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The “new normality”:
Digital technologies
and learning environments
beyond the emergency

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Challenges and opportunities perceived by Swiss vocational education and training (VET) teachers during emergency remote teaching: The role of teachers' digital competence

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Abstract

This research explored the association between teachers' digital competence and their perception of specific topics as challenges or opportunities during the emergency remote teaching caused by the Covid-19 pandemic. The data were collected from 2282 Swiss vocational education and training (VET) teachers through open-ended questions and self-reported measures based on DigCompEdu. The results suggest that digital competence is associated with the tendency to perceive specific topics in terms of challenges or opportunities. Specifically, the teachers who reported *assessment*, *students' empowerment* and *self-directed learning* as opportunities had higher levels of competence in the respective DigCompEdu areas compared to those who perceived the same topics as challenges.

Keywords: Covid-19, Challenges, Opportunities, Digital Competence, Teachers, Vocational Education and Training.

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Introduction

The Covid-19 pandemic has posed several challenges to education caused by the suspension of face-to-face teaching, which required schools to suddenly implement emergency remote teaching (ERT; Hodges et al., 2020). Apart from constituting a challenge, ERT has also provided many opportunities, such as integrating online learning into the curriculum and upskilling and reskilling teachers in integrating new technologies (Gaur et al., 2020). At the same time, some authors argue that the risk of perceived challenges outweighing opportunities experienced during the ERT period could reinforce a negative attitude towards the use of digital technologies for teaching and learning (Hodges et al., 2020). Thus, understanding the factors associated with teachers' perceptions of ERT-related aspects as challenges or opportunities is important.

Researchers have investigated the perceived challenges and opportunities reported during the emergency period (Abu Talib et al., 2021; Ferri et al., 2020), focusing specifically on higher education (HE) (Turnbull et al., 2021). However, to the best of our knowledge, no studies have focused on the factors that could be positively or negatively associated with teachers' perceptions of ERT challenges and opportunities. In this study, we explored the role of digital competences as a specific factor that could affect teachers' perceptions of ERT challenges and opportunities. Specifically, we expected that teachers with higher levels of digital competence would have perceptions of more opportunities compared to teachers with lower levels of digital skills.

To explore this hypothesis, after investigating the perceived challenges and opportunities related to the educational, professional, and organizational issues of ERT, we compared them with the level of digital competences of teachers. A total of 2282 Swiss vocational education and training (VET) teachers participated. We focused on VET because although it was particularly disrupted by the pandemic, especially for the practical-based component of the educational system (International Labour Organization [ILO], 2021), this educational context has been underexplored compared to HE in the context of ERT.

Emergency remote teaching: Differences and similarities with online learning

Many different terms have been used to define the period of the forced shift to online teaching caused by the pandemic, including distance learning and online learning (Ferri et al., 2020). In the context of this paper, we use the definition provided by Hodges et al. (2020) of ERT, which is a concept used in contrast to the notion of online learning. Online learning refers to experiences planned from the beginning and designed to be online. In contrast, ERT refers to a temporary shift in instructional delivery to an alternative delivery mode due to crisis circumstances. ERT involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or in blended mode and that are expected to return to that format once the crisis has abated. In contrast with online learning, the primary objective in ERT circumstances is not to re-create a robust educational ecosystem but rather to provide temporary access to instructional support as fast as possible. The need to ‘just get it online’ is in direct contradiction to the time and effort normally dedicated to developing a quality online course. Consequently, it is not surprising that in most educational contexts, challenges and barriers are perceived more often than opportunities and advantages when referring to ERT. For these reasons, Hodges et al. (*ibid.*) suggest that the primary focus of analysis focused on ERT should be ERT itself as a process to understand where teachers and students struggled most with ERT and then to best address these operational challenges in the future.

