INVESTIGATING TEACHERS' PERSPECTIVES ON DIGITAL COMPETENCE ACROSS EDUCATIONAL LEVELS

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Abstract

Nowadays, digital technologies have become an integral part of educational practices, but understanding their effective use to improve learning and pedagogy remains crucial. This study stems from the activities of the Erasmus+ D-Paideia project, which aims to fill the gaps in the DigCompEdu framework by emphasising social and emotional competences, digital well-being and mental health. The research involved consultations with teachers, using a mixed-methods approach with a Likert scale questionnaire and thematic analysis of open-ended responses. Results from 158 participants showed distinct practices, needs and challenges across different educational levels (from ISCED 0 to ISCED 3), alongside some common themes. Notably, there was consensus across all levels on the importance of professional engagement, including promoting well-being practices and understanding ICT policies. Overall, while teachers are increasingly incorporating digital tools into their teaching, there is a pressing need for continuous training, improved resources and strategies to address online risks and enhance student engagement.

Keywords: Digital literacy, Teachers' Professional Development, ISCED levels, Erasmus project.

1 INTRODUCTION

The integration of technology into education is expanding, but realizing its full potential remains complex [1] due to a misalignment between educational policies and teachers' actual practices. While policies encourage student-centered, constructivist approaches, many teachers continue using technology in traditional, teacher-centered ways. This gap is influenced by factors such as inadequate training, limited resources, and cultural or personal beliefs [2][3][1]. Additionally, the effectiveness of technology use depends on school readiness, socio-economic context, and educational level [4]. In primary schools, for example, technology is often used in teacher-centered approaches, particularly in subjects like math and language, while higher grades may adopt more student-centered uses [5]. Schools with limited support systems or where technology integration is viewed as compliance rather than transformation tend to have less impactful use of technology [6]. However, there is no single solution to these challenges, as different needs require diverse approaches [7][5]. Understanding teachers' perspectives is essential for effectively using digital tools, tailoring practices to instructional needs, and fostering mindful use of digital resources. The Erasmus+ D-Paideia project, launched in 2023, aims to address gaps in teachers' digital competence, particularly in areas like social-emotional skills, digital well-being, and mental health, using a mixed-methods approach to explore how school contexts influence technology use.

2 METHODOLOGY

2.1 Purpose and context of the study

This study is part of a broader research project on the validation of the D-Paideia Qualification Framework. Following an extensive literature review, innovative elements - related to professional development and socio-relational competences - were identified [9]. The first change refers to the integration of three competences in the professional engagement dimension: awareness of local and global policy, motivation for adopting digital technologies and balance and safety 'onlife'. The second change concerns the addition of a new dimension in the area of educators' pedagogical competences: the section on social skills and communication, including managing educational relationships with ICT, diverse and flexible teaching strategies and digital identity and reputation management.

To evaluate the relevance of these new dimensions, consultations were conducted between June and July 2023 with teachers and experts who voluntarily joined various events organised in different European countries, achieving a significant level of participation.

The study aims to address the following research question: What are the differences and peculiarities related to digital teaching skills among teachers of different school levels? Based on these analyses, this study will provide insights to inform policies and practices, taking into account the diverse contexts across Europe and reflecting the European strategy [10].

2.2 Collection and analysis of mixed data

The data were collected during the teachers' consultations via a questionnaire that included 12 questions with a Likert scale (1-7) to investigate the degree of agreement or disagreement with statements related to the topics of possible additions to DigCompEdu, as well as an open-ended question. In mixed methods research strategies, the survey can be viewed as a blend of different approaches, such as a semi-structured questionnaire featuring semi-open or open-ended questions, structured in sequence and formulation [11].

