instructional programs, including supervision and evaluation of instruction, curriculum coordination, and the creation of a supportive organizational climate in which teachers can improve their DC. Teachers' preference for collaboration and coordination amongst themselves continues to be a positive trend, but the leadership must make it more meaningful, particularly between young and old generations of teachers to better address their DC. We can conclude that, in addition to teachers' DC beliefs, their organizational environment can really make a difference, and the role of school leadership remains phenomenal.

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