Emergency remote teaching during the Covid-19 pandemic: Challenges and opportunities

The impact of the Covid-19 lockdown on schools varied according to different factors, including the level of education. Most of our knowledge regarding schools’ responses to ERT comes from HE and healthcare (Deery, 2020; Gordon et al., 2020). Healthcare education was particularly disrupted by the pandemic because increasing pa-

tient demand created a greater need for healthcare professionals and, at the same time, many health science students experienced delays and other shifts in their clinical education. Reviews of the healthcare sector generally reported a good response to the pandemic's challenges, because HE institutions reacted immediately with innovative educational practices, for example, by introducing new simulation solutions (*ibid.*). Abu Talib et al. (2021) reported opportunities related to HE, such as *flexibility* provided by remote learning, *discussion and communication* that specifically experimented with different formats of communication to have more direct communication between students and lecturers, as well as the possibility for teachers to *self-reflect* and *innovate* their practices. Other reported advantages relate to the *effectiveness* of ERT for students' learning and *exposing students to modern and relevant technologies*.

At the same time, HE also faced key disadvantages (*ibid.*). The most frequently reported challenges were *inequality and inaccessibility*, meaning that online learning exacerbated differences between students based on their socio-economic background. The second challenge was *inadequacy*, which means that online training was not easily adaptable to specific kinds of teaching practices, such as hands-on training. The third challenge was *communication quality*, which is related to the difficulties in building relationships between students. The fourth challenge was *infrastructure*, specifically poor internet connections and other technical issues that interfere with the flow of communication. Other challenges included students' *well-being*, teachers' level of *digital competences*, low levels of *engagement* by students, difficulties in *assessing student performance*, especially for practical courses, *teachers' work-life balance* and privacy concerns.

Despite the challenges and opportunities reported during the ERT caused by Covid-19 (see, for example, Abu Talib et al., 2021), to the best of our knowledge, no studies have investigated whether the perception of challenges and opportunities is associated with the presence of barriers and enablers for technology integration in the educational settings studied. Scholars have emphasized the important role that barriers and enablers play in the effective integration of digital technologies in schools (Schmitz et al., 2022). The most

common reference framework proposed by Ertmer (1999) classifies barriers and distinguishes between first order and second-order barriers. The former includes external obstacles related to school infrastructure (Sicilia, 2005) and curriculum organization, such as a lack of technology access, resource availability, training, support, and time (British Educational Communication and Technology Agency, 2004; Sicilia, 2005). Second-order barriers are intrinsic to teachers and refer to their personal beliefs about technology use in education and pedagogy. This internal barrier seems to be more complicated to overcome than first-order barriers (Ertmer, 2005).

Tsai and Chai (2012) suggest that the lack of design thinking by teachers, which strictly relates to the teachers' digital competence, could be the third-order barrier. If the lack of digital competence can be considered a barrier to the adoption of digital technologies in teaching, a good level of digital competence could be a strong predictor of teachers' willingness and efforts to use technology, even when faced with limited resources or time (Ertmer et al., 2006). As teachers' intrinsic factors are significantly more influential than extrinsic factors in their decisions to use technology (*ibid.*), teachers' digital competence could play a significant role in ERT. In recent years, several efforts have been made to define the digital competences that teachers need to use technology in the classroom (Krumsvik et al., 2016). The digital competence of teachers not only includes the technical skills of using technological devices and digital resources in an educational context but also considers the pedagogical dimension (Re-decker, 2017), attitudes, strategies and awareness that enable teachers using technology to achieve teaching and learning goals effectively (Hämäläinen et al., 2021).

