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Exploring teachers' perceptions of critical digital literacies and how these are manifested in their teaching practices

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ABSTRACT

Digital systems are increasingly becoming central to the running of contemporary schools. A range of digital tools are also adopted by teachers to facilitate face to face teaching and learning and more recently to accommodate remote schooling. Similarly, digital technologies lie at the heart of how students support their learning but also interact with peers. These digital practices raise questions in relation to teachers' own critical digital literacies as well as their role in developing students' critical digital literacies. This paper presents the findings of a qualitative study that aimed to develop an understanding of teachers' current experiences and future needs relating to critical digital literacies within school contexts. Drawing on empirical data collected during focus group interviews with primary and secondary school teachers in Finland, Italy, Spain and the UK this paper looks at teachers' perceptions of critical digital literacies and explores whether and how these are manifested in their practices. Findings revealed that different dimensions of critical digital literacies were more prevalent for each national group and highlighted the disjuncture between how Critical digital literacies (CDL) is defined and perceived in academic research with a stronger emphasis on the "critical" and between the more "twenty-first century skills" oriented policy agendas and curricula which inform teachers' practice. The paper goes on to discuss the implications of these findings and identifies gaps in relation to teachers' understandings of critical digital literacies. Last, it offers original insights for future policymaking, research and practice regarding the challenges of supporting teachers with developing critical digital literacies.

Introduction

Digital technology use has become an integral aspect of contemporary education and can shape how formal schooling is being carried out. Digital systems are increasingly seen as central to the running and organisation of modern educational institutions

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and a range of digital tools are adopted by teachers to facilitate teaching and learning as well as support their professional development (Selwyn et al., 2017). At the same time digital technologies often lie at the heart of how students engage with or support their learning but also communicate, interact and hang out with peers (Smahel et al., 2020). The increased adoption of digitised and platformised practices clearly has implications for how teaching and learning take place within technology-mediated contexts but also for how teachers and students navigate these digital worlds (Pangrazio et al., 2020). Furthermore, altered economic, social and technological environments create significant challenges for understanding what it means to be digitally literate today (Bulfin & McGraw, 2015; Hobbs, 2020) and raise questions regarding the role that formal education institutions might play in supporting students with developing new forms of digital literacy. Although the term "digital literacy" is contested and "suffers from a lack of agreed definition" (Merchant, 2021, p. 96) developing digital competences is seen as an important facet of teacher and student education (Ilomäki et al., 2016). Still, training activities and curricula are often predominantly focused on the acquisition of technical skills whereas cultivating a more critical disposition towards emerging phenomena in the digitalised world is often overlooked (Raffaghelli & Stewart, 2020; Ranieri, 2019).

Against this background, this paper presents the findings of a qualitative study that aimed to develop an understanding of teachers' current experiences and future needs in relation to Critical digital literacies (CDL) within a school context. The study was conducted as part of a three-year Erasmus + project, which aims to support school teachers with developing their understanding and practices relating to the various dimensions of digital literacies. Drawing on empirical data collected during focus group interviews with primary and secondary school teachers in Finland, Italy, Spain and the UK this paper looks at teachers' perceptions of the various dimensions of critical digital literacies and explores how these are manifested in their teaching practices. The goal of this paper is twofold. First, we aim to develop an understanding of the dimensions of critical digital literacies that feature more prominently in teachers' practices across the different national contexts. Second, our goal is to draw attention to new and emerging issues that require critical disposition in the fast-changing digitised world and to identify areas that, although at present do not feature in teachers' perceptions of critical digital literacies, they need to be integrated into future policy-making agendas and addressed through relevant teacher training opportunities.

Background

The notion of digital literacy is central to research and education policy, however, it is ever-evolving and often contested, and multiple definitions have emerged in academic literature and policy documents since the term was first coined by Gilster (1997). In particular, the early 1990s signalled the introduction and growing popularity of a range of other terms associated with the changing nature of literacy. These ranged from multiliteracies (New London Group, 1996), computer literacy (Burniske, 2006), media literacy (Hobbs & Mihailidis, 2019; Livingstone, 2003), new literacies (Lankshear & Knobel, 2011), and multimodal literacy (Jewitt & Kress, 2003) to name but a few. Regional differences have also been noted, with the term "digital literacy" used mainly in English speaking

parts of the world whereas "digital competence" is more prominent in European countries such as Spain, Italy and the Nordic countries (Spante et al., 2018).

Several conceptual frameworks have been developed in recent years as a means of capturing different aspects of "digital literacies" or "digital competencies" resulting in increased complexity regarding the conceptual understanding of what these terms entail (Erstad et al., 2021). Academic research in the field acknowledges the complexity and messiness of digital literacy as well as its increasingly expanding conceptualisations to ingrate previously distinct understandings of literacy such as information literacy, computer literacy and media literacy (Marsh, 2019). At the same time multimodality is seen to be at the heart of digital literacy (Gillen, 2014) as meaning and knowledge are no longer built up though words only but also through various modalities such as images, texts, symbols, interactions, abstract design, sound etc. (Gee, 2003) as digital technology use is becoming increasingly common in homes and classrooms.

This plethora of terms and definitions adopted in academic research publications over the past decades indicates the complex, multi-faceted and constantly evolving nature of digital literacy. As others have highlighted it is no longer accurate to perceive digital literacies merely as technical skills or competences in isolation from the range of social, economic and political factors that underpin digital practices in the twenty-first century (McDougall et al., 2018). As such, this research study is consistent with previous work, which argues that educators' and students' choices and actions when using digital technologies need to be underpinned not only by relevant skills but also by critical understanding and agency (Ávila, 2021; Pangrazio, 2016).

Furthermore, we adopt the plural form "critical digital literacies" rather than "literacy" in this paper in order to break away from one-dimensional understandings of the term and to capture instead its more complex and dynamic nature that encompasses a multitude of dimensions. As Erstad et al. (2019) argue the plural form of "literacies" is used in recognition of the "sociocultural perspectives on literacy as social practice"; of "the diversity of contemporary digital literacy practices that young people take part in" and "of the plurality of ways that this concept has been interpreted in academic accounts" (p. 1). Recognising how the notion of digital literacies has been shaped by often "diverse scholarly lineages" we embrace Nichols and Stornaiuolo's (2019, p. 15) conceptualisation of critical digital literacies as an assemblage of meanings and practices and less as a bounded concept.

At the same time, when referring to the concept of critical digital literacies, although we acknowledge the relevance of technical skills for digital technology use and participation, we predominantly seek to emphasise the "critical" aspects of digital literacies and highlight how engaging effectively in digital practices "requires a complex amalgam of linguistic, technological, contextual, and critical skills, knowledge, and understandings" (Tour et al., 2021, p. 2). Furthermore, our understanding and theorising of CDL has been informed by Pötzsch's (2019) interpretation of critical digital literacies which emphasises not only the new competences required to use digital technologies responsibly and efficiently, but also the ability "to contextualise this use with an eye on capitalist dynamics, environmental ramifications, and individual empowerment" (p. 222). As Burnett and Merchant (2020) note, the complex ways in which text entangles with social, political and civic life creates a pressing need to cultivate critical literacy in education ranging from what they have called the "small c" critical literacy which refers to "developing evaluative,

discerning readers" to "Big C" critical literacy which is "championed by educators committed to social justice and political empowerment" (p. 87).

Although academic research in the field of critical digital literacies strongly emphasises the varied operational, multimodal, sociocultural and critical dimensions of digital literacies practices, relevant policy agendas and curricula at large prioritise the development of "twenty-first‑century skills" required for participation in knowledge economies (Nichols & Stornaiuolo, 2019; Wood et al., 2020). For example, from a policy perspective, the different frameworks developed so far largely emphasise the technical aspects of using digital technologies effectively in the classroom, focus on issues of e-safety and also place emphasis on digital skills that will enhance students' future employment opportunities such as computing and programming (European Union, 2020; Redecker, 2017; UNESCO, 2018). As such, there appears to be a disjuncture between how the concept of critical digital literacies is understood and conceptualised in academic research and how it is operationalised through relevant education policy agendas and curricula.

While the importance of digital literacies for teachers is well recognised, relevant research studies often focus on exploring teachers' technical digital literacies or look at their levels of readiness and self-efficacy in relation to using digital technology to support teaching and learning (Hatlevik, 2017; Tondeur et al., 2017). The move to remote schooling during the pandemic has also highlighted the great variation regarding teachers' digital readiness and prior familiarity with digital technology use to support teaching and learning in ways that go beyond digital content creation (Carretero Gomez et al., 2021; Gouseti, 2021) and integrate digital technology into meaningful social practices (Iivari et al., 2020).

Teachers' understandings and interpretations of digital literacies play a prominent role in how these are translated into distinct learning objectives and relevant classroom activities (Oudeweetering & Voogt, 2018). To this end, this paper aims to develop relevant insights regarding the level and nature of teachers' perceptions and experiences with critical digital literacies across four different European contexts and explore whether meaningful connections can be drawn between academic conceptualisations of CDL and teachers' understandings and operationalisation of this concept. In particular, it seeks to address the following research questions:

- What are primary and secondary teachers' perceptions and experiences of critical digital literacies across different educational contexts?
- What are the main issues and gaps that can be identified in relation to teachers' perceptions and experiences of critical digital literacies?

The CDL framework as a data collection and analytical tool

Before discussing the study's methodological approach it is important to provide some context regarding the CDL framework, which informed the data collection and analysis of this study, and to also position ourselves vis-à-vis the framework.

When considering the various ways in which the digital materialises in educational settings and in teachers' and students' lives and in order to respond critically to the increasing complexity and diversity of digital practices, we propose an expanded notion of

critical digital literacies. This encompasses the dimensions of technology use; data litera- cies; information literacies; digital content creation; digital teaching and learning; digital citizenship; digital wellbeing and safety; and digital communication and collaboration (Gouseti et al., 2021). Brief definitions of all dimensions and sub-dimensions can be found in Appendix 1, and these are relevant since the sub-dimensions were used as a coding scheme for the data analysis.

