



A pilot study on individual and contextual factors influencing teachers' digitalisation process

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ABSTRACT

The process of school digitalisation has been on the rise in recent years, but the relationship between technology and teachers has had a strong acceleration during the global pandemic due to the coronavirus disease 2019. 198 teachers from primary to high school fill a questionnaire about demographic variables (age, gender, education level, school level in which they teach and years of seniority at work), perceptions of using some digital tools and specific platforms before and during the pandemic (after the first lockdown), self-esteem, self-efficacy, cognitive flexibility, and burnout perceptions. A non-parametric analysis was first conducted with the application of the Wilcoxon test for paired measures. Subsequently, a MANOVA was applied to verify any differences between teachers belonging to different school levels and having different levels of seniority. According to literature we found that self-efficacy, self-esteem, cognitive flexibility, burnout and service seniority are influential factors for teachers' perceived digitalisation level.

Keywords: school digitalisation, teachers, self-esteem, self-efficacy, cognitive flexibility, burnout, seniority service

INTRODUCTION

Modern schools require digitalisation. This statement is inherently banal and simple to understand, but it involves many challenges. School digitalisation is a complex process. Currently, equipping school facilities with modern information and communication technologies (ICTs) according to momentary needs (e.g. crisis e-learning) or strategic actions enshrined in actions for formal and higher education development is insufficient

(Giritli Nygren & Olofsson, 2020; Olofsson et al., 2019). Education digitalisation requires a comprehensive approach from the perspective of sustained investment in the hardware layer and the recognition of a range of soft indicators for the effective implementation of ICTs in the teaching and learning process (Siddiq et al., 2016; Tondeur et al., 2019).

This approach is in line with the need for the in-depth multidimensional analysis of the functioning of contemporary teachers in the information society. It provides a glimpse of key individual factors impinging on the style and effectiveness of ICT use during two critical periods linked to the coronavirus disease 2019 (COVID-19) pandemic. This research is also a voice in the discussion on the need to analyse the digital competence of teachers in a broad context, beyond the technical aspects of operating ICT equipment or websites (Fransson et al., 2019; Tondeur et al., 2016b).

Theoretical Framework and Research Overview

During the COVID-19 pandemic, teachers were faced with a sudden shift from face-to-face teaching to technology-mediated teaching (Özen & Üçüncü, 2022; Scull et al., 2020). The sudden change was complicated by many issues, but it encouraged many teachers worldwide to challenge themselves and expand their knowledge and skills on the technological tools and platforms used (Assunção Flores & Gago, 2020; Bao, 2020; Cataudella et al., 2021a; Huber & Helm, 2020; Moorhouse, 2020; Zhang et al., 2020). The forced discontinuation of face-to-face teaching due to the COVID-19 pandemic affected all schools at all levels and was unprecedented in history (from kindergarten to university, to vocational education). This situation affected 82.2% of the world's student population in spring 2020 (UNESCO, 2021). This transition and the related difficulties due to contingency can be found throughout the world, as literature shows (Bergdahl & Nouri, 2021; Chandio, 2021; Delcker & Ifenthaler, 2021; Landa et al., 2021; Malandrino & Sager, 2021; Sánchez-Cruzado et al., 2021; Shagiakhmetova et al., 2022; Toto et al., 2021; Wotto, 2020). Tomczyk and Walker (2021) reported that the pandemic represented a situation that tested the digital maturity level among individuals (teachers, students and parents) and institutional (schools and educational institutions' supervisory bodies) dimensions. It also significantly reopened the debate on the practical effectiveness and functionality of distance education and teachers' ICT use (Cataudella et al., 2021b). The situation created by COVID-19 has highlighted, once again, that the relationship between teachers and ICTs, in general, between schools and technologies presents a gap that must be overcome (Cataudella et al., 2021a, 2021b; Dietrich et al., 2020; Mao et al., 2019; Tondeur et al., 2019).

Certainly, COVID-19 has considerably accelerated the transition to digitalisation and the steps to bridge technological misses in the school context. Many studies have underlined how contentious and often difficult has been the relationship between teachers and technology, even though digital literacy and computer skills are accepted requirements today for any individual who assumes a teaching position (Li & Yu, 2022; Loague et al., 2018; Tondeur et al., 2016a). Moreover, as technology develops rapidly, teachers require the time to develop their digital competence and incorporate it into their teaching (Cataudella et al., 2021a; Pears et al., 2017; Penna & Stara, 2010; Toto et al., 2021).

The Italian situation of the relationship between teachers from Italian primary and lower secondary schools and technology is represented in many studies. Salmieri (2019) conducted an interesting analysis which underlined the efforts made, during the time, by the European Union, the Organisation for Economic Co-operation and Development (OECD) countries and the Italian Ministry for Education, University and Research, to improve the digitalisation processes across Europe and Italy. The research highlighted the European Framework for the Digital Competence of Educators (DigCompEdu), which pushed teachers to assess their own personal competencies and implement targeted learning activities (Pastore et al., 2019; Salmieri, 2019). As Salmieri (2019) suggested, teachers do not simply 'do technology' as completely free and rational agents. Rather, any sense of individual agency and action on their part is set against the social, cultural and technological constraints of educational institutions. According to respondents, a discrepancy exists between the complete agreement that new technologies make positive contributions to teaching, on the one hand, and the disparities that emerge in the concrete applications of these principles, on the other hand. Digital innovation is something that teachers themselves take on, and they tend to send it in heterogeneous directions depending on the different and differentiating contexts in which they act.

Also, Mao et al. (2019) stated how in Italy, over the past 20 years and particularly in recent years, ministerial interventions and school network projects have encouraged technology-supported teaching innovations; considerable progress has been evidenced. The need for further changes in Italian educational systems has emerged in their reflections. In Italy, a huge contribution to guide schools in reaching innovation and digitalisation has been given by the National Digital School Plan (PNSD) (law 107/2015) (Malandrino & Sager, 2021), particularly to help teachers have adequate digital literacy and ICT competence, so that they become competitive in future online or classroom practice (Li & Yu, 2022).

Many studies underline that Italian teachers of all educational levels perceive the educational use of technology as fundamental, but they sometimes have low perceptions towards their digital competencies. Understanding why they have not had full success, despite all the efforts made over time to implement ICT use among teachers in their lifelong learning, is important. A body of research wonders about what factors (i.e. motivation and professional development, perceived stress, or low digital skill level) prevent or prevented proper ICT utilisation in education (Daniel, 2020; Legrottaglie & Ligorio, 2014; Muscarà & Messina, 2015; Ranieri et al., 2017; Sangeeta & Tandon, 2021; Toto et al., 2021; Xu, 2022).

Multifarious Factors Influence Teachers' Digitalisation

As previously mentioned, during the COVID-19 pandemic, teachers' use of digital tools has been updated and reinforced at an unprecedented speed (Li & Yu, 2022).

However, the issue of the difficulties of ICT integration into teachers' activities and communication has always been complex and made up of many and multifarious mediating factors that influence it (Harrell & Bynum, 2018; Kim et al., 2022; Muscarà & Messina, 2015; Nelson et al., 2019). These factors can either encourage technology use or act as barriers to its use and integration into school and classroom activities. They can be categorised as either internal/individual (psychological aspect, personal investment in technology, attitude towards technology, teaching seniority and personal experience) or external/contextual (resource, training, school level, poor infrastructure, inadequate technology, lack of sufficient technological tools, effective professional development, support, vicarious experience and sociocultural experience) (DeCoito & Richardson, 2018; Ertmer & Simon, 2005; Hechter & Vermette, 2014; Kim et al., 2022; Özgenel & Mert, 2019; Ruggiero & Mong, 2015; Şen & Yildiz Durak, 2022).

Within public discourse, a tendency to suppose a linear relationship between teachers' years of experience and teaching quality may occur (Brandenburg et al., 2016). Extant research provides mixed evidence, with some correlations between teaching quality and teacher experience. Other studies provide no evidence that experience makes a difference (Dickson et al., 2019; Pianta & Hamre, 2009). Graham et al. (2020) investigated associations between teachers' years of experience and teaching quality. They found no evidence of low teaching quality for beginning teachers (0–3 years of experience), but some evidence of a decline in teaching quality for teachers with 4–5 years of experience. The authors concluded that teaching quality can be high overall, and that targeted support and evidence-informed professional learning benefit all teachers. Other studies have underlined how teacher seniority can create a disadvantage in ICT use (Ay et al., 2016; Lee & Tsai, 2010). For example, Maican et al. (2019) find that teachers with higher levels of seniority in the academic field were more anxious and had lower levels of technology self-efficacy and, in general, they had a less favourable attitude towards the use of online technologies, focused on low performance and effort expectancy, low levels of hedonic motivation, and, consequently, low intention to use these applications in the future.