Emergency remote teaching in the vocational education and training system

As already reported in the introduction, despite the important consequences the pandemic has had for the VET system, only a few studies have explored the responses of VET teachers to the chal-

lenges faced during ERT. An exception is an explorative study by Delcker and Ifenthaler (2020), who focused on the challenges VET teachers faced in ERT during the spring 2020 lockdown in Germany. The authors analyzed 18 in-depth interviews focusing on intrapersonal prerequisites for teaching with technology, the changes in learning and teaching attitudes related to technology integration and the preconditions concerning schools as part of a learning organization. Many of the identified challenges were like those reported by Abu Talib et al' (2021) review of HE: the lack of *infrastructure* in terms of internet connection and the need to use personal equipment; *students' engagement* in terms of participation; teachers' heterogeneous level of digital competences; and students' assessment methods. The authors found that, although most schools were provided with learning platforms, the available systems were used only by a small number of teachers before the pandemic. Consequently, both the VET teachers and the students reported a low level of knowledge about using Learning Management System and that they had difficulties adapting to the change in a short period of time. Moreover, the teachers' responses revealed heterogeneity in terms of their digital competences, which revealed other challenges related to students' participation in learning activities and assessment methods. The only specific aspect of the VET context reported by Delcker and Ifenthaler (2020) was the cooperation between schools and companies where apprentices were employed, which was reported by teachers in terms of both challenges and opportunities. These preliminary results suggest that VET responses to ERT could have some peculiar aspects that need to be further investigated.

Research questions

The aim of this study was twofold: first, to investigate and compare the challenges and opportunities related to ERT reported by Swiss VET teachers during the Covid-19 pandemic and second, to understand the extent to which teachers' perceptions of challenges and opportunities experienced during ERT in the first Covid-19 emergency

were associated with their levels of digital competence. Our specific research questions were as follows:

1. Which ERT-related topics do teachers most frequently report as challenges and opportunities?
2. Is the perception of specific topics more as challenges or opportunities associated with the level of VET teachers' self-assessed level of digital competence?

Methods

Data collection

The data were collected through an online survey completed voluntarily by teachers from Swiss vocational schools between June and September 2020. After receiving permission from the Education Administration, a link to the online questionnaire was sent to all vocational institutions requesting that the school management forward the link to the teachers. All participants were informed of the study's aim, and their anonymity was guaranteed. We collected 3404 responses; 972 were excluded from the analyses because those questionnaires were less than 100% completed. After data cleaning, the final analytical sample included 2282 teachers (M = 1016; F = 1004). Most participants were aged between 40 and 59 years (40-49 = 28.6%; 50-59 = 33 %).

Measures

Challenges and opportunities

The participants were asked to describe the challenges and opportunities experienced during the forced transition to remote teaching in two open-ended questions. We adopted the open-ended format since there are no validated questionnaires for analyzing the challenges and opportunities perceived by teachers during ERT. Moreover, we wanted to provide teachers with the possibility to freely express their perspectives.

Teachers' digital competence

Based on the European Framework for the Digital Competence of Educators (see DigCompEdu2.0 in Redecker, 2017), we used a 22-item self-assessment measure for teachers' digital competence on a 5-point Likert scale (see also Lucas et al., 2021). Digital competence comprises six dimensions: 1) professional engagement, 2) digital resources, 3) teaching and learning, 4) assessment, 5) empowering learners and 6) facilitating learners' digital competence. Compared to other frameworks for assessing digital competences, DigCompEdu includes both competences related to the practice of teaching with technologies and competences related to fostering students' appropriate digital competence.

Qualitative content analysis

Qualitative content analysis is a method that preserves the advantages of quantitative content analysis to transfer and further develop it into qualitative-interpretative steps of analysis (Mayring, 2015). We developed a coding scheme organized into 5 macro-categories and 13 sub-categories (see Table 1) based on the theoretical definition of the aspects of analysis, specifically the literature on challenges and opportunities, barriers, and enablers and the DigCompEdu framework.

Table 1. Coding scheme for the qualitative content analysis

Macro category	Sub-category	Examples of challenges	Examples of opportunities
Professional issue (DigCompEd area 1)	Professional collaboration	Finding resources and support from colleagues.	Collaborating, communicating, and comparing ideas with colleagues.
	Self-directed learning	Difficulties in developing the needed digital competences.	Learning how to apply technologies on the job; discovering new tools.