Table 1. Detail of the close-ended questions

Area	*Competence*	*Label*	*Item*
Professional engagement	Awareness on local and global policy	Q1	The digital competence of teachers must include the ability to responsibly and sustainably organise and manage the digital technologies available to improve working and study conditions.
		Q2	Teachers' digital competence must include understanding the relationship between digital practices in the classroom and institutional and/or national ICT policies, on the one hand, to support social priorities through teaching, and on the other to be able to have a critical eye and be proactive about the policies themselves.
	Motivation for adopting digital technologies	Q3	Motivation to adopt ICT is a fundamental dimension of digital competence: without it, even if able to use existing technologies in their practice, new possibilities are not explored in the classroom.
		Q4	The self-efficacy of in-service teachers in the implementation and use of technological tools can be improved through training.
	Balance and Safety 'Onlife'	Q5	Teachers must be prepared to educate their students about the implications and effects of their digital actions and behaviours on other users, adopting appropriate mitigation strategies if they fall victim to negative behaviours online; moreover, they themselves are subjects whose digital well-being must be actively promoted.
		Q6	DigCompEdu must be integrated with the health dimension, with reference to the need to identify and manage the risks and potential dangers of the network as well as the promotion of health and general well-being.
Social skills and communication	Managing educational relationships with ICT	Q7	Maintaining a remote relationship to communicate and cooperate with families and students is not easy and requires specific training.
		Q8	Keeping all learners motivated and engaged while teaching online, especially those with SEN, is one of the main challenges in the transition from face-to-face to online/distance learning.
	Diverse and flexible teaching strategies	Q9	Converting and preparing activities and content for online learning is one of the main challenges in the transition from face-to-face to online/distance learning.
		Q10	Teachers are not prepared for totally distance teaching as it requires, in addition to the use of digital tools, also the knowledge of a pedagogy related to digital teaching.
	Digital identity and reputation management	Q11	Digital identity management is an important component of digital competence. Teachers must be able to understand security measures, create and manage one or more digital identities, protect their digital reputation and manage data produced across different technologies, environments and digital services.
		Q12	The digital competence of teachers also concerns the ethical-social aspects. Teachers' digital lifestyles, such as participation in online professional communities, can influence how they communicate with peers and with their students.

Quantitative and qualitative analyses of data have been carried out with SPSS and QCAmap. Besides the descriptive statistics on DigCompEdu integrations, participants were categorised according to International Standard Classification of Education. Responses to the open-ended question ("*In your professional practice, what are the most important aspects of digital competence for teaching?*") were analysed using thematic analysis with an inductive categorization approach [12].

2.3 Participants

The sample included 179 teachers. Of these, 158 specified the school level at which they teach and were included in the research. The average age of the participants was 46.46 years (SD = 9.53), with ages ranging from 20 to 67 years. Participants had an average of 19.22 years of professional teaching experience (SD = 9.44). The majority of the teachers were female, and they represented various nationalities across Europe, mostly from the project partner consortium countries (see Table 2).

The sample exhibits a diverse representation across various educational levels. Nearly half of the participants are engaged in Primary Education (48%), while a significant portion works in Lower Secondary Education (23.4%). The Upper Secondary Education context includes 20% of participants and Early Childhood Education has the smallest representation with less than 10%. Otherwise, this distribution provides a comprehensive overview of the various educational stages covered by the study, allowing for a well-rounded understanding of pedagogical practices across different levels.

Table 2. Sample demographics (n = 158)

Factor	*Frequency*	*%*
Gender		
Female	128	81.0
Male	26	16.5
Nationality		
Italy	33	20.9
Spain	39	24.7
Greece	43	27.2
Bulgaria	26	16.5
Other	17	10.8
ISCED (International Standard Classification of Education)		
ISCED 0 (Early Childhood Education)	13	8.2
ISCED 1 (Primary Education)	76	48.1
ISCED 2 (Lower Secondary Education)	37	23.4
ISCED 3 (Upper Secondary Education)	32	20.3

3 RESULTS

3.1 Comparison between subgroups of teachers

Fig. 1 presents a descriptive analysis of results related to all questions. The orange bars represent the items linked to the expanded category of Professional Engagement, while the blue bars indicate those associated with the new Social Skills and Communication category. Both areas received a good level of agreement. Mainly, the average response of teachers falls between 6 (agree) and 7 (strongly agree), although in one-third of the items, particularly concerning the Social Skills and Communication dimension, the average response falls between 5 (slightly agree) and 6.