Self-efficacy plays a significant role in the use of such technological tools among teachers, and many studies have emphasised its importance in this field (Kwon et al., 2019). Self-efficacy is the ability of an individual to process, weigh and integrate diverse information sources concerning their capability to regulate their behaviour and expenditure of effort according to such information (Bandura, 1977). Individuals with high-level self-efficacy make judgments about their own capacity to achieve a certain performance level (Barnes, 2000). Self-efficacy and consequent teaching effectiveness are closely linked because teachers' self-efficacy may influence their emotive state and their persistence to achieve specific goals, new knowledge, and competencies (Hatlevik, 2017; Mannila et al., 2018).

Tschannen-Moran and Johnson (2011) stressed the importance of developing and sustaining teachers' self-efficacy beliefs, as both factors influence teachers' motivation, teaching and students' learning

(Gudmundsdottir & Hatlevik, 2018). Li et al. (2015) found a significant correlation between teachers' technology use in the classroom and their self-efficacy. Teachers' self-efficacy is also crucially important in their digital competence; low teacher self-efficacy affects technology implementation and use.

Krumsvik (2011) distinguished between teachers being confident about their digital competence in using ICT tools and teachers being confident about using ICTs in their teaching. In general, teachers' digital competence is seen as a complex process due to the intersection of cognition, metacognition, motor skills, learning strategies, self-efficacy, and pedagogic-didactic aspects. The digital competence perception is more than merely technical skills, underlining the need for teachers to acquire such competence to improve their teaching. Şen and Yildiz Durak (2022) stated that teachers' self-efficacy in integrating technology into educational environments is one of the most important factors in a successful integration.

Many studies underline the relationship between teachers' self-esteem and use of technology (Kiok et al., 2021).

Self-esteem is an individual's consideration of his/her own self as competent and important, as well as perceiving oneself as successful and valuable. Self-esteem is important for teachers because they are not the only ones who benefit from it. The high self-esteem and positivity of teachers positively influences the self-esteem of students and the entire school and learning process.

Self-esteem plays a key role in psychological adaptation. Self-esteem represents a fundamental element of human beings and their behaviour. It is a construct that is influenced by the opinions of others and is given by the intertwining of individual and contextual factors. Self-esteem also has the potential to reduce stress. Research also indicates that teachers' self-esteem influences their teaching effectiveness and job satisfaction, which increases with age and professional experience. From COVID-19, teachers perceived difficulties in switching to online learning and this had an influence on self-esteem (Kim & Kim, 2022).

Cognitive flexibility is a variable that has been less analysed in technology use research (Cartwright, 2008; Niemi, 2021). Nevertheless, in recent studies, the relationship between cognitive flexibility and technology use has been highlighted (Özen & Üçüncü, 2022). For example, Öztürk et al. (2020) stated that cognitive flexibility may be included among the factors to enable the development and use of techno-pedagogical content knowledge among teachers. Cognitive flexibility is fundamental because the oversimplification in results and in teaching is tied to the inability to transfer knowledge across new and varied domains (Spiro et al., 1991). Cognitive flexibility also allows the survival in external environments, but above all the adaptation to it, it is fundamentally due to the ability of an individual to change their strategy of action and thought by mentally and rapidly reviewing different action plans and chains of thoughts for responding to the sudden changes that occur in a dynamic environment full of competing stimuli (Richter & Yeung, 2012). In addition, cognitive flexibility is a fundamental human ability to adjust cognitive-processing strategies to deal with new and unpredicted situations; thus, it is fundamental for understanding the capability for adaptive thinking (Portoghese et al., 2020). Moreover, cognitive flexibility is explained as a person being aware of alternative ways and options and being flexible and accommodating to new situations (Önen & Koçak, 2015). For Martin and Rubin (1995), cognitive flexibility refers to the following three aspects: a person's awareness that in any given situation, options and alternatives are available; the willingness to be flexible and adapt to a situation; and self-efficacy in being flexible. Although people may be aware that behaviour alternatives exist in each situation and are willing to be flexible, they also need to believe that these alternatives are self-efficacious in bringing out their desired behaviours (Martin & Rubin, 1995). Cognitive flexibility is therefore essential in professions such as that of teachers who are required to have continuous renewal and problem-solving skills (Hanife, 2018). In addition, teachers who possess cognitive flexibility regarding teaching can help students achieve better, grapple with the complexity of engagement to see and analyse various cases and build schemes in relation to their classroom practice (Stein et al., 2018). High cognitive flexibility levels are also needed for the teaching profession to adapt to different situations and formulate alternatives. The cognitive processes involved in learning and determining interactions with specific environments lead to the renewal of teaching methods (Orakçı, 2021).

On the relationship between teacher burnout and technology use, instead, we find numerous studies (Califf & Brooks, 2020; Gómez-Domínguez et al., 2022; Zadok-Gurman et al., 2021). Burnout is represented as a phenomenon that hampers the effectiveness of a teacher's educational work, prevents change and

encourages the adoption of rigid teaching and problem-solving methods, hindering also the use of educational technology tools (Pellerone, 2021; Sokal et al., 2020)

Burnout condition is an emotional exhaustion caused by the perception of not having the resources to respond to demands from environments (Fiorilli et al., 2015; Schaufeli et al., 2009; Skaalvik & Skaalvik, 2014). Thus, emotional exhaustion may lead teachers to a low job satisfaction (Han et al., 2020; Skaalvik & Skaalvik, 2014). Many studies have stressed that stress and burnout among teachers have effects on their sense of self-efficacy (Fiorilli et al., 2015). Even during the pre-pandemic period, teaching was often listed as one of the most stressful professions (Johnson et al., 2005). Responses to COVID-19 even created a long list of new stressors that teachers deal with, including problems caused by the emergency conversion to online teaching (MacIntyre et al., 2020). Teachers' emotional experiences, especially their high burnout levels, could influence their ability to properly utilise the technology-led teaching during COVID-19. These stress factors are significant in their workplace (Panisoara et al., 2020).

As already mentioned, the period related to the COVID-19 pandemic considerably accelerated the transition to digitalisation. Based on the cited literature, our general aim was to investigate how this process was experienced by teachers in terms of their acquisition of digital skills. We investigated possible differences in relation to teachers' seniority and the role of the following variables in the whole process: self-esteem, self-efficacy, cognitive flexibility, and burnout.

In particular, our hypotheses are:

1. during the COVID-19 pandemic, a period in which more technology had to be used, teachers improved their perception of their digital competence;
2. teachers with more seniority did not improve/improved little in the perception of their digital competence;
3. self-esteem, self-efficacy, cognitive flexibility positively correlated with perceived improvement in digital competence;
4. burnout correlates negatively with perceived improvement in digital competence;
5. the teachers' perceptions regarding the digitalisation might differ in relation to the school level in which they teach (primary school, first level secondary school, second level secondary school) and the level of seniority;
6. furthermore, the teachers' perceptions regarding the psychological dimensions investigated (self-esteem, self-efficacy, cognitive flexibility, burnout) might be distinct regarding the school level and the level of seniority.

METHOD

Participants and Procedure

Our participants were 198 teachers, working across five areas of Sardinia (Italy). 171 females (86.4%) and 27 (13.6%) males participated. Among teachers, 18 (9.1%) were aged <35 years, 56 (28.4%) between 36–45 years, 83 (42.1%) between 46–55 years, 40 (20.3%) were aged >56 years. Specifically, participants that worked in the primary school were 80 (40.6%), 49 (24.9%) in the junior high school, and 68 (34.5%) operated in the high school. Regarding their employment, 120 (60.6%) had professional permanency, the remaining had professional instability. Among participants, 91 (46.0%) declare to have a specific training about learning disabilities. The detailed descriptive statistics of all variables were shown in [Table 1](#).

Given the pandemic period and the difficulty in reaching participants, non-probabilistic sampling (convenience sampling, based on teachers' willingness to participate in the survey) was applied. Specifically, the researchers sent an invitation to fill out the research form to the heads of schools in all the provinces of the Sardinia region. These managers extended the invitation to all the teachers at their institutes, who had the opportunity to know the objectives of the research and to decide whether to participate in the study anonymously. This non-probabilistic procedure was applied, making it clear that we aim to recruit teachers with specific features relevant for this study (different levels of schools, different levels of seniority [Rahman, 2023]).