Furthermore, as explained in the previous section we embrace the term critical digital literacies in order to emphasise the significance of adopting a critical stance regarding the digital literacies relevant for teachers and students in the digital era. We see a thread of criticality weaved through all dimensions and sub-dimensions of the CDL framework, even the ones who appear to be more commonplace. For instance, "being critical" can relate to critical thinking and understanding regarding digital technology use as well as critical awareness, self-reflection and evaluation of one's own and others' digital practices and online engagement.

At the same time, in line with Tour et al. (2021) and Pötzsch's (2019) theorisation of the critical aspects of CDL, we argue that developing critical digital literacies also suggests a mind-set shift for educators and students alike. More specifically teachers and students become critical thinkers who question and challenge, for instance, the increased digitisation and datafication of education and wider society, which is often shaped by commercial and other interests. Criticality can also be manifested in how tea- chers and students become co-creators and collaborators who question, rethink and even re-invent digital media rather than simply consume media content or view it as neutral.

Although we embrace all dimensions and sub-dimensions of CDL as relevant for tea- chers' and students' online engagement and participation in education and society, we also acknowledge that not all of them will be pertinent to the same extent for all edu- cational levels and contexts. This is because some aspects of CDL are inherently more complex than others or require varying levels of criticality, which can be fostered as stu- dents get older. For instance, younger students in primary schools can start to develop information literacies regarding online inquiry, source validation and copyright and they can advance, as they get older, to more complex understandings regarding fake news and propaganda. Against this context, we will now go on to discuss the study's methodological approach.

Methodology

The research questions were addressed through an exploratory study conducted through multiple focus group interviews in five European schools and two education levels in Feb- ruary--June 2020 within the framework of a transnational, European collaborative project. Although no national or comparative international analysis is intended, the five cases yield relevant data, which can be studied in search of divergent and concurrent patterns across the different cultural contexts. The relevant Ethics Committees or other local auth- orities as required in each national case granted ethics clearance.

The data collection involved conducting seven semi-structured focus group interviews with teachers from primary and secondary schools in Finland, Italy, Spain and the UK. It should be noted that for the purposes of this paper the focus is on Catalonia and

England rather than Spain and the UK respectively due to the diversification of the education system in the two countries and the different policy agendas and National Curricula that exist within both countries. Participants included 39 teachers in total with three to seven participants per focus group (see Table 1).

Participants were recruited from the Erasmus + project partner schools therefore a convenience sampling method (Cohen et al., 2017) was adopted. Out of the 39 interviewees eight were familiar with the concept of critical digital literacies since they had been involved in previous meetings and activities organised as part of the Erasmus + project. The interviews explored the participants' opinions about critical attitudes towards the use of digital technologies in schools and the preliminary version of a new Critical Digital Literacies framework, developed by the DETECT project, was used as a point of reference during the second part of the interviews once initial teacher perceptions were explored (see Figure 1). The interviews were conducted both face to face (Primary 2 and Secondary 1) and online (Primary 1, Secondary 2 and Secondary 3) due to pandemic-related restrictions. The interviews were audio recorded and transcribed verbatim.

The interview transcripts were analysed using thematic analysis (TA) with a deductive approach since the coding themes were derived from preconceived ideas but the coding was based on qualitative, reflexive interpretation of data, known as codebook TA (Braun et al., 2019). In particular, the CDL framework (see Gouseti et al., 2021) was used as a coding scheme and all interview data were coded in national languages according to the various CDL sub-dimensions.

In the first phase, the data were read and segmented. All relevant excerpts of the interviews addressing aspects related to CDL framework sub-dimensions were marked and

Table 1. Summary of schools and participants.

|	School location	School type	Focus groups	Participants	Subject areas
Primary 1 (UK)	Urban, inner London	State-run primary (students aged 5-11)	2	6 (5 female, 1 male)	Year 3 teachers (4) Year 4 teacher (1) Year 1–6 music teacher (1)
Primary 2 (SP)	Urban, upper Barcelona	Private, secular primary (students aged 6-12)	1	4 (1 male, 3 females)	IT coordinator (Students aged 6-12), Math & Sciences (2), Computer Science, English & Science
Secondary 1 (SP)	Urban, upper Barcelona -	Private, secular baccalaureate (students aged 13-18)	1	5 (3 males, 2 females)	Math (Students aged 12-14), Math, Physics & Chemistry (Students aged 14-16), Science & Technology, Math, Science & Technology, Technology (Students aged 14-16), Economics (Students aged 16-18)
Secondary 2 (FI)	Suburban, Espoo	Comprehensive school, participants from lower secondary level (students aged 13-15)	2	7 (2 males, 5 females)	Native language and literature; Mathematics, Physics and Chemistry; English and Swedish (2); French, English and Drama pedagogy; History and Social studies; Music and Drama pedagogy
Secondary 3 (IT)	Urban school in Florence	Vocational and technical school (students aged 14-19)	3	17 (4 males, 13 females)	Humanities teachers (8) STEM teachers (6) Special needs teachers (3)
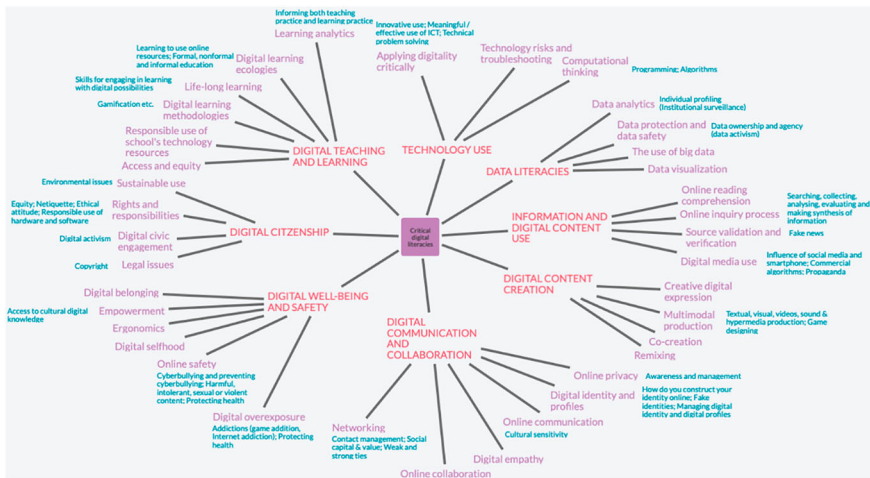
Figure 1. Draft critical digital literacies framework shared with teachers.

chosen for the analysis. Interview excerpts conveying a comment, description or opinion related to CDL were counted as a segment, be that a single word, a clause or a longer excerpt of the text. The total number of marked segments was 666 in all nine focus group interviews. If the segments included a reference relating to two sub-dimensions in a way that was not separable, the excerpt was coded into both.

Researchers in each country analysed the data in their national language. To ensure the reliability of the analyses, the researchers translated and collected a representative sample of codings (n = 117 out of 666) for each sub-category from each school in a shared table (see DETECT, 2021a). The excerpts under the codings were examined by all researchers in several consensus meetings.

The complexity of the notion of critical digital literacies and the sometimes overlapping nature of the sub-dimensions was manifested during the coding and analysis process in different ways. More specifically, difficulties arose in relation to the following: (i) referring to experiences and practices relating to more than one sub-dimension of CDL in the same quotation. This was addressed by having a double code in those quotations if it was not possible to divide them into smaller fragments and this was agreed jointly in the consensus meetings; (ii) difficulties with understanding the context from a detached quotation because of vague wording used by the interviewee, translation issues (i.e. when using colloquial language), or referring to a very local context. This was resolved by adding some contextual comments in the data and discussing them in the meetings; (iii) different interpretation of the quotation by different researchers (not many cases). In order to address this, the coding was changed after researchers' joint discussions about the criteria and this also helped define the dimensions better and produce the final criteria for the final coding. Following this, the researchers made the final analysis for their national data using these jointly agreed criteria.

Last, this study sought to make sense not only of how teachers perceived CDL and which dimensions were more prominent in their discussions but it also aimed to identify misconceptions and gaps in how CDL was interpreted by participants. For this reason, we analysed thematically teachers' discussions around CDL drawing on the dimensions and

sub-dimensions of the CDL framework but we also interpreted the absence of other dimensions as a means of identifying and problematising relevant gaps.

Findings

Our interview findings suggest that teachers in all schools had some level of awareness regarding particular dimensions and sub-dimensions of CDL and there were similarities as well as disparities as to which dimensions of CDL featured more prominently in the discussions of the different focus groups. More specifically Table 2 presents the results of the interview analyses, showing the code groundedness (number of times a code is present in the text) in each CDL category from each school. The paper will now go on to present the cases across the five school contexts with direct quotations highlighting representative themes relating to teachers' perceptions of critical digital literacies and how these are (or are not) manifested in their practices.

Primary 1 (England)

Findings across the two focus groups suggest the biggest emphasis was placed on the dimension of *Digital teaching and learning* and in particular the sub-dimension *Digital pedagogical methods*. English participants predominantly talked about using digital technologies to support their planning and teaching activities. This included amongst others the use of various educational software and schemes of work for creating lessons, laptops used by students for independent research in the classroom as well as using a game-based approach to teaching in order to enhance engagement. For instance, a teacher talked about how the use of a game-learning platform was seen to increase student engagement and motivation:

> Kahoot is really popular with my kids. They really love that. The engagement just goes through the roof, whatever you're trying to practice, they love that. (T1-FG1)

Issues relating to the sub-dimension of *Learning ecologies* were also discussed since the move to remote teaching highlighted that primary school students needed a great level of parental support in order to be able to engage in online learning and as one teacher acknowledged "we'd had to provide the support to the parents to then support their children" (T1-FG2).

Another CDL dimension frequently discussed was that of *Digital well-being and safety* with a particular focus on *Online safety*. This included doing "lots of work on internet safety … how we should keep passwords secret and things like that, and talk about cyber-bullying" (T2-FG1), "what to click on, what to type, what to search for, what's safe, what's not safe" (T4-FG2). Furthermore, some of the teachers acknowledged that although social media sites and video games have age limits they were aware that their students (aged 7–9 years old) had been using these and recognised the need to develop students' critical digital literacies. As one of the teachers put it:

> Obviously things like social media start to be part of their lives more and more, so I think the curriculum does need to change to reflect that and actually understand that children as young as year three could be using social media in some way. (T2-FG1)

Table 2. Results of interview analyses showing the code groundedness (DETECT, 2021b).