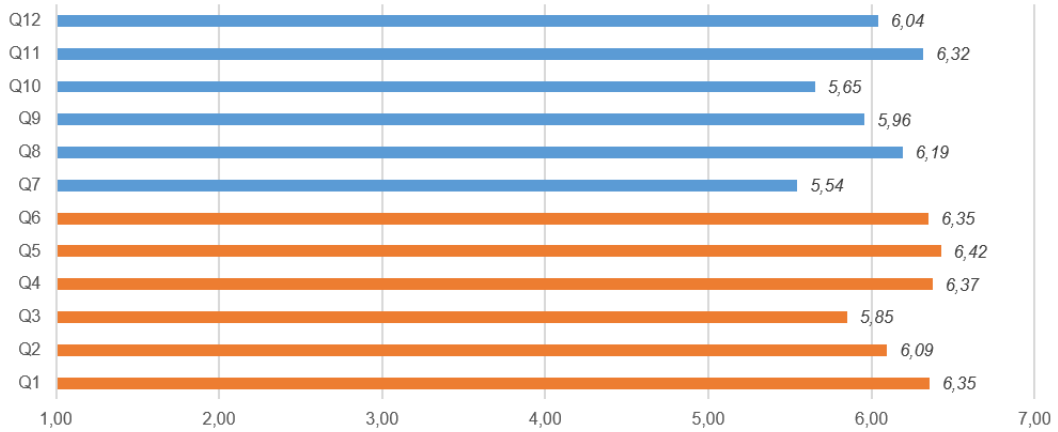

Figure 1. Average agreement for each item on a Likert scale from 1 to 7 (n=158)

The different perspectives on digital competencies of teachers working with different age groups were also explored through the comparison of questionnaire responses and the participant groups. For each subgroup (ISCED levels) and variable (questionnaire item), the Shapiro-Wilk test was performed to check the normality of the response distribution. If the p-value is less than 0.05, the null hypothesis is rejected, indicating that the data do not follow a normal distribution. For the 12 dimensions tested in the questionnaire, the assumptions of normality and homogeneity were not met. Since the Shapiro-Wilk test rejected the hypothesis of normality in the distribution of responses, the Kruskal-Wallis test for independent samples, a non-parametric version of ANOVA, was performed to examine differences between the groups of teachers. In this test, if the p-value is less than 0.05, it indicates significant differences among the groups, but it does not specify which groups differ from each other.

Table 3. Summary of hypothesis testing: Kruskal-Wallis test for independent samples

H0	Sig.[a]	Decision
The distribution for Q1 is the same across teachers from different school levels	0.965	Retain the null hypothesis
The distribution for Q2 is the same across teachers from different school levels	0.791	Retain the null hypothesis
The distribution for Q3 is the same across teachers from different school levels	0.496	Retain the null hypothesis
The distribution for Q4 is the same across teachers from different school levels	0.616	Retain the null hypothesis
The distribution for Q5 is the same across teachers from different school levels	0.511	Retain the null hypothesis
The distribution for Q6 is the same across teachers from different school levels	0.421	Retain the null hypothesis
The distribution for Q7 is the same across teachers from different school levels	0.519	Retain the null hypothesis
The distribution for Q8 is the same across teachers from different school levels	0.682	Retain the null hypothesis
The distribution for Q9 is the same across teachers from different school levels	0.378	Retain the null hypothesis
The distribution for Q10 is the same across teachers from different school levels	0.027*	Reject the null hypothesis
The distribution for Q11 is the same across teachers from different school levels	0.124	Retain the null hypothesis
The distribution for Q12 is the same across teachers from different school levels	0.076	Retain the null hypothesis

a. The significance level is .050 (2-sided test).

The results in Table 3 summarise the outcomes of the Kruskal-Wallis test for independent samples, which was used to assess whether the distribution of responses across different groups of teachers, based on school levels, varied significantly for each of the 12 questionnaire items (Q1 to Q12). For most items, the p-values are above the significance threshold of 0.05, indicating that there are no statistically significant differences in the distribution of responses across groups for these items. Specifically, the null hypothesis — that the distributions are the same across groups — is retained for items Q1 through Q9, as well as Q11 and Q12. However, for Q10 ("*Teachers are not prepared for totally distance teaching as it requires, in addition to the use of digital tools, also the knowledge of a pedagogy related to digital teaching*"), the p-value is 0.027, which is below the threshold of 0.05. This result leads to the rejection of the null hypothesis, suggesting that there is a statistically significant difference in the distribution of responses across the different school levels for this particular statement, which also results in the items with the lowest level of agreement.