Table 1. Descriptive statistics of assessed variables (n = 198)

Variables	Frequency (%)	Mean (SD)
Age		
Less than 35 years old	18 (9.1)	
Between 36 and 45 years	83 (42.1)	
Between 46 and 55 years	56 (28.4)	
56 years and over	40 (20.3)	
Gender		
Male	27 (13.6)	
Education		
Diploma	42 (21.3)	
University diploma	4 (2.0)	
University degree	103 (52.3)	
Post-graduate training	48 (24.4)	
School in which he/she teaches		
Primary school	80 (40.6)	
Secondary school	49 (24.9)	
Post secondary school	68 (34.5)	
Years of seniority in service		15.02 (11.46)
Type of multimedia platform used		
None	17 (8.6)	
Partial interaction	29 (14.6)	
Full interaction	152 (76.8)	
Cognitive flexibility		
Flexibility total		107.70 (18.51)
Flexibility control		43.29 (7.05)
Flexibility alternative		64.41 (15.52)
Burnout		
Client-student-related burnout (CB)		12.93 (5.15)
Personal burnout (PB)		15.28 (5.45)
Work-related burnout (WB)		11.66 (4.10)
Self-efficacy		
Self-efficacy for student engagement SE		6.88 (1.99)
Self-efficacy for classroom management CL		6.64 (7.25)
Self-efficacy for instructional strategies IS		6.94 (2.03)
Self-esteem		
		23.6 (3.15)
Digital competencies		
Self-assessment of digital skills regarding time pre pandemic		2.83 (0.89)
Self-assessment of digital skills regarding time during pandemic		3.31 (0.84)

All the participants gave their informed consent for data collection. The Ethical Committee approved the data research protocol.

Instruments

The teachers that accept to participate in the research, received an email to complete an online questionnaire on Google Forms. The work session lasted approximately 25 minutes, and the form was organised into different sections that were completed in one session.

The first section assessed the following demographic variables: age, gender, education level and years of seniority at work.

The second section identified specific teachers' situations in relation to the technologies they used during the COVID-19 period by proposing some questions. The teachers evaluated these questions using a Likert scale (from 1 to 5).

The third section assessed their self-esteem, self-efficacy, cognitive flexibility, and burnout perceptions.

Self-esteem scale

To assess self-esteem, we use the self-report questionnaire, introduced in 1965 by Rosenberg. It is made up of five positive and five negative worded items. In this study, we used the Italian version by Prezza et al.

(1997). The rating scale was a four-point Likert-type scale, ranging from 1 (strongly disagree) to 4 (strongly agree). The Cronbach's alpha in the Italian sample was good (.86).

Self-efficacy scale

To assess teacher self-efficacy, we applied the Italian adaptation of the Teacher Self-efficacy scale (Tschannen-Moran & Woolfolk Hoy, 2001) by Biasi et al. (2014). The Italian version comprises 24 items organised in three factors: 'Efficacy for Student Engagement' (eight items), 'Efficacy for Instructional Strategies' (eight items) and 'Efficacy for Classroom Management' (eight items). The 'Teachers' Perceptions of Self-efficacy' subscale relates to their abilities to gain students' commitment, choose appropriate teaching strategies and manage classrooms. The 'Efficacy for Student Engagement' subscale measures teachers' sense of efficacy in motivating students. A teacher who can motivate students must be involved and committed to affect the results. The 'Efficacy for Instructional Strategies' subscale identifies teachers' perceptions in using appropriate teaching strategies. The 'Efficacy for Classroom Management' subscale evaluates teachers' perceptions in managing classes in a functional way. The Cronbach's alpha in the Italian sample was good (.97).

Cognitive flexibility scale

To assess cognitive flexibility, we applied the Italian adaptation of the Cognitive Flexibility Inventory (CFI) scale (Dennis & Vander Wal, 2010) by Portoghesi et al. (2020). The Italian version is composed of 20 items divided into two subscales: the alternative subscale that assesses the abilities of an individual to identify alternative explanations within a situation and to generate multiple solutions, and the control subscale that assesses the ability of a person to perceive difficult situations as controllable.

Burnout scale

To assess teachers' burnout, we applied the Italian adaptation of the Copenhagen Burnout Inventory scale (Kristensen et al., 2005) by Fiorilli et al. (2015). The Italian version consists of 19 items, divided into three subscales: personal burnout (PB), work-related burnout (WB) and client-related burnout (CB), for use in different domains. Specifically, the PB subscale refers to the degrees of physical and psychological fatigue and exhaustion experienced by a respondent. The WB subscale represents the degrees of physical and psychological fatigue and exhaustion perceived by a respondent, as related to his/her work. The CB subscale is defined as the degrees of physical and psychological fatigue and exhaustion perceived by a respondent, as related to his/her work with clients; this subscale can be adapted to specific groups of respondents (Rocha et al., 2020). The scales differentiated well among occupational groups in the service sector, and the expected pattern regarding correlations with other measures of fatigue and psychological well-being was found. Analyses of changes over time showed that substantial proportions of employees changed their burnout levels. The analyses indicated satisfactory reliability and validity for this tool.

Data Analyses

In order to evaluate the results of the survey, the data were examined using descriptive statistics (frequencies and percentages for categorical variables; medians, means, standard deviations, skewness, kurtosis for continuous variables), and also, we applied inferential statistics. Specifically, the inferential statistics aimed to investigate the multivariate relationships between the variables, to verify our research hypothesis. In particular: the dimensionality and the psychometric features of the questionnaire were examined applying principal component analysis (PCA) and Cronbach's alpha; the bivariate relationships between the continuous variables were evaluated using Pearson's r coefficient; the differences among the means were evaluated applying some multivariate analysis of variance (MANOVA) models (in detail, the Mixed Design ANOVA – that consider the between and within variables; the factorial MANOVA to consider the potential differences regarding the between factors) (Tabachnick & Fidell, 2013).

Table 2. Results of application of PCA to the items investigating perceptions pre- and post-pandemic

Dimensions inquired	Eigenvalue	% of variance explained	Component loadings	Cronbach's alpha	Mean score (SD)
Self-assessment of digital skills regarding time pre-pandemic	3.26	65.3	From .749 to .865	.865	2.83 (.909)
Self-assessment of digital skills regarding time post-pandemic	3.55	70.9	From .781 to .890	.891	3.35 (.848)

Table 3. Pearson's r correlations between assessed variables

	1	2	3	4	5	6	7	8	9	10	11	12
1 Pre-pandemic digital skills	-											
2 During pandemic digital skills	0.763***	-										
3 Self-esteem	0.257***	0.184*	-									
4 Self-efficacy: SE	0.175*	0.263***	0.349***	-								
5 Self-efficacy: CL	0.170*	0.258***	0.315***	0.963***	-							
6 Self-efficacy: IS	0.167*	0.272***	0.325***	0.958***	0.945***	-						
7 Flexibility alternative	0.296***	0.292***	0.378***	0.573***	0.530***	0.554***	-					
8 Flexibility control	-0.019	0.016	0.060	0.160*	0.154*	0.137	0.238***	-				
9 Flexibility total	0.242***	0.253***	0.340***	0.541***	0.503***	0.517***	0.929***	0.580***	-			
10 Burnout: CB	0.064	0.158*	0.073	0.016	0.001	0.011	0.056	-0.314***	-0.073	-		
11 Burnout: PB	0.058	0.193**	0.030	0.021	-0.017	0.029	0.084	-0.243***	-0.022	0.769***	-	
12 Burnout: WB	0.064	0.170*	0.068	-0.015	-0.039	-0.006	0.074	-0.222**	-0.023	0.780***	0.841***	-
13 Years of seniority in service	-0.239**	-0.247***	-0.124	-0.180*	-0.169*	-0.203**	-0.199**	-0.122	-0.213**	0.192**	0.149*	0.099

Note: * $p < .05$; ** $p < .01$; *** $p < .001$. The significant values are indicated in **bold**.

RESULTS

To summarise teachers' self-rated technological skills in the pre-pandemic and during pandemic periods, two PCAs were performed to the pool of items assessing their technological competencies: the first one regarding the items assessing their digital skills prior to the pandemic; another PCA was applied to the pool of items investigating their technological competencies during the pandemic.

The first PCA was conducted in relation to following question:

'How would you rate the digital skills you had before the pandemic?'

- A) creating digital content
- B) creating documents and folders
- C) using multimedia platforms
- D) formatting texts for students with learning disabilities
- E) managing online groups.

The single component extracted explains 65.3% of variance (eigenvalue = 3.26); the component loadings ranged from .749 to .865. The Cronbach's alpha reliability was .865 (Table 2).

The pool of items investigating the perceptions of competencies during the pandemic was the same, but the question was 'How would you rate the digital skills you had during the pandemic?'. Specifically, the single component extracted explains 70.9% of variance (eigenvalue = 3.55); the component loadings varied from .781 to .890; the Cronbach's alpha coefficient was .891 (Table 2).