CDL dimension	Primary 1		Primary 2		Secondary 1		Secondary 2		Secondary 3		Total	
	f	%	f	%	f	%	f	%	f	%	f	%
TECHNOLOGY USE	27	23.1	21	24.7	22	17.5	15	9.38	82	46.07	167	25.1
Applying digitality critically	0		10		12		8		81		111	
Technology risks and troubleshooting	18		3		5		6		1		33	
Computational thinking	9		8		5		1		0		23	
DATA LITERACIES	3	2.6	1	1.2	16	12.7	4	2.50	8	4.5	32	4.8
Data analytics	0		0		4		0		0		4	
Data protection and data safety	3		1		4		0		1		9	
The use of big/open data	0		0		3		2		2		7	
Data visualisation	0		0		5		2		5		12	
INFORMATION LITERACY	10	8.5	9	10.6	15	11.9	32	20.0	18	10.1	84	12.6
Online reading comprehension	0		0		1		0		3		4	
Online inquiry process	7		2		5		18		0		32	
Source validation and verification	3		4		6		13		14		40	
Digital media use	0		3		3		1		1		8	
DIGITAL CONTENT CREATION	2	1.7	1	1.2	6	4.8	10	6.3	8	4.5	27	4.1
Creative digital expression	1		0		4		2		5		12	
Multimodal production	1		0		0		8		1		10	
Co-creation	0		0		2		0		2		4	
Remixing	0		1		0		0		0		1	
DIGITAL COMMUNICATION AND COLLABORATION	15	12.8	10	11.8	19	15.1	12	7.5	7	3.9	63	9.5
Online privacy	2		2		1		4		0		9	
Digital identity and profiles	0		4		2		0		1		7	
Online communication	9		2		4		4		5		24	
Digital empathy	1		0		1		4		0		6	
Online collaboration	2		2		3		0		1		8	
Networking	1		0		8		0		0		9	
DIGITAL WELL-BEING AND SAFETY	28	23.9	16	18.8	15	11.9	14	8.8	11	6.2	84	12.6
Digital overexposure	3		2		1		3		0		9	
Online safety	23		12		9		10		11		65	
Digital selfhood	1		0		1		0		0		2	
Ergonomics	1		0		0		0		0		1	
Empowerment	0		2		3		0		0		5	
Digital belonging	0		0		1		1		0		2	

(*Continued*)

Table 2. Continued.

CDL dimension	Primary 1		Primary 2		Secondary 1		Secondary 2		Secondary 3		Total	
	f	%	f	%	f	%	f	%	f	%	f	%
DIGITAL CITIZENSHIP	3	2.6	8	9.4	13	10.3	13	8.1	12	6.7	49	7.4
Digital civic engagement	0		0		0		0		6		6	
Rights and responsibilities	3		6		8		12		6		35	
Sustainable use	0		2		5		1		0		8	
DIGITAL TEACHING AND LEARNING	29	24.8	19	22.4	20	15.9	60	37.5	32	18.0	160	24.0
Digital pedagogical methods	25		7		9		41		28		110	
Digital learning ecologies	4		12		11		19		4		50	
Learning analytics	0		0		0		0		0		0	
TOTAL	117	100.0	85	100.0	126	100.0	160	100.0	178	100.0	666	100.0

Interviewees also frequently discussed *Technology use* with a particular focus on the sub-dimensions of *Technology risks and troubleshooting* and *Computational thinking*. For example, teachers talked about teaching computing as part of the National Curriculum as well as frequently having to overcome technical issues and engage in effective trouble-shooting. The Google classroom was adopted to facilitate remote education during the pandemic and the interviewees placed particular emphasis on the time consuming task of troubleshooting in order to resolve mundane issues such as re-sharing students' forgotten log-ins and teaching them basic skills. Teachers also highlighted how there was great variation regarding students' digital skills and talked about how "there is definitely a big divide even in the children's literacy levels when it comes to computers in our own class" (T3 - FG1).

Another CDL dimension discussed albeit to a lesser extent was that of *Digital communication and collaboration*. Teachers mentioned that digital tools such as Google Hangouts were used to facilitate online interaction both amongst students and staff during the lock-down while they also reported that "having it all digital is a lot easier and is really good for collaboration" (T1-FG1). Teachers also reflected on how the move to remote education created an increased need to support students with developing an understanding of a relevant netiquette for online communication. As this teacher described:

> There's been one child that we have had to mute and not necessarily because they're specifically rude to other children, just more silly comments and lots of commenting and we've had to sort of teach them computer etiquette in terms of how you write to one another, how you speak to one another, even using things like emojis. (T4-FG2)

The dimension of *Information literacies* appeared to be less relevant for the English teachers and this can be to some extent justified by the young age of their students since the participants taught students aged 7–8 years old:

> I think higher up in the school […] they look at fake news and not fake news and being able to decipher between what is a reputable kind of website and one that you can trust the information from and which isn't. (T1 – FG1)

Similarly, other dimensions, which featured less in the teachers' discussions included *Digital content creation*, *Digital citizenship* and *Data literacies*. Although the teachers recognised the relevance of these, these informed their teaching practices very little if any at all.

Primary 2 (Catalonia)

The primary school teachers were predominantly concerned about *Technology use, Digital teaching and learning* and *Digital well-being and safety* as critical issues when dealing with technology. In fact, their comments related to the problem of teaching the students to live as an "educational community" and taking care of the available ICT resources. Moreover, the sub-dimension of *Applying digitality critically* appeared relevant, entailing the relationship between the digital and the material side of technologies. The teachers' concern related to the invisibility of the "wealth of resources the school and the families provide" for younger children. In particular, the children were used to getting the needed devices for their work, and in the earlier stages of school, these were school-community resources, which they often disregarded:

In sixth grade, for example, they are very aware of how to take care of the computer, in fifth grade also because it is their computer; but in the middle cycle (8-9 years old), since they use community computers, they do not have the same care, and we often find that they do not know how to use them. (T3)

This also related to the teachers' difficulties in coordinating collaborative activities, in terms of the efforts made to get individual children focused on their materials and digital identity as basics to interact in collaborative environments. The teachers explained that "living together" requires careful planning and guidance, as a base for the more advanced forms of "teaching and learning" with technologies:

I (…) would say that we have the introduction, what tools are introduced at what time. That is, tools (gesture indicating the shape of a device like a tablet) what devices are introduced at any given time, we have it very patterned, very sequenced, and somehow with a logic behind it. (T1)

From the *Digital learning ecologies* perspective, orchestrating the resources, relationships and activities to learning in a continuum between the classroom, the informal groups and the families, was seen by the teachers as requiring further attention.

Last, the least commented dimensions amongst primary school teachers were those relating to *Content creation* and *Data literacy*. In particular, only the problems relating to understanding authorship and licences' limitations to re-use of content and data privacy appeared in the participants' group discussions.

Secondary 1 (Catalonia)

The secondary school teachers from the Catalonian school focused in a balanced way on several of the CDL's dimensions. The issue observed by the teachers was mainly students' lack of effort to solve software usage problems since these fundamental issues were resolved by the assistance provided by the school associated with the sub-dimension of *Applying digitality critically*. At this age, the students worked either with their own devices or school devices and as the teachers pointed out, the careless attitude related to both owned and school devices:

The laziness at the time of problem-solving … It's like "I have a problem with the computer. I don't need to be self-sufficient in this, (…). I go and give it to the support technician and he makes it work for me". (T5)

And this also involves a little care - especially I speak in the first cycle of secondary school (ESO) - in the materials they use. That is, "My computer crashes", and nothing happens. "There's the computer, and they change it for me, or they give me a loan while they send it to the factory, and that's it." They don't care about the material. (T3)

Digital communication and collaboration, represented mainly by the sub-dimensions *Networking* and *Online collaboration* was also a focus of concern. In fact, the teenagers adopted several social media and digital entertainment spaces that could not be controlled by the teacher, leading to conflicting situations. As this teacher explained "we'll get to a point where we do everything via WhatsApp … it's easier, but we don't see them, the group dynamics that can hurt … they are teens … " (T2).

As mentioned, the teachers' discussions spread over several dimensions and the dimension of *Digital well-being and safety* and in particular the sub dimension of *Online*

safety was also frequently addressed. Teachers commented regarding social media usage, privacy and safety, and their discussions were tightly connected also to the sub-dimension of *Networking*. As this teacher put it:

> We always work with safe environments, controlled environments and of course, we don't have situations where things happen that may be outside, yes. So I think we should generate these situations and somehow make students realise that it's one thing to explain it and it's another thing for students to come across such a situation. For example, thinking that you are talking to a … that you are communicating with a partner from another place and it turns out that they are an adult or something like that, and you don't realise it. And simulating these situations, I think, would be interesting. (T4)

Online safety also led to teachers considering the problem of data privacy and described what they did in order to raise students' awareness regarding the data they share and who can access and control it:

> Likewise, to raise awareness, in the first cycle of secondary school (ESO), when we do these hours of tutoring and PAT and talk about screens, mobile phones and such, we try to make them aware of where the data is going to end up; that mobile apps that are free are not free; we put them in a Basté (a journalist) program called "Això no potser" (This Can't Be), which talked about data, and this impacted them a lot, and we try to make this little awareness in the students. (T2)

As for *Data literacy,* the teachers' discussions also dealt with the more technical skills required in developing technological scenarios. The concern around data literacy was discussed across a range of subject areas from science to social subjects to humanities, from a focus on students' inquiry activities requiring data elaboration and interpretation, to the graphic art embedded in visualisation. Moreover, more recently the social subjects' teachers have started to explore the problem of bias in data usages for Artificial Intelligence (AI) purposes. As this teacher described:

> The secondary school project is focused on this: analysing how artificial intelligence analyses … The concept, not in detail, but the concept of how algorithms often control us and how to control from the point of view of personal security what data we give and such … At least we launch it from here … (T3)

The categories which raised less concern were *Digital content creation* and *Digital citizenship*. As for the first case, the comments made by the teachers were relevant and tackled the problem of considering licences while generating digital artefacts as part of the students' activity. As for the second, the debate focused on the rights and responsibilities in adopting technological equipment as well as using digital environments "to be" (a student within the school, a son/daughter in the family, a citizen overall).