Table 4. Q10 descriptive statistics per educational level

Groups	n	M	SD
ISCED 0	13	5,85	1,35
ISCED 1	76	5,39	1,42
ISCED 2	37	5,92	1,40
ISCED 3	32	5,87	1,39

Table 4 presents data on Q10, the item about teachers' preparedness for fully remote teaching, focusing on both digital tool usage and the related digital pedagogy, with comparisons across different educational levels. The subgroup ISCED 2 (Lower Secondary Education) reports the highest mean, whereas teachers from Pre-primary education display a mean of 5.85 (SD = 1.345), and Upper Secondary Education participants show a similar mean of 5.87 (SD = 1.385). Teachers in Primary Education report a slightly lower mean of 5.39 (SD = 1.415), indicating a somewhat lower agreement on being unprepared for fully remote teaching from a pedagogical perspective. These results suggest that primary school teachers, compared to other levels, feel better prepared to handle the transition to fully remote instruction.

3.2 Specificities of pedagogical-digital competence among school orders

The thematic analysis with inductive categorization was employed to explore perspectives related to digital competences across different educational levels, based on teachers' responses (N=154) to the question: "*In your professional practice, what are the most significant aspects of digital competence for teaching?*". The thematic analysis sought to address the guiding question: "*What are the specificities of digital competences for teaching across different school levels?*". Through this process, the study intended to identify distinct patterns in terms of challenges faced, needs expressed and teachers' digital practices. The challenges category highlights the obstacles educators encounter, such as time constraints, ethical concerns, and the risk of over-reliance on technology (Fig. 2). The needs' theme focuses on the resources and support that teachers consider essential for effectively implementing digital technologies (Fig. 3). Finally, the practices category encompasses the concrete actions and strategies that teachers employ to integrate digital technologies into their teaching, such as using, creating and sharing digital content (Fig. 4). Together, these themes provide a comprehensive overview of how teachers perceive digital competences across different educational levels.