A Pearson's r coefficient was applied (Table 3), the analysis highlights significant linear correlations between perceived digital skills in pre-pandemic, perceived digital skills during the pandemic period (immediately, after the first lockdown) and other dimensions indicated in our study: self-esteem, self-efficacy, cognitive flexibility, burnout and year of seniority.

Pre and during pandemic perceived digital skills confirm a significant positive correlation between them ($r = .763$ $p < .001$).

Perceived digital skills a significant positive correlation with self-esteem (pre-pandemic: $r = .257$, $p < .001$; during pandemic: $r = 0.184$, $p < .001$), with the three self-efficacy subscales (pre-pandemic: STE, $r = .175$; $p < .05$; CL, $r = .170$, $p < .001$; CS, $r = .167$; $p < .05$; during pandemic: STE, $r = .263$; $p < .001$; CL, $r = .258$, $p < .001$; CS, $r = .292$; $p < .001$), with the alternative flexibility (pre-pandemic: $r = .296$, $p < .001$; during pandemic: $r = .292$, $p < .001$), and with total flexibility (pre-pandemic: $r = .242$, $p < .001$; during pandemic: $r = .253$, $p < .001$).

Table 4. Mixed-design analysis of variance

Factors	df	F	p	η^2p
Repeated measures	1	97.951	< .001***	0.377
Repeated measures * teaching school level	2	0.123	0.884	0.002
Repeated measures * level of seniority	1	0.268	0.606	0.002
Repeated measures * teaching school level * level of seniority	2	0.890	0.413	0.011
Residual	162			

Note: ***p < .001. The significant values are indicated in **bold**.

Table 5. Multivariate analysis of variance – univariate effects of the factor “Level of seniority in service”

Factor	Dependent variable	df (b;w)	F	P	Mean (SD)	
					Low seniority	High seniority
Level of seniority in service	Self esteem	1;191	6.791	0.010**	24.12 (2.84)	23.00 (3.42)
	Self-efficacy for student engagement (SE)	1;191	9.231	0.003**	7.25 (1.83)	6.40 (2.10)
	Self-efficacy for classroom management (CL)	1;191	8.081	0.005**	7.00 (1.83)	6.19 (2.12)
	Self-efficacy for instructional strategies (IS)	1;191	10.094	0.002**	7.34 (1.83)	6.44 (2.17)
	Flexibility alternative	1;191	10.274	0.002**	67.47 (14.33)	60.61 (16.17)
	Flexibility control	1;191	1.626	0.204	43.85 (7.45)	42.59 (6.49)
	Client-student-related burnout (CB)	1;191	4.515	0.035*	12.22 (4.59)	13.81 (5.67)
	Personal burnout (PB)	1;191	3.797	0.053	14.62 (5.04)	16.09 (5.84)
	Work-related burnout (WB)	1;191	2.494	0.116	11.28 (3.79)	12.15 (4.44)

Note: *p < .05; **p < .01; ***p < .001. The significant values are indicated in **bold**.

Furthermore, the pre and during pandemic perceived skills exhibited a significant negative correlation with years of seniority (pre-pandemic: $r = -.239$, $p < .001$; during pandemic: $r = -.247$, $p < .001$).

To identify if the self-perception of one's digital skills has changed in relation to the comparison between the pre-pandemic and pandemic periods, a mixed-design analysis of variance was applied (Table 4). In this analysis the within-subject factor consists of assessment before/during the pandemic; the school level in which they teach (primary school, first level secondary school, second level secondary school) and the level of seniority (from 1 to 14 years – over 15 years) were applied as factors between subjects. The findings highlighted the significant effect only for the within factor (self-assessment competencies pre/during pandemic – $F = 97.951$, $df = 1;162$, $p < .001$; $\eta^2p = .377$). This result highlights that all teachers (regardless of seniority level and school level) believe their digital skills were higher during pandemic than the pre pandemic time, underling that they have improved their digital skills in the transition from the pre-pandemic period to the pandemic period (pre-pandemic assessment mean = 2.83, $SD = 0.91$; during pandemic assessment mean = 3.35, $SD = 0.85$).

Subsequently, we apply a factorial MANOVA to appraise if there were differences between teachers belonging to different school levels (primary school, first level secondary school, second level secondary school), between teachers having different level of seniority (from 1 to 14 years – over 15 years). Specifically, the differences were evaluated in relation to the following psychological dimensions investigated in the protocol by the validated instruments: self-esteem, self-efficacy, cognitive flexibility, burnout.

The multivariate effect was observed only in relation to the factor “level of seniority” (Wilks' lambda = .893, $F = 2.44$, $df = 9;183$, $p = .012$). The corresponding univariate effects were observed for this factor, highlighting that the mean scores for self-esteem, self-efficacy, alternative cognitive flexibility, are higher in teachers with low years of seniority (see Table 5).

DISCUSSION

Our results show that all teachers perceived an improvement in their digital skills. They are aware that the process of acquiring digital skills has accelerated considerably, which also emerges in their perception of improving their technology use during the pandemic. However, our data highlight an interesting aspect concerning the service seniority dimension. Teachers with less years of experience seem to have no difficulties, despite this acceleration in the digitalisation process: cognitive flexibility, self-esteem and self-efficacy correlate positively with the perception to have had an enhancement of their digital skills. It seems that they perceive the transition as an asset and they may feel self-efficacious because they use new

technologies more than other teachers (Lucas et al., 2021; Scherer et al., 2015). Teachers with more service seniority, on the other hand, present some difficulties: despite perceiving an improvement in their digital skills although it is lower than colleagues with minor service seniority, they show a negative and significant correlation with cognitive flexibility and self-efficacy but a positive and significant correlation with burnout. This is probably due to the fact that, during their years of teaching, they are principally and primarily trained to teach face to face and experienced a face-to-face teaching that privileged the teacher-student relationship with a focus on the attention to interactions and on the ability to observe aspects of students' behaviour that were functional or dysfunctional to learning (Winter et al., 2021). The use of technologies was, probably up to that point, a secondary support to the main historically privileged teaching modalities: interaction/relationship. The pandemic condition has forced the use of technology not only as a teaching support but as the only mode of teacher-student interaction aimed at maintaining the relationship as well as conveying teaching content. This has probably posed a greater challenge for teachers with greater seniority than other younger teachers (Avidov-Ungar & Magen-Nagar, 2014), leading them to feel lower self-efficacy and a higher level of burnout (the CB scale, namely, the degrees of physical and psychological fatigue and exhaustion experienced by teachers in relation to their work with students). Research shows that teachers with seniority lag behind other teachers in the technology integration process. Probably targeted support is needed to close this gap (Ay et al., 2016; Graham et al., 2020). As experience brings with itself a tendency to learn and therefore repeat what has been learnt – in this case, before developing new teaching strategies – senior teachers must partially reconsider and undo what they have learnt throughout their career. Doing so is a psychological and professional challenge that junior teachers do not have to go through (Cataudella et al., 2021a). Such data certainly reflect a generation gap and a sociocultural one. Older and more experienced teachers frequently have lower levels of digital skills (Ay et al., 2016; Hsu et al., 2017) and show more vulnerability to risks than younger and less experienced teachers due to the lack of training and adaptation of some new technological tools (Rey-Merchán & López-Arquillos, 2021).

In line with literature, we found that self-efficacy, self-esteem, cognitive flexibility, and burnout are influential factors for teachers' perceived digitalisation level (Karataşlıoğlu & Özkanal, 2023; Szyzka et al., 2022). The results also confirm the direction of the relationships, and the combination of the variables examined and are coherent with research linked to COVID-19 pandemic period.

For example, Hampton et al. (2020) stated that teacher self-efficacy can be improved through faculty development and can be increased through online teaching experience. According to Bandura (1982, 1998), individuals with high self-efficacy levels have high cognitive flexibility. This finding also emerges in our sample where teachers with high self-efficacy levels have a positive correlation with the alternative CFI scale, which assesses their ability to find alternative explanations within a situation and generate multiple solutions; thus, their problem-solving abilities are demonstrated. The same aspect is found for the cognitive flexibility scale. Specifically, high cognitive flexibility levels in pre-service teachers or teachers with less years of experience can be interpreted as having high awareness for the presence of new situations and the willingness and energies to adapt to new situations. Literature consistently confirms the link between high teacher effectiveness and high self-esteem (Cataudella et al., 2021a; Chesnut & Burley, 2015; Khan et al., 2015; Pressley & Ha, 2021). The relationship between self-efficacy and burnout is also confirmed, in fact, teachers with a lower level of burnout also perceive better self-efficacy both didactically and organisationally, they are more open to new ideas and new teaching applications also related to ICT (Geraci et al., 2023; Pellerone, 2021).