To conclude, the teachers' discussions were focused on technology use and digital communication and collaboration both in the secondary and primary school levels. One might consider the school peculiarities in this sense. In fact, the school put relevant efforts into working as a learning community (sharing and re-using devices) and working collaboratively. As a result, the teachers' discussions about their practices were concurrent with these two dimensions. As diversified aspects, it was clear to find more concern on the criticalities raised by going "outside" in the digital world by teens. Also their competences to become an active part of recent innovations in digital environments were a concern for teachers.

Secondary 2 (Finland)

Many aspects mentioned in the focus group interviews of the Finnish school were discussed from the viewpoint of educational practices (dimension *Digital teaching and learning*). The sub-dimension *Digital pedagogical methods* emerged most frequently, but usually together with some other sub-dimension - in the following example related to *Online privacy*:

> I have shown them that klips klips klips how a picture is moved to another website and modified a bit, this is how it goes, that never put there anything that you are not ready to show your grandma or father. (T1, FG1)

Also issues related to *Digital learning ecologies* were frequently mentioned, especially addressing the availability and use of high-quality digital teaching and learning materials as well as the adequacy of technical resources for teachers and students in the school.

Otherwise the most frequently discussed CDL sub-dimensions were *Online inquiry process* and *Source validation and verification* (both under Information literacies), and *Rights and responsibilities* (under Digital citizenship). Concerning *Online inquiry*, the teachers discussed their students lacking skills in searching for information, the need to teach students better online information seeking skills and versatile use of information sources besides Wikipedia as well as the teachers' own pedagogical practices to teach online inquiry skills. For example:

> In a way, in that age you don't know where to search for … where it is worth searching for, let alone knowing which keywords you should use. (T4, FG2)

> I have mainly insisted that they must tell their sources, Wikipedia cannot be the only source. (T2, FG1)

Comments on *Source validation and verification* addressed issues of source criticism in general and various practices that should be taught to students related to evaluating sources. As this teacher explained:

> A lot of attention has to be paid all the time to the issue that they don't know how to evaluate the reliability of information. And it's challenging then to think how to teach students how to evaluate the reliability of sources. Like now, well, now, for example, during this Corona time, which information about corona is reliable and which is not. There's all kinds of rubbish that the Web is full of, if you make them write an essay about Corona. (T5, FG2)

All comments and discussions in the interviews, categorised under *Digital rights and responsibilities*, related to copyright issues and plagiarism. For example, as this teacher explains "whatever is done [with students], we always pay attention to whether you have the right to use images, for example, and this type of issues" (T6, FG2).

Under the dimension *Digital well-being and safety*, a few discussions related to *Online safety* (all on cyberbullying), and under the dimension *Digital content creation*, a few comments focussed on *Multimodal production* (mostly including examples of student tasks applied by the teachers that represented multimodal production). Otherwise these dimensions received little attention. Issues relating to *Data literacies* were addressed minimally, and many sub-dimensions also under other dimensions of the CDL framework got only single mentions or were not mentioned at all (e.g. *Co-creation, Remixing, Online collaboration, Networking, Learning analytics*).

To conclude, the discussions in the focus group interviews of the Finnish school mostly addressed aspects concerning epistemic and knowledge-related practices, such as online inquiry, source validation and verification, copyright, multimodal production or the use of teaching and learning materials. Technical, social or well-being and safety issues were less-frequently mentioned. Perhaps knowledge-related issues are more relevant in lower-secondary level where teaching is organised according to subjects and the curriculum emphasises the learning of subject-specific content and skills.

Secondary 3 (Italy)

Through the analysis of the interviews of the Italian teachers three sub-dimensions of the CDL framework emerged as most common and included *Applying digitality critically*, *Digital pedagogical methods* and *Source validation and verification*. In relation to the sub-dimension of *Applying digitality critically*, before the pandemic, teachers were used to integrating digital technologies into their daily practices according to their levels of digital competence. Therefore, some teachers were advanced and intense users, while other teachers were just beginners and occasional users. However, the lockdown due to Covid-19 forced teachers to adopt digital tools for remote teaching and develop new competences, despite some challenges mainly due to the self-training which was necessary for the educational use of ICTs. As this teacher explained:

> At the beginning I struggled a lot, if I hadn't had my son, I would not have known how to set up an online lesson. These things made me proud, and from this experience I gained new competences. (T6, FG1)

Teachers also highlighted how students were better equipped to engage with digital activities linked to their interests and hobbies and less so when it came to using digital technology for study purposes. For instance this teacher emphasised the importance of relevant guidance:

> Students had a little experience with digital technologies, although they are considered as digital natives. They are able to do what interests them (video games, social) but if they have to download a digital version of a book or need to send an email, teachers have to guide them. (T4, FG1)

Finally, teachers highlighted the need for specific training to improve their own level of digital competence in relation to *Digital teaching and learning*. As this teacher put it:

> I would like to deepen the remote teaching methods, even if it doesn't replace the in presence teaching, but could be an opportunity for professional development. (T6, FG1)

Regarding *Digital pedagogical methods*, on one hand, teachers discussed their digital teaching practices comparing their uses before and during the Covid-19 pandemic: the adoption of the flipped classroom method for teaching history, web writing activities, creating effective messages for Twitter. As reported by a teacher:

> I've carried out my teaching activities adopting the flipped classroom methods, giving them a video the day before the lesson, then I selected 1 or 2 students who presented an historical character or event, and I created conceptual maps of what was being discussed. Finally, I also gave them 3 questions to assess their understanding of the main concepts. (T3, FG1)

On the other hand, some difficulties in managing remote lessons were also underlined, especially referring to the assignments' review and class management. Another important emerging aspect was related to the cross-curricula characteristics of teaching digital competences, which cannot be taught through teacher-centred theoretical input, but also requires practical hands on engagement.

The challenge of fake news and the need for checking the source of online information was seen by teachers as extremely relevant and it was associated with the critical aspects of CDL relating to *Information literacies* and in particular *Source validation and verification*. As this teacher explained:

> It is important knowing from where the information is taken and understanding its sources. When I need to do a translation, not to select the first translator that came from my search. The students need to learn by questioning what they are doing and reading. (T4, FG2)

Finally, the less discussed framework sub-dimensions were *Digital media use, Data protection and safety, Online collaboration, Digital identity and profile, Multimodal production, Technology risks and troubleshooting*.

Discussion

Our findings highlight a range of similarities and differences underpinning teachers' perceptions and experiences of critical digital literacies and also help us to identify relevant issues and gaps. Our first research question related to teachers' contextual experiences about critical digital literacies. We adopted this perspective across cases (UK, FI, IT, ES) and schooling level (Primary, Secondary) attempting to understand the commonalities and the divergences, which can shed light on how teaching practices are rooted in contextual factors. Based on the findings from all the focus group interviews, the dimensions of CDL that featured more predominantly in teachers' discussions across all four countries were *Digital teaching and learning* and *Technology use*. Under the dimension of *Information literacies,* the sub-dimensions of *Online inquiry process* and *Source validation* were frequently discussed in the Finnish and Italian teacher groups while *Online safety* gained significant attention in the English and Spanish (primary) teacher interviews. Less prominent dimensions of CDL across all cases were *Data literacies, Digital content creation, Digital citizenship* and *Digital communication and collaboration*.

Since the majority of focus group interviews were conducted during the first pandemic lockdown it is understandable that issues associated with *Digital teaching and learning* emerged frequently in the discussions. In each group, topics such as how to adopt the use of digital tools in the classroom were addressed. It is also noticeable how much the relevance of adopting suitable digital pedagogical methods for enhancing students' CDL prevailed in the Secondary 2 case compared to other cases where discussions mainly centred around digital pedagogies suitable for the teaching and learning across the various subject areas of the curriculum. Furthermore, the heightened emphasis on the CDL dimension of *Digital teaching and learning* was particularly timely and relevant especially when considered in light of the move to remote education during our fieldwork. Although participants acknowledged their prior familiarity with digital technology use in the classroom, the adoption of relevant tools and pedagogies to facilitate remote schooling appeared to "have taken on renewed salience" during the pandemic

(Williamson et al., 2020). This in turn suggests that the effective integration of digital technologies in the teaching practices presupposes not only technological proficiency but also familiarity with relevant pedagogical approaches (Glover et al., 2016; Starkey, 2020).

Profound attention was also paid across all national contexts and educational levels to the dimension of *Technology use* with an increased focus on *Critical technical skills*. Indeed, the focus group discussions centred a lot around the acquisition of basic, albeit fundamental, technological competences that would allow students to use digital tools and navigate online environments in more efficient and also innovative and meaningful ways. Contrary to dominant assumptions regarding students being *au fait* with digital technology use and living what boyd (2014, p. 5) describes as "networked lives", teachers' accounts highlighted how one of their main priorities was supporting students with developing relevant and versatile technical proficiency. Furthermore, students' initial contact with technologies meant understanding their materialities as well as creating appropriate attitudes around the use and care of digital devices and this was particularly relevant for the Primary 2 case. Establishing cultures of "ethics of care for materials" and the "right to repair" (Houston & Jackson, 2016) among schools and student communities is particularly relevant in light of current concerns regarding the sustainability of educational technology use due to its ongoing impact on environmental degradation (Selwyn, 2021).

Another dimension frequently addressed by the focus groups cohered around the *Digital well-being and safety* with a particular emphasis on enhancing students' understandings of online safety (e.g. cyberbullying, harmful contacts). Not only is this an issue discussed a lot in public conversation and in research literature (Adorjan & Ricciardelli, 2019; Smahel et al., 2020), it also features prominently in policy making and national curricula across the different countries and it is, thus, reasonable that teachers gave prominence to this particular dimension. Conversely, positive aspects of digital well-being, such as digital belonging or empowerment, were hardly mentioned by the interviewees. Perhaps the worries about online safety relate also to the relatively low attention the dimension of *Digital collaboration and communication* received. Even though participation in social media forums and online communication and interaction are common practices for students growing up in a digital world (POLIS, 2015), such practices seem not to be emphasised by teachers, at least with younger students as Martinez (2021) also notes in her study.