Didactic issue (DigCompEdu areas 2-6)	Digital resources (area 2)	Availability, selection and creation.	Editing and personalisation; sharing.
	Teaching and learning (area 4)	Designing, planning and implementing lessons and educational programmes.	Effectiveness of new methods on learning; creativity, flexibility and enrichment.
	Assessment (area 3)	Testing; formative and summative assessment.	Revisions and feedback; monitoring.
	Empowering learners (area 5)	Motivating; sustaining attention and participation; supporting students' accessibility and autonomy.	Designing personalised and adaptive learning paths according to the students' learning needs.
	Communicative relations (areas 3 and 5)	Maintaining and sustaining contact with students.	Increased trust in the relationship between teachers and students;
	Learners' digital competence (area 6)	Low level of learners' digital competence.	Learning autonomy and digital skills; ethical use of digital technologies.
Organisational issue	Personal	Physical and psychological fatigue; work-life imbalance-related anxieties.	Working from home; reducing commuting; flexibility in private life organisation; tracking working time.
	Institutional	Poor institutional directives, higher workload.	ICT support; collaboration with external institutions.

Technological issue	Use of digital tools	Software and platforms functioning; displeasure with the use of ICT.	Using technologies in teaching; enlarging the range of digital technologies adopted.
	Infrastructure	Availability of internet network.	<i>Not mentioned as an opportunity</i>
Transversal issue	Time	Perceived lack of time.	Opportunities for time management.

Our units of analysis (UA) were the individual answers to the two open-ended questions on challenges and opportunities (Strijbos et al., 2006). A coder assigned one or more sub-categories to the 4564 UA, following a non-mutually exclusive approach. Inter-coder agreement between two coders was calculated on 15% of the UA ($K = .904$). We calculated the sub-categories' frequencies in the 4564 UA. To analyze the differences in the challenges and opportunities reported by VET teachers, we performed McNemar tests on these paired nominal data using IBM SPSS Statistics (version 27). We used the coding 0 ('no') and 1 ('yes') for all categories, which were always coded separately to depict the challenges and the opportunities. As this resulted in 2×2 tables for the analysis, we report Cramer's V as the effect size when the McNemar test elicited significant differences (Miers et al., 2007).

Merging of quantitative and qualitative data

We first reported the descriptive statistics for *teachers' digital competence*. We triangulated the quantitative data only for the sub-categories where the difference between challenges and opportunities was statistically significant. We used the t test to determine whether the average level of digital competences was different between the group of people who reported a specific topic as a challenge and the group who reported the same topic as an opportunity. Cohen's D is reported as a measure of the effects size.

Results

Which ERT-related do teachers most frequently report as challenges and as opportunities?

From the analysis of the macro categories, it emerged that the didactic dimension occurred mostly as both a challenge and an opportunity (Figure 1). Four dimensions were reported more frequently as challenges than as opportunities: didactic, organizational, technological and time. Only the professional dimension was reported more frequently as an opportunity than as a challenge.

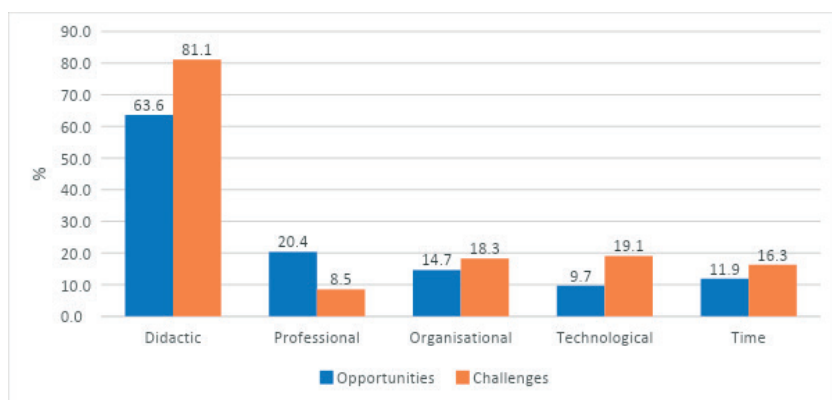


Figure 1. Frequencies of macro-categories in terms of challenges and opportunities