These results are useful to think about training interventions focused on teacher's needs and devoted to enhancing their engagement in using ICT.

CONCLUSION

Resistance to technology use can be attributed to infrastructural channels or psychological resistance due to individual factors (Gunawan et al., 2020). The results of our study suggest that teachers need to be supported in the process of transitioning to digitalisation. It is important that this support considers individual and contextual variables.

For example, teachers with more service seniority who are not confident in using new technological tools tend to have low perceptions of its value. Hence, the tools will not be used to their full capacity. Failing to

provide teachers with enough professional development creates an internal barrier that also leads to low self-efficacy (Adov & Mäeots, 2021). Technology resources provided by schools can be different among them and can influence teachers' relationship with technology: poor infrastructure, lack of network bandwidth and shortage of devices may cause teachers to feel discouraged and abandon the full technology implementation in their practice. It is fundamental to address these barriers in a positive direction, to try to close this gap, identifying the variables that cause the raising of barriers and those that can help teachers to face new challenges linked to the use of new methodologies and technologies. The support to be given to teachers may include instructional, technological or emotional aspects (Pressley, 2021). At present, projects on school digitalisation and specifically teachers have focused on strengthening resources and training on digital literacy and ICT use to support active methodologies (Malandrino & Sager, 2021; Mao et al., 2019). In addition to these aspects, promoting targeted training aimed at creative digital use and digital fluency through a systemic approach based on combinations of individual contextual factors is interesting. Data from this study can help plan possible interventions on the basis of constant training in the relational/interactional field and in technology use, with particular attention to older and more experienced teachers. In this case, supporting teachers in the process of reorganising their knowledge/competencies, by preparing them for the unravelling process before learning new relational and teaching strategies, is important. Training has to take into account the characteristics of the teachers to whom it is addressed, especially in relation to seniority of service which, in this particular historical moment, still corresponds to a generation gap of teachers (senior teachers vs. young teachers and senior teachers vs. students). Older' teachers might consider the use of technology not always as a support to teaching but sometimes as an obstacle as an element that stands in the way rather than facilitating communication/relationship with students, communication/relationship whose quality is essential in the learning process. This hypothesis could be supported by the result related to a higher level of burnout for 'senior' teachers in relation to the relationship with students.

Limitations and Future Directions

It will be useful to include the evaluations of additional individual and psychological dimensions (e.g. motivation, job satisfaction, coping strategy, locus of control, enthusiasm, workload, profession perception, well-being and resistance to technology use) and context variables (e.g. social support and workload) in the future protocol. It will be also important to have a focus, more specific, on digital burnout and digital self-efficacy.

This valuation can be further effective if it is based not only on self-assessment but also on the objective estimations of digital skills and ICT use, although the issue of measuring digital literacy and digital fluency is an extremely complex process (Chigona, 2018; Karakus & Kiliç, 2022; Novković Cvetković et al., 2018). Currently, weaknesses in measuring these key skills through self-evaluation are increasingly noted in literature (Tomczyk, 2021). Therefore, the use of standardised tests, showing the real knowledge levels and skills of handling ICTs in the didactic and educational context, is postulated in future studies that will combine perspectives of skills with psychosocial characteristics of teachers.

Given that the term 'ICT' encompasses numerous tools and applications, focusing on some of them is useful to make the research specific on its effectiveness in being used by teachers.

In the ongoing research development, applying longitudinal assessments to appreciate the development and stability of these perceptions is interesting. Training improvement must be given focus in the future. Finally, attention should be paid to improving contextual variables, restructuring and reorganising schools and considering all these aspects (Toto et al., 2021).

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results of the survey will be processed in order to identify the most appropriate prevention and promotion interventions; (d) the owner of the data collected through the following questionnaire is Prof. Cataudella (scataudel@unica.it).

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REFERENCES

- Adov, L., & Mäeots, M. (2021). What can we learn about science teachers' technology use during the COVID-19 pandemic? *Education Sciences*, 11(6), Article 255. <https://doi.org/10.3390/educsci11060255>
- Assunção Flores, M., & Gago, M. (2020). Teacher education in times of COVID-19 pandemic in Portugal: National, institutional and pedagogical responses. *Journal of Education for Teaching*, 46(4), 507–516. <https://doi.org/10.1080/02607476.2020.1799709>
- Avidov-Ungar, O., & Magen-Nagar, N. (2014). Teachers in a changing world: Attitudes toward organizational change. *Journal of Computers in Education*, 1(4), 227–249. <https://doi.org/10.1007/s40692-014-0014-x>
- Ay, Y., Karadag, E., & Acat, M. B. (2016). ICT integration of Turkish teachers: An analysis within TPACK-practical model. *International Journal of Progressive Education*, 12(2), 149–165.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (1982). The assessment and predictive generality of self-percepts of efficacy. *Journal of Behavior Therapy and Experimental Psychiatry*, 13(3), 195–199. [https://doi.org/10.1016/0005-7916\(82\)90004-0](https://doi.org/10.1016/0005-7916(82)90004-0)
- Bandura, A. (1998). Personal and collective efficacy in human adaptation and change. *Advances in Psychological Science*, 1(1), 51–71.
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113–115. <https://doi.org/10.1002/HBE2.191>
- Barnes, G. V. (2000). Self-efficacy and teaching effectiveness. *Journal of String Research*, 1, 627–643. <https://doi.org/10.1177/194849920005-100103>
- Bergdahl, N., & Nouri, J. (2021). COVID-19 and crisis-prompted distance education in Sweden. *Technology, Knowledge and Learning*, 26(3), 443–459. <https://doi.org/10.1007/s10758-020-09470-6>
- Biasi, V., Domenici, G., Patrizi, N., & Capobianco, R. (2014). Teacher self-efficacy scale (Scala sull'auto-efficacia del Docente–SAED): adattamento e validazione in Italia [Adaptation and validation in Italy]. *Journal of Educational, Cultural and Psychological Studies*, 10, 485–509. <https://doi.org/10.7358/ecps-2014-010-bias>
- Brandenburg, R., McDonough, S., Burke, J., & White, S. (Eds.). (2016). *Teacher education: Innovation, intervention and impact*. Springer. <https://doi.org/10.1007/978-981-10-0785-9>
- Califf, C. B., & Brooks, S. (2020). An empirical study of techno-stressors, literacy facilitation, burnout, and turnover intention as experienced by K-12 teachers. *Computers & Education*, 157, Article 103971. <https://doi.org/10.1016/j.compedu.2020.103971>
- Cartwright, K. B. (2008). Cognitive flexibility and reading comprehension: Relevance to the future. In C. C. Block, & S. R. Parris (Eds.), *Comprehension instruction: Research-based best practices* (2nd ed., pp. 50–64). The Guilford Press.
- Cataudella, S., Carta, S. M., Mascia, M. L., Masala, C., Petretto, D. R., Agus, M., & Penna, M. P. (2021a). Teaching in times of the COVID-19 pandemic: A pilot study on teachers' self-esteem and self-efficacy in an Italian sample. *International Journal of Environmental Research and Public Health*, 18(15), Article 8211. <https://doi.org/10.3390/IJERPH18158211>
- Cataudella, S., Carta, S. M., Mascia, M. L., Masala, C., Petretto, D. R., & Penna, M. P. (2021b). Psychological aspects of students with learning disabilities in e-environments: A mini review and future research directions. *Frontiers in Psychology*, 11, Article 611818. <https://doi.org/10.3389/fpsyg.2020.611818>
- Chandio, A. R. (2021). Evaluating ICT utilization in education administration and management during the COVID-19 outbreak in Pakistan: An empirical review. *Journal of Research in Instructional*, 1(2), 81–94. <https://doi.org/10.30862/jri.v1i2.15>
- Chesnut, S. R., & Burley, H. (2015). Self-efficacy as a predictor of commitment to the teaching profession: A meta-analysis. *Educational Research Review*, 15, 1–16. <https://doi.org/10.1016/j.edurev.2015.02.001>