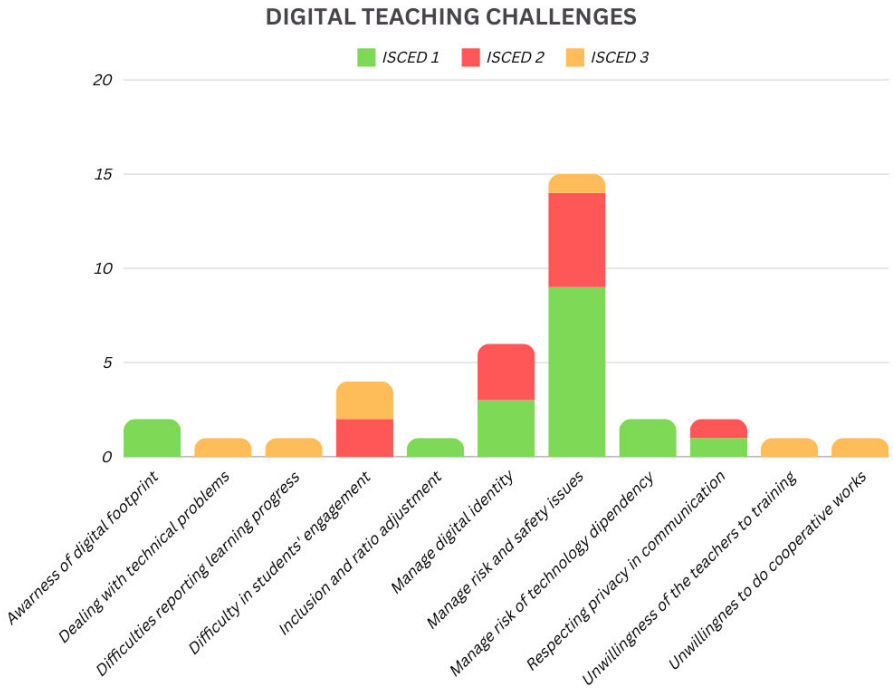

Figure 2. Overview of digital teaching challenges among school levels

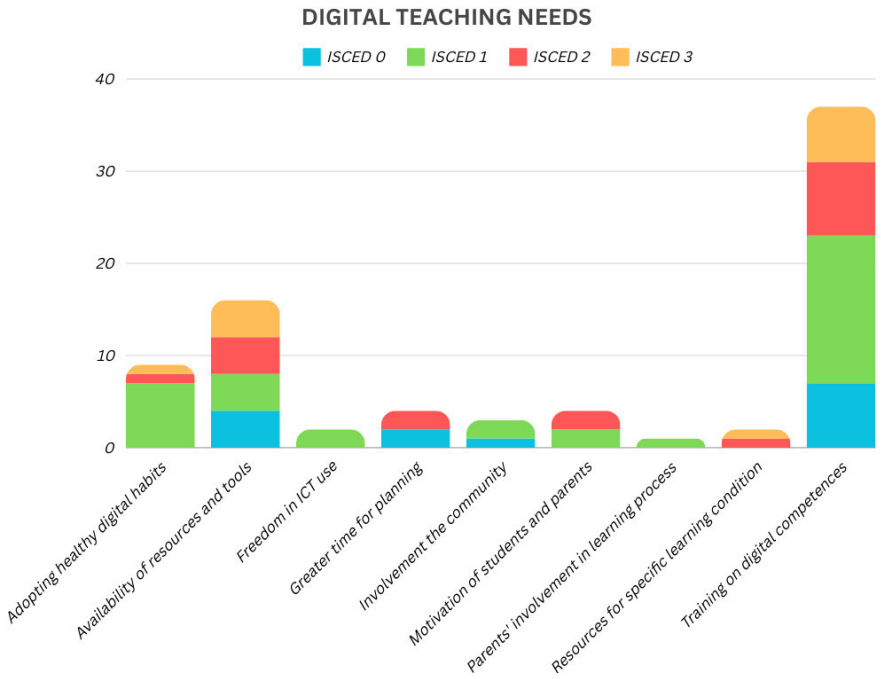

Figure 3. Overview of digital teaching needs among school levels

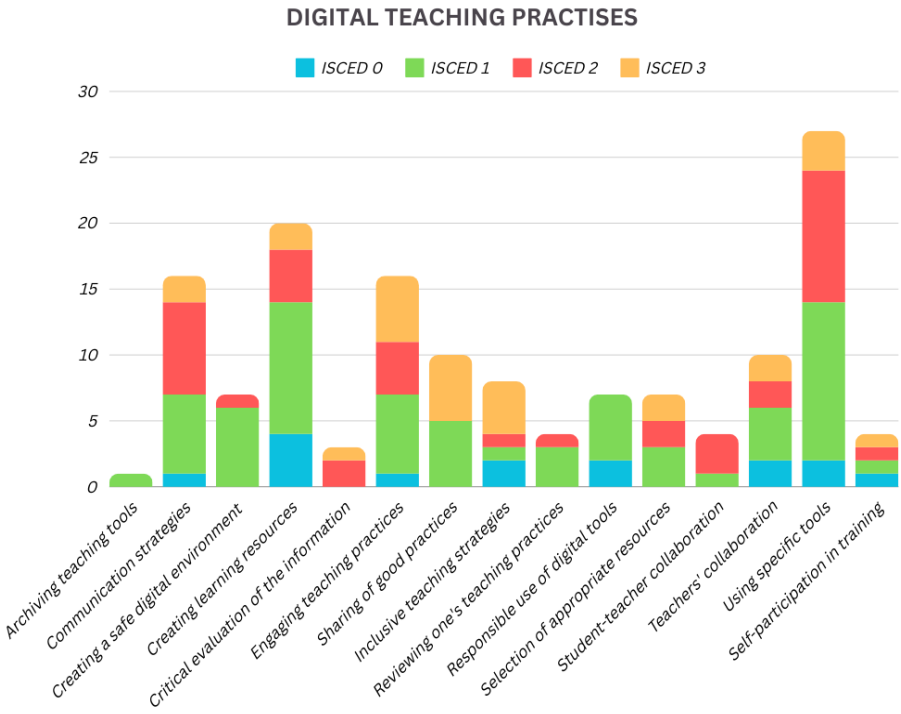

Figure 4. Overview of digital teaching practices among school levels

In the following subsections, the results will be presented with a focus on the particularly distinctive elements of each ISCED level, as these were either frequently mentioned or uniquely identified by the teachers at that level.

3.2.1 Early childhood education

Teachers working in early childhood education highlighted practices primarily related to "*developing learning resources adapted for working with preschool children*" (159_I0), utilising technical support tools such as "*interactive whiteboards*" (159_I0) or "*tablets, beebots, screens to complement learning!*" (156_I0). Additionally, collaborative practices among teachers were noted, particularly within shared

digital workspaces like "*Google workspace and cloud space*" (165_I0). Practices aimed at fostering student inclusion were also mentioned, such as those that "*favour the involvement of pupils in the design of a research-action project and cooperative learning*" (161_I0), ensuring that "*the needs of all students are met"* (152_I0). The final two practices pertain to the implementation of communication strategies and voluntary participation in professional development activities, such as "*online conferences and seminars*" (164_I0).