The analysis of the sub-categories (Figure 2) revealed that the most frequently reported challenges related to empowering learners (45.5%), followed by teaching and learning (31.2%), communicative relations (23.7%) and the use of digital technologies (13.4%). The most frequently reported opportunities related to teaching and learning (23.4%), followed by supporting learners' digital competence (17%), empowering learners (16.5%), personal organization (13.8%) and self-directed learning (13.5%).

Five out of thirteen sub-categories were reported significantly more often as challenges than opportunities. Among these, three categories are associated with the DigCompEdu areas: teaching and learning ($\chi^2(1) = 6.064$, $p = .014$, $V = .050$), assessment ($\chi^2(1) = 12.509$, $p \leq .001$, $V = .072$) and empowering learners ($\chi^2(1) = 26.483$, $p \leq .001$, $V = .105$). The other two categories relate to institutional organization ($\chi^2(1) = 10.202$, $p = .001$, $V = .065$) and the general use of digital technologies ($\chi^2(1) = 4.524$, $p = .033$, $V = .044$).

The analysis of the qualitative data suggests that some of these challenges have specific characteristics in the VET context. For example, role-playing simulation, which is commonly adopted in VET both for teaching and learning and for assessment, was one of the challenges commonly reported by VET teachers (Extract 1):

Extract 1: *The main challenge for me was to re-design simulation activities, which are characterized by practical group activities, by using digital technologies* (VET Teacher 1)

Two sub-categories were reported statistically more often as opportunities than as challenges: teachers' self-directed learning ($\chi^2(1) = 20.825$, $p \leq .001$, $V = .103$), which is associated with area 1 of the DigCompEdu, and personal organization ($\chi^2(1) = 24.183$; $p = .000$, $V = .101$).

As per the former, teachers often reported the opportunity to learn how to use tools their schools offered that they had never had the chance to learn before ERT (Extracts 2-3):

Extract 2: *An opportunity was to learn how to use the tools that we have, of which I did not know the potential. This knowledge will be useful during in-person lessons* (VET Teacher 2)

Extract 3: *I could hardly have dedicated so much time in a normal situation to learning how to use Moodle and other tools we have from our school* (VET Teacher 3)