- Chigona, A. (2018). Digital fluency: Necessary competence for teaching and learning in connected classrooms. *The African Journal of Information Systems*, 10(4), Article 7.
- Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, 49(1–2), 91–96. <https://doi.org/10.1007/s11125-020-09464-3>
- DeCoito, I., & Richardson, T. (2018). Teachers and technology: Present practice and future directions. *Contemporary Issues in Technology and Teacher Education*, 18(2), 362–378.
- Delcker, J., & Ifenthaler, D. (2021). Teachers' perspective on school development at German vocational schools during the COVID-19 pandemic. *Technology, Pedagogy and Education*, 30(1), 125–139. <https://doi.org/10.1080/1475939X.2020.1857826>
- Dennis, J. P., & Vander Wal, J. S. (2010). The cognitive flexibility inventory: Instrument development and estimates of reliability and validity. *Cognitive Therapy and Research*, 34(3), 241–253. <https://doi.org/10.1007/s10608-009-9276-4>
- Dickson, M., McMinn, M., & Kadbey, H. (2019). Do years of teaching experience make a difference for teachers working in Abu Dhabi government schools? *Cypriot Journal of Educational Science*, 14(4), 471–481. <https://doi.org/10.18844/cjes.v11i4.347>
- Dietrich, N., Kentheswaran, K., Ahmadi, A., Teychene, J., Bessiere, Y., Alfenore, S., Laborie, S., Bastoul, D., Loubiere, K., Guigui, C., Sperandio, M., Barna, L., Paul, E., Cabassud, C., Line, A., & Hebrard, G. (2020). Attempts, successes, and failures of distance learning in the time of COVID-19. *Journal of Chemical Education*, 97(9), 2448–2457. <https://doi.org/10.1021/acs.jchemed.0c00717>
- Ertmer, P. A., & Simons, K. D. (2005). Scaffolding teachers' efforts to implement problem-based learning. *International Journal of Learning*, 12(4), 319–328. <https://doi.org/10.18848/1447-9494/CGP/v12i04/46447>
- Fiorilli, C., De Stasio, S., Benevene, P., Fioredistella Iezzi, D., Pepe, A., & Albanese, O. (2015). Copenhagen burnout inventory (CBI): A validation study in an Italian teacher group. *TPM: Testing, Psychometrics, Methodology in Applied Psychology*, 22(4), 537–551. <https://doi.org/10.4473/TPM22.4.7>
- Fransson, G., Holmberg, J., Lindberg, O. J., & Olofsson, A. D. (2019). Digitalise and capitalise? Teachers' self-understanding in 21st-century teaching contexts. *Oxford Review of Education*, 45(1), 102–118. <https://doi.org/10.1080/03054985.2018.1500357>
- Geraci, A., Di Domenico, L., Inguglia, C., & D'Amico, A. (2023). Teachers' emotional intelligence, burnout, work engagement, and self-efficacy during COVID-19 lockdown. *Behavioral Sciences*, 13(4), Article 296. <https://doi.org/10.3390/bs13040296>
- Giritli Nygren, K., & Olofsson, A. (2020). Managing the COVID-19 pandemic through individual responsibility: The consequences of a world risk society and enhanced ethopolitics. *Journal of Risk Research*, 23(7–8), 1031–1035. <https://doi.org/10.1080/13669877.2020.1756382>
- Gómez-Domínguez, V., Navarro-Mateu, D., Prado-Gascó, V. J., & Gómez-Domínguez, T. (2022). How much do we care about teacher burnout during the pandemic: A bibliometric review. *International Journal of Environmental Research and Public Health*, 19(12), Article 7134. <https://doi.org/10.3390/ijerph19127134>
- Graham, L. J., White, S. L. J., Cologon, K., & Pianta, R. C. (2020). Do teachers' years of experience make a difference in the quality of teaching? *Teaching and Teacher Education*, 96, 1–10. <https://doi.org/10.1016/j.tate.2020.103190>
- Gudmundsdottir, G. B., & Hatlevik, O. E. (2018). Newly qualified teachers' professional digital competence: Implications for teacher education. *European Journal of Teacher Education*, 41(2), 214–231. <https://doi.org/10.1080/02619768.2017.1416085>
- Gunawan, G., Suranti, N. M. Y., & Fathoroni, F. (2020). Variations of models and learning platforms for prospective teachers during the COVID-19 pandemic period. *Indonesian Journal of Teacher Education*, 1(2), 61–70.
- Hampton, D., Culp-Roche, A., Hensley, A., Wilson, J., Otts, J. A., Thaxton-Wiggins, A., Frush, S., & Moser, D. K. (2020). Self-efficacy and satisfaction with teaching in online courses. *Nurse Educator*, 45(6), 302–306. <https://doi.org/10.1097/NNE.0000000000000805>
- Han, J., Yin, H., Wang, J., & Zhang, J. (2020). Job demands and resources as antecedents of university teachers' exhaustion, engagement and job satisfaction. *Educational Psychology*, 40(3), 318–335. <https://doi.org/10.1080/01443410.2019.1674249>

- Hanife, E. A. (2018). The relationship between pre-service teachers' cognitive flexibility and interpersonal problem solving skills. *Eurasian Journal of Educational Research*, 18(77), 105–128. <https://doi.org/10.14689/ejer.2018.77.6>
- Harrell, S., & Bynum, Y. (2018). Factors affecting technology integration in the classroom. *Alabama Journal of Educational Leadership*, 5, 12–18.
- Hatlevik, O. E. (2017). Examining the relationship between teachers' self-efficacy, their digital competence, strategies to evaluate information, and use of ICT at school. *Scandinavian Journal of Educational Research*, 61(5), 555–567. <https://doi.org/10.1080/00313831.2016.1172501>
- Hechter, R., & Vermette, L. A. (2014). Tech-savvy science education? Understanding teacher pedagogical practices for integrating technology in K-12 classrooms. *Journal of Computers in Mathematics and Science Teaching*, 33(1), 27–47.
- Hsu, C. Y., Tsai, M. J., Chang, Y. H., & Liang, J. C. (2017). Surveying in-service teachers' beliefs about game-based learning and perceptions of technological pedagogical and content knowledge of games. *Journal of Educational Technology & Society*, 20(1), 134–143.
- Huber, S. G., & Helm, C. (2020). COVID-19 and schooling: Evaluation, assessment and accountability in times of crises—reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educational Assessment, Evaluation and Accountability*, 32(2), 237–270. <https://doi.org/10.1007/s11092-020-09322-y>
- Johnson, S., Cooper, C., Cartwright, S., Donald, I., Taylor, P., & Millet, C. (2005). The experience of work-related stress across occupations. *Journal of Managerial Psychology*, 20(2), 178–187. <https://doi.org/10.1108/02683940510579803>
- Karakus, I., & Kiliç, F. (2022). 'Digital' overview at the profiles of pre-service teachers: Digital awareness, competence and fluency. *Problems of Education in the 21st Century*, 80(2), 324–338. <https://doi.org/10.33225/pec/22.80.324>
- Karataşlıoğlu, R. E., & Özkanal, B. (2023). Digital burnout in distance education process: Investigation of secondary school teachers' opinions. *Journal of Advanced Education Studies*, 5(2), 319–341. <https://doi.org/10.48166/ejaes.1353517>
- Khan, A., Fleva, E., & Qazi, T. (2015). Role of self-esteem and general self-efficacy in teachers' efficacy in primary schools. *Psychology*, 6, 117–125. <https://doi.org/10.4236/psych.2015.61010>
- Kim, J., & Kim, E. (2022). Relationship between self-esteem and technological readiness: Mediation effect of readiness for change and moderated mediation effect of gender in South Korean teachers. *International Journal of Environmental Research and Public Health*, 19(14), Article 8463. <https://doi.org/10.3390/ijerph19148463>
- Kim, L. E., Oxley, L., & Asbury, K. (2022). "My brain feels like a browser with 100 tabs open": A longitudinal study of teachers' mental health and well-being during the COVID-19 pandemic. *British Journal of Educational Psychology*, 92, 299–318. <https://doi.org/10.1111/bjep.12450>
- Kiok, P. K., Din, W. A., Said, N., & Swanto, S. (2021). The experiences of pre-service teachers teaching practicum during the COVID-19 pandemic: A systematic literature review. *International Journal of Education, Psychology and Counseling*, 6(43), 280–295. <https://doi.org/10.29329/ijpe.2022.431.5>
- Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work & Stress*, 19(3), 192–207. <https://doi.org/10.1080/02678370500297720>
- Krumsvik, R. J. (2011). Digital competence in the Norwegian teacher education and schools. *Högre Utbildning*, 1(1), 39–51. <https://doi.org/10.23865/hu.v1.874>
- Kwon, K., Ottenbreit-Leftwich, A. T., Sari, A., Khlaif, Z., Zhu, M., Nadir, H., & Gok, F. (2019). Teachers' self-efficacy matters: Exploring the integration of mobile computing device in middle schools. *TechTrends*, 63, 682–692. <https://doi.org/10.1007/s11528-019-00402-5>
- Landa, N., Zhou, S., & Marongwe, N. (2021). Education in emergencies: Lessons from COVID-19 in South Africa. *International Review of Education*, 67(1), 167–183. <https://doi.org/10.1007/s11159-021-09903-z>
- Lee, M., & Tsai, C. (2010). Exploring teachers' perceived self efficacy and technological pedagogical content knowledge with respect to educational use of the world wide web. *Instructional Science: An International Journal of the Learning Sciences*, 38(1), 1–21. <https://doi.org/10.1007/s11251-008-9075-4>