Regarding needs, there was a strong emphasis on promoting digital competence training for "*the whole teaching team*" (157_I0), both in terms of "*skills and knowledge in advance preparation*" (163_I0) for incoming teachers, and continuous professional development, to remain "*a good reference for our students*" (155_I0). Other needs included the availability of tools within the school and accessible resources for students, as well as the need for "*greater time for digital educational planning*" (157_I0) and the engagement of the entire educational community in teaching practices. No challenges were identified at the ISCED 0 level.

3.2.2 Primary education

In relation to primary school teachers, the predominant practices revolve around the creation of learning resources deemed "*suitable for our students*" (60_I1). The development of resources includes producing "*their own exercises, teaching materials that can be uploaded to their online classroom or presented during lessons"* (73_I1) or "'*programming*" (41_I1). Various digital tools are used to present these materials in the classroom, such as "*visual teaching aids*" (75_I1), digital apps and also presentation tools such as "*PowerPoint*" (62_I1), which promote interaction and "*help pupils memorise content*" (49_I1). Attention to using devices in a safe, responsible and critical manner is an aspect often mentioned by teachers, particularly with regard to the use of the Internet or the pedagogical application of "*social networks*" (35_I1). Another common practice within ISCED 1 is the use of ICT to structure engaging and participatory teaching, as "*digital media capture the attention of students, allowing students to learn without realising they are being taught*" (57_I1). Some teachers also promote media education by "*engaging students in simple digital literacy activities*" (62_I1).

Finally, a practice that emerged exclusively in ISCED 1 is the creation of an archive of the tools used.

Concerning the needs, teacher training emerged as the most pressing issue, with several instances indicating that it is sometimes insufficient: "*Specific preparation, which teachers do not always possess*" (66_I1). The need for ongoing and periodic training "*for the entire educational community*" (38_I1), including for school leaders, and the provision of "*constant support with training*" (29_I1), were also frequently mentioned. The availability of "*human and equipment resources*" (24_I1) was cited as essential, as it would "*enable teachers to work freely and with motivation*" (27_I1). Additionally, the need for "*an organised network of computers accessible to students within each classroom*" (83_I1) was highlighted.

Two specific needs emerged uniquely within ISCED 1: the "*freedom to work with technology in classrooms*" (29_I1) and the "*involvement of parents in children's learning process*" (31_I1).

Regarding challenges, frequent concerns were raised about managing online risks and safety to protect students: "*It is also very important for teachers and students to understand internet safety. Teachers should inform their students about the dangers of the internet so they can be cautious*" (73_I1). A unique issue underlined was the impact of the digital footprint: "*the traces we leave on everything we do online. Our digital identity is an indelible mark that identifies us and exposes us to those who know it and wish to misuse it*" (79_I1). Additionally, only in ISCED 1 was the issue of overcrowded classrooms raised, with concerns about its negative impact on inclusion: "*it is necessary to lower ratios and comply with the inclusion decree as a matter of priority*" (24_I1).

3.2.3 Lower secondary education

Lower secondary school teachers frequently highlighted the use of specific tools to support teaching, such as "*free digital applications for gamification, augmented reality, virtual reality, and public history*" (92_I2), "*AI tools*" (90_I2), and "*Padlet*" (107_I2), aimed at enhancing both student participation and inclusion. Tools designed for communication and collaboration were also mentioned, including "*email, discussion forums or online platforms*" (116_I2), as well as virtual meeting tools like "*Zoom, Skype, Teams, and Viber*" (102_I2), and collaborative online spaces such as "*Google Workspace*" (103_I2). Communication strategies surfaced as a central theme in pedagogical practices, employed to "*present the material as comprehensively as possible*" (97_I2) and to sustain effective communication with students and families in a remote context.

The creation of accessible and student-specific materials was also a common practice, to increase student engagement and participation: “I must be able to use technology to create engaging and interactive learning, including multimedia presentations, videos, interactive exercises and games” (116_I2).

In terms of needs, teachers expressed a strong demand for improved professional development, both initial and ongoing, which they felt was still insufficient: “It needs a lot of work...from everyone in this direction...to make it appear more efficient in the future” (118_I2). There was also a clear call for easily accessible “resources, hardware, and software” (88_I2), alongside “adequate technical support for hardware and specialised software” (94_I2) within the school context. Lastly, teachers emphasised the importance of the motivation and the positive attitude of students when using technology in learning, as well as the need for more time to design and create instructional content and specific programme for specific learning conditions: “It would help to have special programmes for each condition, e.g. a puzzle game for children with autism spectrum disorder or special programmes for children who cannot see well” (107_I2).