Information literacies and in particular the sub-dimensions of *Online inquiry* and *Source validation and verification* were relevant for teachers in secondary education and featured particularly prominently in the Finnish teachers' discussions. On one hand this chimes with other research that has shown that teenagers' online inquiry competencies vary substantially and often appear to be underdeveloped (Brand-Gruwel & Strien, 2018; Kiili et al., 2008). Furthermore, it ties in with recent policy making calls towards adopting a more critical and informed stance towards misinformation in the era of fake news (European Union, 2020)**.** On the other hand, the heightened focus of the Finnish teachers on this dimension highlights the contextualised nature of the interviewees' experiences since there is particular emphasis on developing students' critical thinking skills within the Finnish National Curriculum (Horn & Veermans, 2019).

Points of similarity were also detected in relation to the issues and gaps that can be identified regarding teachers' perceptions of critical digital literacies which were

the focus of our second research question. When looking at the dimensions of CDL that were considered by the teachers albeit to a much lesser extent, it was noticeable how little attention *Digital content creation*, *Digital communication and collaboration*, *Digital citizenship* and *Data literacy* received. In particular, aspects of the first two dimensions relating to *Co-creation* and *Online collaboration* received very little attention and similarly the creative sub-dimensions of *Digital content creation* such as *Multimodal production* and *Remixing* featured very little, if at all, in teachers' discussions.

Various commentators have highlighted the potential of digital production and co-creation to facilitate students' active learning and dynamic understanding and contribute to a participatory culture (Hobbs, 2017) as well as enhance their critical thinking and problem-solving skills (Trust & Maloy, 2017). Furthermore, collaboration and creativity have been widely perceived as pivotal to educational practice, often alongside digital technology use, within policy papers and the National Curriculum of the four countries (see Department for Education, 2013; Finnish National Agency for Education, 2016; Jefatura del Estado de España, 2020; Ministry for Education, 2015). However, the instantiation of creativity, co-creation and collaboration in actual classroom contexts was rarely reported by the teachers who instead focused on equipping students with technical competences and adopting teacher-centred practices mediated by digital technology use. As such, although students' active engagement in using digital tools to facilitate creative and co-creational activities is often highlighted in national curricula, policy papers and research literature, our findings suggest that there is a discrepancy between teachers' practical experiences and officially stated goals.

The limited emphasis on creative and collaborative aspects of CDL does not come as a surprise considering the "high stakes culture of accountability" that exists in educational systems which "may not be conducive to the experimentation and risk-taking often associated with more creative applications of digital technologies" (Burnett, 2016, p. 34). Furthermore, as Burnett (ibid.) goes on to explain "more flexible open-ended opportunities may sit uneasily with the tightly framed and fast paced lessons that are often devised to ensure children meet the targets that will enable them to do well in high-stakes national tests". Similarly, Henriksen et al. (2021, p. 2102) contend that creative engagement with technology-mediated practices presupposes "in-between moments of struggle, doubt and fear" as well as exploration, experimentation and discovery and this necessitates adequate time and relevant institutional support for educators to embrace such practices.

Another dimension of CDL that featured very little in teachers' discussions was that of *Data literacy*. The increased platformisation and datafication of contemporary schools over the past decade has raised concerns relating to commercial platforms' "tendencies towards pervasive data extraction and surveillance" (Perrotta et al., 2020, p. 102) and questions have been raised regarding "platform capitalism" being inserted into public schooling (Williamson, 2017). At the same time, datafied practices not only underpin contemporary schooling but also comprise an integral element of the lives of students through their active engagement with a range of digital media as they are particularly vulnerable in relation to personal data collection and profiling (Pangrazio & Selwyn, 2021). Notwithstanding the heightened attention the above have received in academic

literature, issues associated with the sub-dimensions of *Data analytics*, *Data protection and safety*, *Data visualisation* and the use of *Big and open data* received very little attention by the participating teachers. To this end, there is a pressing need to enrich teachers' critical perceptions of data literacy (Marín et al., 2021) so that schools can support students' understandings of how to protect their personal data and "take control of their data footprints" (The Children's Commissioner for England, 2018, p. 22).

While further research is required to determine the extent to which the findings of this study can be more generalisable within and across wider national contexts, this paper offers original insights in relation to teachers' perceptions and experiences of critical digital literacies and adds to the empirical literature in this field. It also advances the academic debate about critical digital literacies by drawing attention to the disjuncture between academic research, policy and everyday practice. In particular, this paper highlights that teachers' perceptions and experiences of CDL are underpinned by their everyday realities which are shaped to a large extent by external imperatives as well as the demands of the school context within which they are situated (Starkey, 2020). The heightened emphasis teachers placed on the particular dimensions of CDL discussed earlier in the paper is further justified given the strong national and international policy making efforts towards capacity building so as to meet the demands of the "knowledge economy". For example, recent policy documents highlight the need to enhance students' digital competences in order to prepare them for "for life and work in a digital society" (Redecker, 2017, p. 12) or operationalise digital literacy as competences relevant "for employment, decent jobs and entrepreneurship" (UNESCO, 2018, p. 6). Given these claims, it does not come as a surprise that a strong focus on more technical and pragmatic aspects of CDL is evidenced through the teacher discussions across different localised school contexts. As Oudeweetering and Voogt (2018) also highlight, dimensions of digital competencies that had not yet been integrated into education policy were perceived to be less integrated into teachers' practice.

Furthermore, teachers' experiences demonstrated a rather pragmatic adoption of digital technology use in order to support teaching and learning as well as to meet policy and national curriculum aims, such as equipping students with technical skills and raising their awareness regarding online safety and source validation. This is understandable given the immense time pressures teachers experience and the need to prioritise internal and external imperatives. Nonetheless this rather narrow approach that appeared to underpin their experiences and practices can undermine the deeper potential to focus on aspects of CDL that are particularly relevant when considering students' engagement with digital environments. These could include a greater focus on dimensions of CDL that centre around *Digital content creation, Digital communication and collaboration, Digital citizenship* and *Data literacy* and which encapsulate dispositions that children and young people require for being critical and active participants in the digital age. Whilst we acknowledge the significance of technical skills necessary to navigate digital environments and participate in an increasingly digitised world, it is equally important to recognise the importance of soft skills or competences (Schulz, 2008) such as criticality, collaboration, problem-solving and how these are manifested in the various dimensions of the CDL and play out across educational, social and other contexts. As Livingstone et al. (2020, p. 197) point out:

> Even when children develop the operational skills necessary for functional internet use, challenges remain in ensuring they have the critical, informational and creative skills for uses that bring tangible outcomes of value in their everyday lives.

It is also worth considering whether teachers' priorities and experiences in relation to CDL epitomised their rather limited understanding of the multifaceted nature of this area and their preparedness to enhance their students' critical digital literacies. Admittedly, the majority of the teachers did not feel well prepared to embrace the teaching of CDL. This is in line with the findings of Voogt et al. (2013) who report insufficient preparation of teachers as one of the main barriers for the limited implementation of digital competences in actual educational practice. At the same time, significant enablers for teachers' professional development in relation to digital literacies relate to whether and how training courses facilitate the operationalisation of this new knowledge within actual school contexts (Ranieri et al., 2018).

In light of our findings, and particularly given the absence of a range of CDL dimensions and sub-dimensions from teachers' discussions, it is necessary to critically reflect on the complexity and plausibility of adopting this framework both from a practice and policy perspective. Indeed, it could be argued that the multiple dimensions and sub-dimensions of the CDL framework combined with the time and curriculum constraints that schools and teachers constantly face, could make the adoption of this unrealistic and impractical. Still, we argue that teachers and students are experiencing an unprecedented era of digitisation and now it is more vital than ever to open up new ways of thinking and new problematisations around critical digital literacies. This is not a simple process of course and will require radical reform and transformation to national policies, curricula and schooling practices. It is certainly a challenge to think through and address the implications of widening the scope of critical digital literacies in this way, but we hope this article provides important starting points for reflection and re-thinking of CDL practices and policies in the digital age.

Conclusion

Exploring the topic of critical digital literacies from the perspective of primary and secondary school teachers offers a much-needed balance to the views of policy-makers and other stakeholders in the field of education. It is clear from our findings that there was a range of commonalities as well as disparities across the different contexts and these can be justified by diversified emphases on national curricula, the special characteristics of each school or the particular sample of teachers participating in the interviews.

By no means, our limited data collection and the contextual nature of our cases endow us to make inferences to the national level. Nevertheless, we can assume that each school as a unique entity identified specific areas of concern around critical digital literacies. Indeed, as Manca et al. point out (2021) "the 'glocal dimension' of social media suggests not only the complexity of social media literacy, but how composition, dynamics, and affect shape literacy" (p. 11). Therefore, as this study has highlighted, a universal critical digital literacies framework addressing global and decontextualised competences for media and digital education entails risks. As such, the local adaptation and understanding of situated and context-dependent critical digital literacies is central. Furthermore, while

we understand that arranging our findings by national context rather than by themes can be seen as a limitation, it has enabled us to emphasise how different dimensions of CDL are prioritised in different national contexts and educational levels. In particular, it has allowed us to develop a more in-depth understanding of the intricate disparities underpinning teachers' perceptions and practices in relation to CDL, and to highlight how these are largely contextualised. This type of evidence is particularly relevant in order to show that one-size-fits-all policymaking in the area of CDL either at national or EU level is not conducive.

We also acknowledge that looking at teachers' critical digital literacies though the various dimensions and sub-dimensions of the CDL framework instead of aiming for a more in-depth exploration and analysis of only one or a few aspects of CDL, can be perceived as a limitation. However, focusing on one or fewer dimensions of the framework would not have allowed us to consider more broadly teachers' priorities and experiences in relation to CDL. Adopting this broader stance has allowed us to highlight the disjuncture across the complex, multi-faceted and constantly evolving nature of CDL (as defined and perceived in academic research), the more "twenty-first century skills" oriented policy agendas and curricula which inform teachers' practice, as well as the reality of teachers' CDL priorities and experiences within varied school contexts.