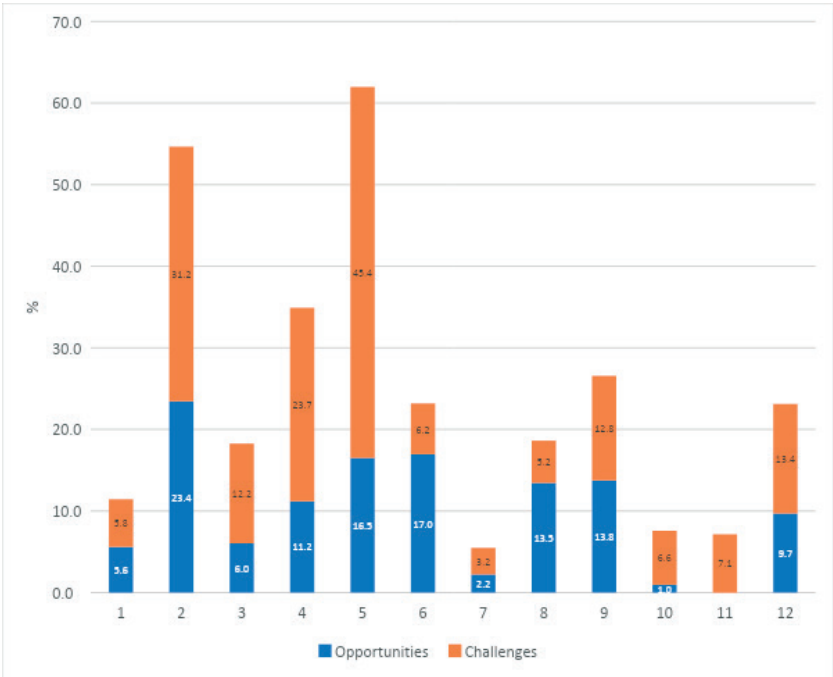


Figure 2. Frequencies of sub-categories in terms of challenges and opportunities

Digital competences, challenges, and opportunities

The general descriptive statistics of the six areas of digital competence are presented in Table 2. The highest mean score was observed for the *digital resources' selection* area and the lowest for the *assessment* area of competence (for more information, see Cattaneo et al., 2022).

Table 2. Descriptive statistics of digital competence (N = 2282)

	Mean	SD
Area 1: professional engagement	2.29	.784
Area 2: digital resources	2.67	.73
Area 3: teaching and learning	1.88	.83

Area 4: assessment	1.68	.90
Area 5: empowering learners	2.14	.77
Area 6: facilitating learners' digital competence	1.84	.82

To test whether digital competence was associated with the likelihood of reporting a specific topic as a challenge or as an opportunity, we considered the four topics directly aligned to the DigCompEdu areas: teaching and learning; assessment; empowering learners; and teachers' self-directed learning. The teachers who reported *assessment*, *students' empowerment* and *self-directed learning* as opportunities had significantly higher levels of competence in the respective DigCompEdu areas compared to those who perceived the same topics as challenges (see Table 3 for more details). Extract 4 presents an example of opportunities identified by a VET teacher in relation to assessment:

Extract 4: *the possibility to use Moodle tools to create quizzes, cross-words etc.; using the Moodle platform to personalize assignments for written and oral assessments* (VET Teacher 4)

There were no statistically significant differences in terms of digital competence in the corresponding area of teaching and learning between those teachers who reported the topic of teaching and learning as a challenge and those who reported it as an opportunity.

Table 3. Comparison of digital competences of the teachers who reported assessment, empowering learners, and self-directed learning as a challenge or as an opportunity

	Challenges <i>Assessment</i>			Opportunities <i>Assessment</i>			t test		
	N	M	SD	N	M	SD	t	p	D
Digital competence <i>Assessment</i>	249	1.68	.88	109	1.96	.88	2.89	.004	.332
	Challenges <i>Empowering learners</i>			Opportunities <i>Empowering learners</i>					
	N	M	SD	N	M	SD	t	p	D
Digital competence <i>Empowering learners</i>	827	2.18	.70	168	2.33	.77	2.51	.012	.213

	Challenges			Challenges					
	<i>Self-directed learning</i>			<i>Self-directed learning</i>					
Digital competence	N	M	SD	N	M	SD	t	p	D
<i>Professional engagement</i>	82	2.1	.704	271	2.29	.72	2.09	.037	.264

Discussion and conclusion

In this study, we investigated the challenges and opportunities related to ERT during the Covid-19 pandemic perceived by a large sample of VET teachers in Switzerland.

In line with the literature on HE (Abu Talib et al., 2021), assessment, students’ empowerment, teaching and learning, infrastructure and institutional organization were perceived by VET teachers more frequently as challenges than opportunities. Despite similarities with HE, the analysis of the qualitative data suggests that these challenges have specific characteristics in the VET context.

The only two topics perceived more often as opportunities than as challenges concerned the teachers’ side, specifically the possibility of self-directing their learning and better organizing their work.

Interestingly, a few topics that in previous papers were reported more as challenges (*ibid.*) were reported equally as challenges and as opportunities in the Swiss VET context, including the use of digital resources, the possibility to communicate with students and learners’ development of digital competence. These results suggest that the average level of teachers’ digital competence and infrastructure in Swiss VET contexts is sufficiently good to face commonly perceived challenges (Cattaneo et al., 2022). Only 7% of the teachers reported issues related to infrastructure, in contrast with previous studies, which reported infrastructure as one of the main ERT-related challenges (Abu Talib et al., 2021).