- Legrottaglie, S., & Ligorio, M. (2014). The use of technology at school: Teachers' point of view. *Italian Journal of Educational Technology*, 22(3), 183–190. <https://doi.org/10.17471/2499-4324/188>
- Li, L., Worch, E., Zhou, Y. & Aguiton, R. (2015). How and why digital generation teachers use technology in the classroom: An explanatory sequential mixed methods study. *International Journal for the Scholarship of Teaching and Learning*, 9(2). <https://doi.org/10.20429/ijstl.2015.090209>
- Li, M., & Yu, Z. (2022). Teachers' satisfaction, role, and digital literacy during the COVID-19 pandemic. *Sustainability*, 14, Article 1121. <https://doi.org/10.3390/su14031121>
- Loague, A., Loague, A., Caldwell, N., & Balam, E. (2018). Professors' attitudes and perceptions about technology use in the classroom. *Alabama Journal of Educational Leadership*, 5(1), 1–11.
- Lucas, M., Bem-Haja, P., Siddiq, F., Moreira, A., & Redecker, C. (2021). The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? *Computers & Education*, 160, Article 104052. <https://doi.org/10.1016/j.compedu.2020.104052>
- MacIntyre, P. D., Gregersen, T., & Mercer, S. (2020). Language teachers' coping strategies during the COVID-19 conversion to online teaching: Correlations with stress, wellbeing and negative emotions. *System*, 94, Article 102352. <https://doi.org/10.1016/j.system.2020.102352>
- Maican, C. I., Cazan, A.-M., Lixandriou, R. C., & Dovleac, L. (2019). A study on academic staff personality and technology acceptance: The case of communication and collaboration applications. *Computers & Education*, 128, 113–131. <https://doi.org/10.1016/j.compedu.2018.09.010>
- Malandrino, A., & Sager, F. (2021). Can teachers' discretion enhance the role of professionalism in times of crisis? A comparative policy analysis of distance teaching in Italy and Switzerland during the COVID-19 pandemic. *Journal of Comparative Policy Analysis: Research and Practice*, 23(1), 74–84. <https://doi.org/10.1080/13876988.2020.1844544>
- Mannila, L., Nordén, L. Å., & Pears, A. (2018). Digital competence, teacher self-efficacy and training needs. In *Proceedings of the 2018 ACM Conference on International Computing Education Research* (pp. 78–85). <https://doi.org/10.1145/3230977.3230993>
- Mao, J., Ifenthaler, D., Fujimoto, T., Garavaglia, A., & Rossi, P. G. (2019). National policies and educational technology: A synopsis of trends and perspectives from five countries. *TechTrends*, 63, 284–293. <https://doi.org/10.1007/s11528-019-00396-0>
- Martin, M. M., & Rubin, R. B. (1995). A new measure of cognitive flexibility. *Psychological Reports*, 76(2), 623–626. <https://doi.org/10.2466/pr0.1995.76.2.623>
- Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *Journal of Education for Teaching: International Research and Pedagogy*, 46(4), 609–611. <https://doi.org/10.1080/02607476.2020.1755205>
- Muscarà, M., & Messina, R. (2015). Perceived competency, perceived ICT usefulness in classroom and teachers training models. *Italian Journal of Educational Research*, (13), 181–196.
- Nelson, M. J., Voithofer, R., & Cheng, S. L. (2019). Mediating factors that influence the technology integration practices of teacher educators. *Computers & Education*, 128, 330–344. <https://doi.org/10.1016/j.compedu.2018.09.023>
- Niemi, K. (2021). The best guess for the future? Teachers' adaptation to open and flexible learning environments in Finland. *Education Inquiry*, 12(3), 282–300. <https://doi.org/10.1080/20004508.2020.1816371>
- Novković Cvetković, B., Stošić, L., & Belousova, A. (2018). Media and information literacy-the basis for applying digital technologies in teaching from the discourse of educational needs of teachers. *Croatian Journal of Education: Hrvatski Časopis za Odgoj i Obrazovanje*, 20(4), 1089–1114. <https://doi.org/10.15516/cje.v20i4.3001>
- Olofsson, A. D., Fransson, G., & Lindberg, J. O. (2019). A study of the use of digital technology and its conditions with a view to understanding what 'adequate digital competence' may mean in a national policy initiative. *Educational Studies*, 46(6), 727–743. <https://doi.org/10.1080/03055698.2019.1651694>
- Önen, A. S., & Koçak, C. (2015). The effect of cognitive flexibility on higher school students' study strategies. *Procedia-Social and Behavioral Sciences*, 191, 2346–2350. <https://doi.org/10.1016/j.sbspro.2015.04.680>
- Orakci, Ş. (2021). Exploring the relationships between cognitive flexibility, learner autonomy, and reflective thinking. *Thinking Skills and Creativity*, 41, Article 100838. <https://doi.org/10.1016/j.tsc.2021.100838>

- Özen, F., & Üçüncü, A. S. (2022). The effect of teachers' cognitive flexibility on attitudes towards compulsory distance education during the COVID-19 pandemic. *International Journal of Psychology and Educational Studies*, 9(2), 492–508. <https://doi.org/10.52380/ijpes.2022.9.2.752>
- Özgenel, M., & Mert, P. (2019). The role of teacher performance in school effectiveness. *International Journal of Education Technology and Scientific Researches*, 4(10), 417–434. <https://doi.org/10.35826/ijetsar.42>
- Öztürk, G., Karamete, A., & Çetin, G. (2020). The relationship between pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies. *International Journal of Contemporary Educational Research*, 7(1), 40–53. <https://doi.org/10.33200/ijcer.623668>
- Panisoara, I. O., Lazar, I., Panisoara, G., Chirca, R., & Ursu, A. S. (2020). Motivation and continuance intention towards online instruction among teachers during the COVID-19 pandemic: The mediating effect of burnout and technostress. *International Journal of Environmental Research and Public Health*, 17(21), Article 8002. <https://doi.org/10.3390/ijerph17218002>
- Pastore, S., Manuti, A., & Scardigno, A. F. (2019). Formative assessment and teaching practice: The point of view of Italian teachers. *European Journal of Teacher Education*, 42(3), 359–374. <https://doi.org/10.1080/02619768.2019.1604668>
- Pears, A., Dagiene, V., & Jasute, E. (2017). Baltic and Nordic K-12 teacher perspectives on computational thinking and computing. In V. Dagiene, & A. Hellas (Eds.), *Informatics in schools: Focus on learning programming* (pp. 141–152). Springer. https://doi.org/10.1007/978-3-319-71483-7_12
- Pellerone M. (2021). Self-perceived instructional competence, self-efficacy and burnout during the COVID-19 pandemic: A study of a group of Italian school teachers. *European Journal of Investigation in Health, Psychology and Education*, 11(2), 496–512. <https://doi.org/10.3390/ejihpe11020035>
- Penna, M. P., & Stara, V. (2010). Opinions on computers, and efficacy of a computer-based learning: A pilot study. *Education and Information Technologies*, 15(3), 181–204. <https://doi.org/10.1007/s10639-009-9104-1>
- Pianta, R. C., & Hamre, B. K. (2009). Conceptualization, measurement, and improvement of classroom processes: Standardized observation can leverage capacity. *Educational Researcher*, 38(2), 109–119. <https://doi.org/10.3102/0013189X09332374>
- Portoghese, I., Lasio, M., Conti, R., Mascia, M. L., Hitchcott, P., Agus, M., Gemignani, A., & Penna, M. P. (2020). Cognitive Flexibility Inventory: Factor structure, invariance, reliability, convergent, and discriminant validity among Italian university students. *PsyCh Journal*, 9(6), 934–941. <https://doi.org/10.1002/pchj.401>
- Pressley, T. (2021). Factors contributing to teacher burnout during COVID-19. *Educational Researcher*, 50(5), 325–327. <https://doi.org/10.3102/0013189X211004138>
- Pressley, T., & Ha, C. (2021). Teaching during a pandemic: United States teachers' self-efficacy during COVID-19. *Teaching and Teacher Education*, 106, Article 103465. <https://doi.org/10.1016/j.tate.2021.103465>
- Prezza, M., Trombaccia, F. R., & Armento, L. (1997). La scala dell'autostima di Rosenberg: Traduzione e validazione Italiana [The Rosenberg self-esteem scale: Italian translation and validation]. *Giunti Organizzazioni Speciali*, 223, 35–44.
- Rahman, M. M. (2023). Sample size determination for survey research and non-probability sampling techniques: A review and set of recommendations. *Journal of Entrepreneurship, Business and Economics*, 11(1), 42–62.
- Ranieri, M., Bruni, I., & Orban de Xivry, A.-C. (2017). Teachers' professional development on digital and media literacy. Findings and recommendations from a European project. *Research on Education and Media*, 9(2). <https://doi.org/10.1515/rem-2017-0009>
- Rey-Merchán, M. D. C., & López-Arquillos, A. (2021). Management of technostress in teachers as occupational risk in the context of COVID-19. *Medical Sciences Forum*, 4(1), Article 5. <https://doi.org/10.3390/ECERPH-3-08999>
- Richter, F. R., & Yeung, N. (2012). Memory and cognitive control in task switching. *Psychological Science*, 23(10), 1256–1263. <https://doi.org/10.1177/0956797612444613>
- Rocha, F. L. R., Jesus, L. C. D., Marziale, M. H. P., Henriques, S. H., Marôco, J., & Campos, J. A. D. B. (2020). Burnout syndrome in university professors and academic staff members: Psychometric properties of the Copenhagen Burnout Inventory–Brazilian version. *Psicologia: Reflexão e Crítica*, 33. <https://doi.org/10.1186/s41155-020-00151-y>