Notwithstanding the limitations of this study, we can certainly support the claim that the CDL framework was functional as a tool for uncovering differences and specific, contextual characteristics across the five schools. Therefore, it can be seen as a valuable means of enabling teachers and schools to evaluate the critical issues requiring attention, and the needed interventions to respond to these. At the same time, the dimensions that featured less prominently in teachers' discussions can been seen as helpful in identifying areas of CDL which need to be considered by schools in the future and inform future practices. If the CDL framework represents a plausible assembly of dimensions that each school should pay attention to, it can be seen as a map relevant for addressing teachers' interventions, but also for understanding where professional development might be needed. Needless to say, a critical approach encompasses the possibility of generating not only innovations within teaching, but also reflective practice and analysis of impact as an educational response to new societal trends and problems.

Some concrete recommendations for policy makers, educators and other stakeholders emerge from our findings and these are centred on the following main areas. First, it is important to acknowledge the disjuncture between the complex and multi-dimensional conceptualisation of critical digital literacies in academic research and the strong focus on developing employability skills that is often enshrined in policy and curricula. Questioning the rhetoric of "twenty-first century skills" that has come to shape policymaking and school agendas will involve moving away from focusing only on the "technical" and embracing also the "critical" as well as acknowledging the multifaceted dimensions of critical digital literacies that need to be taught in schools. As Burnett (2016, p. 36) points out, schools' and policymakers' response to the digital age "should reflect not just what children may do or need in the future, but what they are doing now". This suggests that supporting students with digital skills aimed at employability does not suffice but there is also a pressing need for "nurturing the attitudes and practices

associated with the effective participation in social, civic, economic and political life" (ibid.). This would not only assume reimagining and redesigning future policies and national curricula in light of CDL but also loosening the "grip of education's conservatism" (Reich, 2020, p. 14) and the rigid structures of schooling to allow educators and students the time and space for creative risk-taking and failure (Henriksen et al., 2019).

Second, governments and policymakers across different national contexts need to explore ways to create relevant Initial Teacher Training (ITT) programmes as well as continuous professional development (CPD) activities for cultivating educators' theoretical and operational understandings of critical digital literacies given that their efficacy actively shapes their teaching practices (Hatlevik, 2017). This study has shown that not only is there divergence in relation to teachers' critical digital literacies within and across national contexts but CDL also needs to be seen through a sociocultural perspective, in which it is dependent on and shaped by a range of economic, social and political factors (Cope & Kalantzis, 2015). To this end, policy makers and relevant stakeholders need to be mindful that adopting a "one size fits all" approach to ITT and CPD would not be conducive since teachers reportedly will have highly variable previous ITT experiences and different levels of familiarity with the various dimensions of critical digital literacies. As such, any relevant training should be ongoing and based on contextualised needs shaped by the social, cultural, economic and political context in which teachers and students make use of digital technologies.

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Appendix 1: Definition of Critical Digital Literacies dimensions and sub-dimensions (adapted and summarised from Gouseti et al., 2021).

Dimension	Subdimension	Description
Technology use		The dimension of technology use encompasses the various technical skills significant for understanding digitalisation and the digital competences relevant for using digital technology in our daily life, for studies and work. These can range from basic technical skills necessary for navigating digital environments and using digital tools efficiently to the ability to overcome technical issues and engage in effective troubleshooting as well as competences relating to computational thinking.
	Technology risks and troubleshooting	This refers to the ability to identify and mitigate technical risks associated with hardware viruses and security risks (e.g. spyware and adware) as well as the ability to overcome technical issues and engage in effective troubleshooting. In particular, within a school context this can involve: identifying and solving technical problems when using digital platforms and tools to facilitate teaching and learning; developing strategies for creating strong, secure passwords and keeping these safe; supporting students and families with resolving technical issues; developing students' awareness of technical risks when operating devices and participating in online environments, and thus reducing their exposure to such risks; and last, using the school's software and hardware technologies in responsible ways.
	Applying digitality critically	Relevant technical skills include skills of using digital technology and applications, which are needed for everyday life, work and studies in a meaningful way. Technical skills are significant for understanding digitalisation in general, and, for example, the other elements of this framework. Because digital technology is in constant change, similar to daily life and expectations for work and studies, it is not sensible to create lists or models of the necessary technical skills in detail. The level of technical skills varies from very basic skills to the use of a computer, tablet or some applications to develop a real mastery of digital technology. For learning technical skills, one should learn to understand the principles of digital technology, not only to mechanically repeat some basic operations of using digital tools or applications. It is widely accepted, and promoted on international policy level, that digital skills are one of the key competencies and it is essential that every citizen should master these. Technical skills also include innovative and meaningful use of ICT, which requires sufficient technical competence.
	Computational thinking	This refers to: i) understanding the basic/fundamental principles and concepts of computing, coding and programming (e.g. understanding what algorithms are, creating and debugging simple programmes, using logical reasoning to explain how simple algorithms work and detect and correct errors) and ii) designing tasks and activities for students to develop and enhance their computational thinking skills.
Data literacies		Data literacies relate to an intertwined group of skills including not only the techniques to process data but also the ability to analyse data as a social and cultural phenomenon with implications for our personal lives. With the unprecedented evolution of digital systems and environments, digital data from users can be collected, shared, or simply extracted. This situation has a social impact, based on both enthusiastic and cautious discourses around data in society. At school level, a critical perspective around data includes diversified areas of practice such as considering the beneficial potential of data on democracy and social innovation when shared as open, public knowledge; interpreting critically graphs and or numbers used in informational contexts aimed at specific targets; understanding how personal data or data shared through social media can be used to feed algorithms supporting intelligent systems.

Continued.

Dimension	Subdimension	Description
	Data analytics	Data analytics refer to a new phenomenon of massive digital data collection, elaboration and representation through dynamic/interactive graphs (also called dashboards) and text across the internet, mobile apps and other connected digital devices (like the Internet of Things). While this could generate innovations in digital products and services, it has also been argued that data tracking by some few big companies allow them to extract high value from the behavioural, emotional and cognitive patterns observed through data and processed through specific algorithms. When aligned with forms of personalised communication, where data is translated into automatic recommendations and dashboards, with specific impacts over the life of individuals, this creates a critical side of data analytics. An outcome that is under debate relates to the fact that data analytics have become an exchange value, of which not all users are aware or in the position to control. Recently coined concepts as "data slavery" and "dataveillance" highlight the fact that the users are paying a high price in the digital interaction. Educational interventions at school should deal with awareness and some initial technical skills supporting students' agency in relation to data analytics. Some activities could cover understanding the business models behind social media platforms; the way personal data is extracted and used; what algorithms mean and how they are used in recommender systems. This would entail a deeper debate over the effects (including social inequalities) entailed by "surveillance capitalism".
	Data protection and data safety	Data protection in simple terms covers who has the right to access data about individuals and how they store and use it. Data protection is covered by laws such as the General Data Protection Regulations (GDPR) at a pan-European level. However, the key critical aspects are not just how organisations structure themselves to protect our data in line with legislation, but how we as citizens develop an understanding of the data we are sharing, and how it is being used - how we develop our own sense of agency regarding our data and own its use. Therefore, at school level the key issues to engage with are developing an understanding of the data that each individual student shares, understanding who they share it with, the risks associated with this, and understanding the structures that are there to help us protect our data, including proactive decisions about not using particular applications or websites.
	The use of big/open data	Big data refers to the massive amount of digital data that can be collected and analysed in relatively short timeframes and at low cost. Big data is created upon the data trace, namely, the collection and storage of digital data generated by the users upon their interactions with digital and smart environments. There is controversy regarding the positive and negative issues relating to the usage of big data, processed through several Artificial Intelligence techniques (see the term "data analytics"). Some of the negative effects are connected to the usage of private data extracted from social media or other digital platforms; addressing users' attention to commercial products or services through the data mined; and profiling of users and usage of such information for social, political and market decision making. The positive perspective over data usages can be connected to a movement based on the usage of public data like Open Government Data and Open Research Data. Educational interventions should go beyond technical skills (like data collection, statistical processing, computational treatment and graphic elaboration). Instead, a political and ethical vision of data usages in the society has to go hand in hand with such technical requirements. At school, simple forms of open data can be used as open educational resources, through critical and interdisciplinary lenses. For example, topics belonging to the sphere of health, environment or social care could be supported by the search of open datasets at public open data repositories; the data could be treated using basic statistics and algorithmic procedures (entailing computational thinking) and lead to the development of infographics/visualisations.
	Data visualisation	Data visualisation has been portrayed as the ability to understand the data arranged through graphical means. This is not a new practice, but the recent computational and graphic technological developments have encompassed new attractive

forms of visual representations. These new approaches include the possibility of dynamic visualisations where the data can be arranged according to the user queries over a dataset, but most importantly, artwork. In terms of education and training, data visualisation has evolved from the ability to read data to the ability to generate engaging, colourful and original visualisations of data embedded into infographics. However, a critical vision of data visualisation entails also the development of a capacity to understand the several layers of meaning in a visualisation, through the lens of semiotics (the art and science of interpretation, which has been applied to other mass and digital media). The design or the ability to read visualisations requires, in addition to technical statistical and programming skills, a contextualised and contextualising approach, seeking not what is new, or what others define as "useful", but what may be relevant and aesthetically "equitable" for the human group who has created a representation to whoever reads it.