Regarding challenges, teachers expressed concerns about digital risks and security, with a special focus on students with SEND, to “ensure students' safety and teach them how to protect themselves in the digital world” (99_I2). Closely related to this were issues surrounding the protection of digital identity, personal data, and digital reputation. Another significant challenge identified was the difficulty in communicating and engaging students effectively: “the kids just didn't follow...!!! only the very good students did” (112_I2).

3.2.4 Upper secondary education

Upper secondary school teachers frequently highlighted participatory practices, such as “*facilitating the production of a group paper through online activities*” (130_I3) and “*engaging and stimulating activities for classes, particularly focused on current events*” (145_I3). Collaboration and sharing of best practices were also prominent, both among colleagues within the same institution and across different schools and educational levels: “*exchange of good practice between colleagues from schools of all levels*” (145_I3). Inclusive teaching practices were emphasised, ensuring “*clear presentation of the learning material so that each learner learns according to their own learning speed*” (143_I3), alongside personalised approaches through the use of digital tools like “*interactive whiteboards, digitisation of cultural programs via video creation*” (144_I3), and “*educational platforms and software*” (142_I3).

In terms of identified needs, teacher training remains a priority, as many “*teachers are not yet fully prepared for distance learning, which requires additional skills that are not part of their current training*” (136_I3). The availability of resources and tools was also flagged as essential, including “*high-speed internet connections*” (128_I3) and “*sufficient equipment*” (129_I3), which are often lacking. There was also a call for “*diverse teaching materials to cater to different students*” (125_I3), as well as the need to foster healthy digital habits, not only for students but for teachers themselves: “*teachers are also subjects whose digital wellbeing must be actively promoted*” (153_I3).

The challenges faced by upper secondary teachers included difficulties with “*effective communication and engaging students in the educational process*” (127_I3), which made teaching particularly demanding. Concerns about student safety were also highlighted: “*teachers must be equipped to educate students on the consequences and impact of their online behaviour on others, and help them develop coping strategies in case of negative online experiences*” (153_I3). Challenges unique to ISCED 3 teachers included “*the reluctance to participate in cooperative work*” (134_I3), which negatively affected relationships with both colleagues and students. Additionally, there was mention of “*teachers' unwillingness to engage in professional development or attend training that fosters digital literacy and introduces tools for innovative and inclusive teaching*” (146_I3). Other challenges included “*managing technical problems*” (136_I3) and difficulties in “*accurately tracking what students have genuinely learned*” (140_I3).

4 CONCLUSIONS

Digital technologies are a fundamental part of education today, but it is essential to prepare teachers to use them effectively to enhance their pedagogical practices. Increased knowledge of teachers' needs and perceptions in this area may help developing better training programme. From this perspective, the present study found that teachers across different educational levels largely agreed on aspects of digital competence to be added to the DigCompEdu framework, particularly in areas related to professional engagement, such as promoting well-being and understanding ICT-related policies. However, primary

school teachers were less supportive of being prepared for fully remote teaching compared to those in other levels. In parallel, qualitative analysis highlighted both shared and unique practices and challenges across education levels (ISCED 0-3). In early childhood and primary education, the focus is on creating digital resources, ensuring safe technology use, and fostering inclusion. As for primary education it is also emphasised managing technology dependency, digital footprints, and parent involvement. In lower secondary, advanced tools like augmented reality and gamification are used, while communication strategies and online safety remain key concerns. Upper secondary education focuses on collaborative learning and personalised instruction but faces challenges with technical issues and teacher reluctance to adopt digital tools. Across all levels, there is a strong demand for continuous teacher training, better access to digital resources, and increased attention to online risks and student engagement.

LIMITATIONS

Despite the significance of this study in providing valuable insights into digital teaching practices, some limitations must be acknowledged. Firstly, the data were collected through a self-reported questionnaire, which may introduce bias due to subjective responses. Additionally, while the sample includes teachers from diverse educational levels, it is unevenly distributed, with early childhood education (ISCED 0) being underrepresented. This unequal distribution could limit the generalizability of the results across all school levels. Finally, the participants were primarily from European countries, which restricts the broader applicability of the findings to other geographic contexts.

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