- Ruggiero, D., & Mong, C. J. (2015). The teacher technology integration experience: Practice and reflection in the classroom. *Journal of Information Technology Education: Research*, 14, 161–178. <https://doi.org/10.28945/2227>
- Salmieri, L. (2019). The rhetoric of digitalization in Italian educational policies: Situating reception among digitally skilled teachers. *Italian Journal of Sociology of Education*, 11(1), 162–183. <https://doi.org/10.14658/pupj-ijse-2019-1-8>
- Sánchez-Cruzado, C., Santiago Campión, R., & Sánchez-Compañía, M. T. (2021). Teacher digital literacy: The indisputable challenge after COVID-19. *Sustainability*, 13, Article 1858. <https://doi.org/10.3390/su13041858>
- Sangeeta, & Tandon, U. (2021). Factors influencing adoption of online teaching by school teachers: A study during COVID-19 pandemic. *Journal of Public Affairs*, 21, Article e2503. <https://doi.org/10.1002/pa.2503>
- Schaufeli, W. B., Leiter, M. P., & Maslach, C. (2009). Burnout: 35 years of research and practice. *Career Development International*, 14(3), 204–220. <https://doi.org/10.1108/13620430910966406>
- Scherer, R., Siddiq, F., & Teo, T. (2015). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Computers & Education*, 88, 202–214. <https://doi.org/10.1016/j.compedu.2015.05.005>
- Scull, J., Phillips, M., Sharma, U., & Garnier, K. (2020). Innovations in teacher education at the time of COVID-19: An Australian perspective. *Journal of Education for Teaching*, 46(4), 497–506. <https://doi.org/10.1080/02607476.2020.1802701>
- Şen, N., & Yildiz Durak, H. (2022). Examining the relationships between English teachers' lifelong learning tendencies with professional competencies and technology integrating self-efficacy. *Education and Information Technologies*, 27, 5953–5988. <https://doi.org/10.1007/s10639-021-10867-8>
- Shagiakhmetova, M. N., Bystritskaya, E. V., Demir, S., Stepanov, R. A., Grishnova, E. E., & Kryukova, N. I. (2022). Primary teachers difficulties related to compulsory distance education during COVID-19. *Contemporary Educational Technology*, 14(2), Article ep357. <https://doi.org/10.30935/cedtech/11589>
- Siddiq, F., Scherer, R., & Tondeur, J. (2016). Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education. *Computers & Education*, 92–93, 1–14. <https://doi.org/10.1016/j.compedu.2015.10.006>
- Skaalvik, E. M., & Skaalvik, S. (2014). Teacher self-efficacy and perceived autonomy: Relations with teacher engagement, job satisfaction, and emotional exhaustion. *Psychological Reports*, 114(1), 68–77. <https://doi.org/10.2466/14.02.PRO.114k14w0>
- Sokal, L. J., Eblie Trudel, L. G., & Babb, J. C. (2020). Supporting teachers in times of change: The job demands-resources model and teacher burnout during the COVID-19 pandemic. *International Journal of Contemporary Education*, 3(2), 67–74. <https://doi.org/10.11114/ijce.v3i2.4931>
- Spiro, R. J., Feltovich, P. J., Feltovich, P. L., Jacobson, M. J., & Coulson, R. L. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology*, 31(5), 24–33.
- Stein, K. C., Minness, A., & Kintz, T. (2018). Teachers' cognitive flexibility on engagement and their ability to engage students: A theoretical and empirical exploration. *Teachers College Record*, 120(6), 1–38. <https://doi.org/10.1177/016146811812000607>
- Szyska, M., Tomczyk, Ł., & Kochanowicz, A. M. (2022). Digitalisation of schools from the perspective of teachers' opinions and experiences: The frequency of ICT use in education, attitudes towards new media, and support from management. *Sustainability*, 14, Article 8339. <https://doi.org/10.3390/su14148339>
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Pearson.
- Tomczyk, Ł. (2021). Declared and real level of digital skills of future teaching staff. *Education Sciences*, 11(10), Article 619. <https://doi.org/10.3390/educsci11100619>
- Tomczyk, Ł., & Walker, C. (2021). The emergency (crisis) e-learning as a challenge for teachers in Poland. *Education and Information Technologies*, 26(6), 6847–6877. <https://doi.org/10.1007/s10639-021-10539-7>
- Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2016a). Preparing beginning teachers for technology integration in education: Ready for take-off? *Technology, Pedagogy and Education*, 26(2), 157–177. <https://doi.org/10.1080/1475939X.2016.1193556>

- Tondeur, J., Scherer, R., Baran, E., Siddiq, F., Valtonen, T., & Sointu, E. (2019). Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. *British Journal of Educational Technology*, 50(3), 1189–1209. <https://doi.org/10.1111/bjet.12748>
- Tondeur, J., Tondeur, J., Forkosh-Baruch, A., Prestridge, S., Albion, P., & Edirisinghe, S. (2016b). Responding to challenges in teacher professional development for ICT integration in education. *Journal of Educational Technology & Society*, 19(3), 110–120.
- Toto, A., Limone, P., Rodrigo San Juan, C., & Caballé, S. (2021). Motivation, stress and impact of online teaching on Italian teachers during COVID-19. *Computers*, 10, Article 75. <https://doi.org/10.3390/COMPUTERS10060075>
- Tschannen-Moran, M., & Johnson, D. (2011). Exploring literacy teachers' self-efficacy beliefs: Potential sources at play. *Teaching and Teacher Education*, 27(4), 751–761. <https://doi.org/10.1016/j.tate.2010.12.005>
- Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing and elusive construct. *Teaching and Teacher Education*, 17, 783–805. [https://doi.org/10.1016/S0742-051X\(01\)00036-1](https://doi.org/10.1016/S0742-051X(01)00036-1)
- UNESCO. (2021). *Education: From COVID-19 school closures to recovery*. UNESCO: Building Peace through Education, Science and Culture, Communication and Information. <https://www.unesco.org/en/covid-19/education-response>
- Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of COVID-19. *Irish Educational Studies*, 40(2), 235–246. <https://doi.org/10.1080/03323315.2021.1916559>
- Wotto, M. (2020). The future high education distance learning in Canada, the United States, and France: Insights from before COVID-19 secondary data analysis. *Journal of Educational Technology Systems*, 49(2), 262–281. <https://doi.org/10.1177/0047239520940624>
- Xu, J. (2022). A person-centered approach to teacher motivation towards information technology: Integrating achievement goals and expectancy-value perspectives. *Educational Technology Research and Development*, 70, 397–417. <https://doi.org/10.1007/s11423-022-10085-0>
- Zadok-Gurman, T., Jakobovich, R., Dvash, E., Zafrani, K., Rolnik, B., Ganz, A. B., & Lev-Ari, S. (2021). Effect of inquiry-based stress reduction (IBSR) intervention on well-being, resilience and burnout of teachers during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(7), Article 3689. <https://doi.org/10.3390/ijerph18073689>
- Zhang, W., Wang, Y., Yang, L., & Wang, C. (2020). Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak. *Journal of Risk and Financial Management*, 13(3), Article 55. <https://doi.org/10.3390/JRFM13030055>