Information literacy		Information literacy can refer to the ability to locate and evaluate information, think critically about how it has been created and understand how it can be used to create new knowledge. The dimension of information literacy is essential because information is a critical topic when we talk about the internet, social media, fake news and overload of information in our new digital media landscape.
	Online reading comprehension	Online reading comprehension refers to the competence of understanding the content published on the Web. The reading of Web based articles is a different process compared to reading printed documents: the printed document is generally complete in itself, and comprehension consists of technical understanding (reading skills), and such other issues as understanding the underlying message and having an understanding about meta-information (such as the length of the text, the meaning of the titles, or the table of contents). Comprehension of an online document includes, of course, the technical competence of reading, but also the following skills: the technical use of the application (how to start, how to proceed, how to use a mouse etc.), understanding the meaning and use of internal and external links, the multimodality of the "text" (besides text and pictures, there can also be videos, music, simulations etc.). In a school context, it is important that students work with different types of digital material and that they also produce these themselves. Students usually learn during leisure time to work with some digital materials, but at school they should learn online reading competence in a systematic way by frequently working through a variety of different subjects and types of resources in assignments at all levels of primary and secondary education.
	Online inquiry process	Online inquiry means the process of successfully seeking information for open questions and challenges using sources from the Internet. As such, online inquiry consists of similar steps as any inquiry: to set goals for the inquiry, plan the process, create meaningful search terms, search for information, to evaluate its relevance and credibility, to synthesise the results, and finally to present the results. Searching information from the Internet is a demanding activity for students, at all levels. First, there has to be enough background knowledge about the topic for creating search terms and other search options. Second, to evaluate relevance and credibility of the findings requires understanding the principles of truthful information. Students need to understand, e.g. the nature of fake news. At school, students learn online inquiry skills best if they can practice these skills during school years, starting from small-scale inquiry activities. The teachers' task is to create the inquiry assignments, support and scaffold the process, but let the students take the responsibility of managing the inquiry task involving all stages.
	Source validation and verification	The great amount of information available on the web can be considered to be a substantial benefit, but at the same time it requires the ability to search, select and evaluate information reliability and a source's credibility. On the web, everyone can publish digital contents (through social media platforms and other user generated websites), without any standards or quality requirements: incorrect or misleading news (fake news) could be published intentionally, while the sharing practices facilitate their dissemination without control. Children and young adults are increasingly exposed to the negative implications derived from the quantity and quality of digital information, due to their role as consumers and to their lower risk perception than adults. In this context, it is necessary to train young people in online inquiry (as detailed above), on

Dimension	Subdimension	Description
		evaluation of information according to its reliability and credibility, and on how to creatively use the information found. Nevertheless, some scholars have pointed out that education paths for information literacy cannot be the only answer to the problem of fake news, and that regulatory intervention on platforms may be the most appropriate way forward.
	Digital media use	The increasingly pervasive and frequent presence of digital technologies in everyday life to mediate social relationships and to provide access and use of various digital media (such as journals, news, social media) can have a substantial impact on a person's life. Thus, it is of considerable importance to promote conscious use of digital media by adults and young people and also support their relationship with social media, in order to exploit the positive potential of the platforms for growth and participation in society, and also for their use in their educational development. In particular, it is essential to have a critical understanding of digital media, which are not free online services, but the most advanced form of a new model of business that could be named "digital capitalism". The famous quote "if it's free, you are the product" summarises the importance of overcoming a superficial vision of the media to understand instead its deep dynamics and the power it can exert on our own choices, and also on our political and social behaviours. In addition, it is also necessary to understand how to use digital media in the educational field for teaching and learning.
Digital content creation		The dimension of digital content creation means practices and related competencies where people create something using computers and digital tools. Content creation can be done individually or collaboratively with others. The basic practices to create all kinds of materials like reports, videos, or pictures digitally are familiar for everyone and also common activities in schools. The sub-dimensions of digital content creation that our Critical Digital Literacy framework highlights are such that require more advanced skills, or are not so common or they include issues that require some kind of critical attitude.
	Creative digital expression	Digitality is one more tool for creative expression, and there is a wide variety of digital art and other creative outcomes as well as artists who use digitality as a starting point for their artistic work. In creative digital expression, technology is not just a tool (e.g. as word processing is a tool for writing stories, or poems, and a digital piano for playing music), but it has an independent role in the artistic outcome. For instance, a computer produces a combination of music and pictures randomly, of course based on the design of the artist. Digitality also offers new possibilities for "old" forms of art, which changes the previous outcomes, e.g. animations using digitality. It is expected that creative digital expressions will have many more forms with application of other technological innovations, such as artificial intelligence. Within a school context, creative digital expression can offer students opportunities for such activities, which, similarly as any artistic activity, help them to understand the world and themselves. In addition, digitality is often a natural world for students and motivates them as such. These creative activities offer possibilities for natural integrations with music, visual arts, technology education and maker-culture in general.
	Co-creation	Co-creation can be defined to mean practices in which two or more people interact with each other to produce something together. Co-creation can relate to items such as, designing and developing new goods and services, authoring texts and media products for publishing, developing solutions to joint problems, and to creating artistic compositions. Web-based digital tools, such as cloud services and interactive platforms have vitally changed the possibilities for co-creation, because they enable the sharing and modifying of digital knowledge artefacts together in ways that have not been possible before: sharing the joint artefact and working with it online, and even at the same time. Participation in digital co-creation requires skills to manage so-called socio-material practices, which include engagement in social interaction, coordination of activities, modification of artefacts as well as application of digital tools for mediating the joint efforts. In educational settings, co-creational activities can be used as a group work method to support students' learning of some content, but

		they are also important to provide students with opportunities to learn important competencies for digital co-creation and socio-material practices.
	Multimodal production	Multi-modality involves the production of works that contain two or more different forms of engagement e.g. the combination of text, image, video and sound. An example in physical form would be a picture book, the combination of visuals and text, and sometimes objects to touch and feel. In digital forms, it could be for example, the inclusion of video content within a news item, or the addition of an animal sound to an article about animals. Digital artefacts offer opportunities to take advantage of the affordances of the platform and enhance traditional experiences. In a school-based context, this can often be explored through the development of digital news articles about particular items, enabling students to combine materials that they discover from multi-modes into a singular news piece. This could enable the notion of "digital authoring" and the ways in which children create multi-modal, digital media texts to be explored. In addition, items such as games and hypermedia texts can be constructed which enable individuals to traverse or combine multiple modes of consumption.
	Digital publishing	When we think about digital publishing, we are generally thinking about how we either transform existing content from its existing form into a digital version (e.g. print to digital), or how we capture content straight to digital platforms. Digital publishing brings with it a range of issues that we need to continue to consider and develop responses to. For example, Intellectual Property Rights; funding and licensing models (e.g. Open Access licensing); interoperability, access and archival issues; curation; capitalising on the affordances of digital forms. In a school-based context, the focus will fall on both the creative aspects of Digital publishing, how we design and deliver digital content; and on discussion of the issues linked to it.
	Remixing	Remixing means to take cultural artefacts, like stories, videos, pieces of artwork, or photographs, and modify or combine them into new kinds of products. Digitalisation has made remixing easy, and it provides a popular way to create new digital artefacts or media products by altering and combining existing ones. Digital remixing is a modern way of producing knowledge, and it also relates to building identities and participating in digital cultural practices. Remix literacies include mastering relevant digital techniques but also understanding media representations and cultural practices of remixing as well as respecting copyright principles and the ethical aspects related to remixing.
Digital communication and collaboration		The dimension of digital communication and collaboration refers to using digital technologies such as social media and other web-based platforms and tools for communicating and collaborating online. The dimension of digital communication and collaboration included in the CDL framework emphasises the need to develop a more critical stance and develop an in-depth understanding of the opportunities and challenges associated with online communicative and collaborative practices as well as issues relating to online privacy, digital profiles and digital empathy.
	Online privacy	Online privacy covers what information we share when we are using Internet based platforms, including mobile technologies. It covers who has access to our data; everything from browser data, through online purchases, to our personally identifiable information. It covers what structures are available to help us limit access to our data and covers the value organisations place on our data, so individuals can get a better understanding of why organisations wish to track us. In a school-based context, the focus is likely to be on two elements, creating an awareness of the data we are generating when we are browsing and conducting activities on the web/our mobile devices, and producing an understanding of how we can better manage the privacy around our activities e.g. through monitoring our privacy settings and choosing wisely who we share our data with.
	Digital identity and profiles	The construction of digital identity is one of the main themes related to the way we are online. On the internet, identity is a representation of oneself that emerges from every kind of content published on websites and blogs or shared on social networks. Digital identity is usually expressed through the creation of a personal profile inside an online service or platform. That is why we can say that giving shape to one's own identity through iconic and textual representations is the essential

Dimension	Subdimension	Description
		prerequisite for building oneself as an active subject of digital communication. The profile construction is obviously pre-determined by the service itself and the fields provided during the registration phase but is also the result of a complex process of self-reflection and impression management in order to translate our private self into a public representation. Being related to our online agency and participation, the construction of digital identity is necessary to promote awareness about benefits (from personal, educational and professional perspectives) and drawbacks (related to risks and implications of sharing personal information), together with technical and communication competences to manage them. In this context, it is essential to acquire the online ability to choose the contents to share and to select contacts and followers online.
	Online communication	This refers to the ability to use a range of digital platforms and tools to communicate effectively online with students, parents, colleagues and other educational stakeholders on a one-to-one basis as well as in groups. This is particularly relevant as new forms of platformised education are rapidly proliferating across education settings and the use of online platforms and social media has become central to interaction and participation in schools. Online communication competences are essential for using virtual learning environments and other digital tools to disseminate information, resources etc. to students and parents as well as for providing feedback or responding promptly to questions and queries. Within the CDL framework online communication also refers to being able to achieve the following: i) select appropriate digital communication tools and approaches for different audiences and purposes, ii) ensure privacy in private communications, iii) identify and deal with fraudulent and suspicious digital communications (e.g. phishing) and iv) demonstrate cultural sensitivity when performing communication online (e.g. being aware of cultural diversity and respecting the norms of other cultures).
	Digital empathy	The concept of digital empathy is multifaceted and can take different shapes and forms. First, digital empathy is seen as having a deep awareness and consideration in relation to one's access to digital infrastructure, internet connectivity and digital competences. This means that teachers are attuned and responsive to students' needs in relation to digital technology use and they recognise and address that students have diverse online experiences, digital access and competences. They are aware of and respond to potential issues of accessibility when planning their lessons and homework tasks and ensure that all students have access to the digital resources, virtual learning environments etc. used for teaching and learning. Second, digital empathy is also associated with one's ability to understand and respect the feelings of others within an online environment. It is important both for teachers and students to develop an awareness of how private and public online actions (often hiding behind online anonymity) can have a significant negative impact on the wellbeing of others.
	Online collaboration	Online collaboration refers to a range of different competences and practices and is multidimensional. Within a school context, it can involve: i) The use of digital technologies to engage in professional networks and collaborate with others in order to share knowledge, exchange good practices and produce educational or professional development resources. (e.g. collaborate within the school with colleagues, on eTwinning projects etc.). ii) The use of digital technologies to facilitate student collaboration within the classroom (e.g. as part of collaborative tasks and assignments, peer-learning etc.) or outside the classroom (e.g. as part of collaborative activities in the context of a collaborative project with other schools).
	Networking	Social networking refers to a social structure involving individuals or organisations sharing similar interests. They are supported by web services allowing users to create a public or semi-public profile, to generate lists of friends and to traverse their list of connections, forming a public online network community. The exchange within social networks produces what is called "social capital", that is the overall amount of actual, or potential resources available in a durable network. There are two types of social capital relating to the different forms of connections/ties linking the members of a