Except for infrastructure, which was reported only as a challenge, all the topics were reported in terms of challenges and opportunities, although with different frequencies. This result can be understood by examining specific aspects of the topics considered. For example, with

reference to the sub-category of communicative relations, social presence (Cui et al., 2013) was treated mainly as a challenge, while immediacy and frequency of communication were treated as opportunities. Besides the objective constraints of digital technologies that teachers adopted during ERT, teachers needed to be competent to identify the educational opportunities of these technologies (Withagen et al., 2012). In this respect, the novelty of this research was to try to connect the challenges and opportunities reported by VET teachers with their level of digital competence by triangulating open-ended answers with quantitative self-report measures. The results suggest that the level of digital competence is associated with the tendency to perceive specific topics more as challenges or opportunities. The teachers who perceived *assessment*, *students' empowerment* and *self-directed learning* as opportunities had significantly higher levels of digital competence in the respective DigCompEdu areas than the teachers who perceived these three topics as challenges. Teachers who self-assess their digital competence as good are likely to have a positive attitude towards remote teaching and, in general, towards online teaching (Antonietti et al., 2022). Therefore, teachers who believe they are competent in using digital technologies for assessing and supporting learners can better identify strategies to accomplish these objectives, even in the different settings of remote teaching.

This research has some limitations that need to be addressed in future research. First, we focused on the challenges and opportunities reported exclusively by VET teachers. Consequently, our data are affected by a teacher-centered approach. By including vocational students and school management, we would probably have been able to collect more information in relation to the challenges related to the work-based learning component of students' apprenticeships and the digital transformation of vocational schools, which were rarely mentioned by the VET teachers in their answers. The teachers were also asked to express their challenges and opportunities during ERT with open-ended answers. In most cases, the teachers provided quite short answers, probably expressing the most salient challenges and opportunities. In-depth interviews would have allowed for the collection of fine-grained information regarding their experiences during

ERT. The third limitation is the exclusive focus on VET teachers' digital competence. The effective integration of digital technologies in teaching depends on several potential enablers and barriers. Not only individual factors, such as teachers' digital competences, attitudes, and beliefs, but also contextual factors, such as school infrastructure (Sicilia, 2005), curriculum organization (British Educational Communication and Technology Agency, 2004; Sicilia, 2005) and professional development opportunities, which we did not take into account in this research, could affect teachers' perceptions of challenges and opportunities during ERT.

Despite these limitations, this research has shown that challenges and opportunities during ERT can be associated with a specific kind of enabler, which is teacher digital competence. If, on the one hand, having a higher level of self-assessed digital competence could facilitate teachers in identifying opportunities in ERT, on the other hand, having a lower level of digital skills might make challenges more salient than opportunities. Hodges et al. (2020) identified the risk that negative experiences during ERT could reinforce a negative attitude towards online teaching and the use of digital technologies for teaching and learning. In response to this risk, schools should monitor teachers' attitudes towards digital technologies for teaching and learning. Attitude towards digital technologies is affected by two main beliefs: the perception that the technology is useful for teaching activities and the perception that the technology is easy to use (Scherer et al., 2019). Thus, continuing training for teachers should be personalized as much as possible towards their teaching needs so that they perceive the technology as useful. Other studies have shown an important correlation between attending further education on technology integration and self-assessed digital competence (Rauseo et al., 2021). Moreover, training should propose digital technology with a gradual level of complexity based on the teacher's level of proficiency with specific educational technologies, not to reinforce the belief that digital technologies are difficult to use. Having teachers with a positive attitude towards digital technologies is quite important in VET, since digital technologies can be used to bring more practice into the training of VET students (Dobricki et al., 2020) and to facilitate the

combination of school-based and company-based tracks, supporting the development of key professional competences.

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