		network, that is the bridging social capital based on weak ties mainly characterised by strengthening the capacity for information exchange, and the bonding social capital based on strong ties associated with the provision of mutual support and affective benefits.
Digital well-being and safety		Digital well-being and safety relate to those areas and issues presented which impact broadly on the individual and groups of users. In school-based contexts these are important to consider to ensure that we are safeguarding children from the harm which can be presented within digital environments. With the continually expanding use of digital technologies this dimension is critical to develop and explore with young people, so that they develop mechanisms to support their responses to the issues presented in this area.
	Digital overexposure	The use of interactive screens has been linked to several problems, such as child obesity, sleep problems, adolescent depression and aggressive behaviour, and increased symptoms of attention deficit disorder. Digital overexposure refers to the possible implications related to the overuse of both interactive screens and devices' content, which could lead to the development of addictive behaviour, such as smartphone, internet or video game addictions. These negative implications impact on the social, physical, cognitive and emotional dimensions of children's life. From an educational perspective, a significant debate is emerging in the literature with researchers looking to provide guidelines on how to balance educational opportunities with the students' well-being.
	Online safety	Online safety or else known as e-safety, or internet safety, is a multifaceted sub-dimension of CDL. Predominantly, it refers to the ability to understand the risks associated with participating in digital environments and being able to mitigate these. More specifically, this includes: identifying, reporting and protecting oneself and others from cyberbullying and other harmful, intolerant, sexual or violent content online; understanding safety and security measures and protecting personal information when using different digital tools; developing an awareness of how digital participation can negatively impact physical and mental wellbeing and empowering oneself and others to manage such risks. Also, schools need to collaborate with parents and carers in order to raise their awareness regarding these issues and provide them with relevant knowledge and tools to support children's online safety at home. This sub-dimension is interconnected with digital overexposure described above.
	Digital selfhood	Digital selfhood relates to understanding who you are online and understanding how this fits into your wider sense of self. The internet offers many opportunities to do things that individuals may not normally do in a physical world (e.g. experiment with different kinds of behaviours and pretend to be someone else). Digital selfhood is about understanding how individuals may do some of these things safely, whilst also understanding the impact of particular behaviours on representations of who you are as an individual. In a school-based context some of the key critical considerations are: how online behaviours impact on your own and others' interpretations of self; how to represent yourself online; and the impact of data trails on digital selfhood. Schools may also wish to critically engage students with recent legislation around the "right to be forgotten" as increasingly this will impact on individuals.
	Ergonomics	Ergonomics is a field of study that focuses on improving people's working conditions concerning workplace arrangements and tool design. The goal of ergonomic principles and recommendations is to reduce strain, fatigue, and injuries caused by unhealthy postures and working practices. Increased use of computers in studying and spare time requires that computer ergonomics of teachers and students must be taken care of both in schools and at home. An effective way to anticipate problems is to provide teachers and students with adequate knowledge and specific guidelines about issues related to computer ergonomics, such as arranging the equipment, taking care of one's posture, or having enough breaks.
	Empowerment	Empowerment is manifested as a process that can impact on individuals, groups, organisations, and other entities. The process involves movement from positions of limited power and control, through to the development of self-efficacy in achieving particular tasks and activities. Entities can be at different levels of empowerment dependent on the action(s) to be achieved. Empowerment can be enhanced through items such as: the sharing of power (e.g. by giving learners more

Continued.

Dimension	Subdimension	Description
		self-autonomy in the classroom), access to and the sharing of cultural digital knowledge (e.g. by helping learners to understand themselves and others); and the development of skills (e.g. knowledge retrieval skills on the web).
	Digital belonging	Digital technologies and social media have created new opportunities for engagement and participation in various online environments and communities. This allows individuals to find new ways of socialisation and a new sense of belonging in a digitalised society. Within the CDL framework this sub-dimension is used to refer to how teachers and students negotiate issues of belonging within professional communities and friendship or interest-driven, peer networks. This can include negotiating issues of status, engaging in reputation building, constructing online identities as well as moving between different networks and re-negotiating their online identity and sense of belonging. It is also important for teachers to develop awareness that lack of digital access or other barriers can limit students' sense of belonging and may result in feelings of detachment (e.g. from belonging to online student communities).
Digital citizenship		Digital citizenship refers to a range of elements which require individuals to think critically about how they engage responsibly within societal spaces, including engagements with communities, with organisations and with governmental entities. Guiding effective participation within societal spaces is something which we need to introduce to learners at all levels, with schools and colleges providing effective environments within which to teach responsible physical and digital citizenship.
	Digital civic engagement	Digital civic engagement concerns the new forms of civic engagement and active citizenship, enabled by the use of new digital media, in particular the so-called web 2.0 tools, and inspired by the principles of participatory culture. A participatory culture is characterised by the absence (or low number) of obstacles to artistic expression and civic engagement, and by the strong support for sharing one's creations in environments supported by forms of informal mentorship. It can result in forms of digital activism where people utilise the digital tools to make their voices heard.
	Rights and responsibilities	A range of rights and responsibilities are associated with accessing and participating in digital environments. It should be noted that this is a particularly complex dimension with various social and political implications, and that it is not possible to explore all aspects in depth here. Within the context of the CDL framework this sub-dimension refers to understanding and being able to exercise the rights and responsibilities that go with being a citizen of the digital world. This includes but is not limited to the right to digital access, the right to online privacy and freedom of speech, the right to copyright for one's online work and content. Digital responsibility refers to the ability to exercise these rights in a respectful, legal and ethical manner. For example, responsible use of and participation in digital environments for teachers alludes to understanding how to use, and share, their personal information, as well as their students' identifiable information online, using and managing digital content responsibly, acknowledging copyright and intellectual property rules or open access alternatives (e.g. creative commons) when adopting or modifying the work of others, and empowering learners to become responsible digital citizens.
	Sustainable use	This refers to developing awareness and understanding of how digital technology use impacts the natural environment and how it contributes to digital pollution. This includes: i) understanding how digital technology use contributes to energy consumption and greenhouse gas emissions (e.g. the impact of online video streaming and data centres), ii) understanding the environmental contamination and pollution caused by the inappropriate disposal of digital devices, iii) considering how educational technology use can be made more sustainable within the school, iv) developing awareness about how digital technology use at personal level can be more sustainable (e.g. responsible digital usage and cutting down your environment digital footprint).
Digital teaching and learning		

The dimension of digital teaching and learning refers to the digital literacies necessary for adopting and organising digital technology use in meaningful, creative ways for facilitating the teaching and learning process; supporting students with developing their own CDL; understanding digital learning ecologies and understanding the complexity of learning analytics.

Digital pedagogical methods	Nowadays there are many methodologies that are used to promote students' learning, and if we think about digital settings, the possibilities are exponentially increased. Digital technologies provide tools and spaces to promote students' active role in their own learning by allowing them to express themselves in ways that were previously impossible. Teachers can take advantage of these possibilities by applying active methodologies in which students are the centre of the learning process such as gamification, the flipped classroom, project-based learning, design thinking or collaborative learning. The application of these methods allows students to learn to use technology embedded in authentic settings, and to use it in a responsible way (see also Rights and Responsibilities). In addition, these methods promote learning based on not only content but also the skills and competencies needed later in their studies.
Digital learning ecologies	Digital learning ecologies (DLE) can be defined as the set of contexts of activities, resources and relationships that students and teachers have at their disposal and that can generate new learning opportunities. This concept provides students and teachers with an individual asset for their learning and professional development, but also points out the relevance of relationships with the families, colleagues and students that can be boosted by digital technology use. Many students (or students' families) use personal technologies that enable them to be fluent in several areas of school learning. As for the teachers, many of them use the potential offered by technology and social media to be professionally updated and to be aware about new trends on using ICT for educational practices that can make their teaching more attractive for their students. Learning opportunities generated by DLE can be found in different contexts: formal, but also, and above all, non-formal and informal, just as we can find them in face-to-face, mixed or completely virtual interactions. Understanding and being able to use this rich complexity is what can make us learn more, and in improved ways.
Learning analytics	Learning analytics are digital analytics based on advanced data processing modalities, in some cases Big Data, arising from educational environments, or extracted from learning activities across digital platforms. The purpose of educational data mining is the translation of educational data into information, which can be presented in the form of reports or visual dashboards, and can be used to aid students' learning journeys. Learning analytics are not only used to help the teacher to understand a student or class situation but are also used through predictive modelling to anticipate students' risk or success behaviours. Eventually the learning analytics can be presented from the student's side, supporting self-regulation and more efficient engagement with the learning activities. Welcomed with strong initial enthusiasm, its detractors are not lacking today. In fact, learning analytics can be of great help in the teaching task, providing the teacher with information about student activity within a digital platform. However, the problem is to define sound metrics facilitating pedagogical reflection or decision taking. Usually, pedagogical constructs are not easy to grasp and what the analytics can capture are simple metrics from students' behavioural interaction with the digital platform.