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Mind the gap! Exploring teachers professional learning needs to cultivate critical data literacies
Mind the gap! Esplorare il fabbisogno formativo degli insegnanti per sviluppare forme di alfabetizzazione critica ai dati

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ABSTRACT

Critical Data Literacy as approach to the emergent problem of datafication requires teachers' skills and awareness. However, this professional learning need appears to be overlooked. Our study aimed at exploring teachers' discourses in an attempt to map out professional practices and identify learning needs, therefore the metaphor of "Mind the Gap" was used. We adopted a mixed-methods, constructionist inquiry along three phases (106, 39 and 49 participants respectively) embedded into a transnational project on critical digital literacies (CDL) involving Finland, Italy, Spain, and the UK. The focus was placed on re-defining critical data literacy components and dimensions and identifying gaps in relation to teachers' professional learning needs. The results indicate that data literacy was not as present as other dimensions across the teachers' accounts about the most immediate and relevant "data" problems. This has clear implications regarding the need to implement systematic professional development approaches to cultivate critical data literacy.

L'approccio critico all'alfabetizzazione digitale e in dati (*Critical Data Literacy)*, mirante a far fronte al problema emergente della *dataficazione*, richiede competenze e consapevolezza da parte degli insegnanti. Tuttavia, questo bisogno di apprendimento professionale sembra essere trascurato. Il nostro studio ha come obiettivo esplorare i discorsi degli insegnanti nel tentativo di tracciare una mappa delle pratiche professionali e di identificare i bisogni di apprendimento. Considerando il focus sul fabbisogno formativo, è stata utilizzata la metafora del "*Mind the Gap*". Abbiamo adottato un metodo misto basato su un'indagine costruzionista in tre fasi (106, 39 e 49 partecipanti rispettivamente), inserita in un progetto transnazionale sulle alfabetizzazioni digitali critiche (CDL) che ha coinvolto la Finlandia, l'Italia, la Spagna e il Regno Unito. L'attenzione si è concentrata sulla ridefinizione delle componenti e delle dimensioni dell'alfabetizzazione critica dei dati, nonché sull'identificazione delle esigenze di aggiornamento professionale degli insegnanti. I risultati indicano che l'alfabetizzazione ai dati non era presente come altre dimensioni nei racconti degli insegnanti sui problemi «dati» più immediati e rilevanti. Ciò ha chiare implicazioni sulla necessità di implementare approcci di sviluppo professionale sistematici per coltivare l'alfabetizzazione critica ai dati.

CONFLICTS OF INTEREST
The Authors declare that there is no conflict of interest.

1. Introduction

Recently, concepts like "datafication", "datafied", "data storytelling", "data-analytics" are gaining increasing prominence. These new terms reflect new practices and an ongoing relevant societal change, which directly impacts the types of skills and knowledge the education system (and hence the teachers) is expected to nurture. To complicate things, the interpretations around data in the society are uneven, representing a fragmented panorama where data science is the ultimate frontier of knowledge jointly with a dystopian vision of data as instrument of surveillance. Educational researchers, teachers and policy makers have reacted in disparate ways, cultivating several approaches that appear to co-habit uncritically the practice of teaching and school leadership.

As a matter of fact, a strand of research has focused on the adoption of data as key feature of teachers' professionalism. In this regard the evidence-based education policies (Slavin, 2002), as well as the progressive digitization of processes and services have created a culture of data-driven educational practices (Daniel, 2015; Mandinach, 2012), with critical implications for the teachers' agency (Hartong & Förschler, 2019). Nonetheless, the openness and reusability of educational research data has been deemed an accelerator of educational research collaboration and discovery (van der Zee & Reich, 2018). Also, using open data within the educational practice has been seen as an opportunity of civic monitoring and critical understanding of data (Coughlan, 2019) as well as an opportunity for getting en-

gaged in citizen science and contributing to the generation of relevant knowledge (Catlin-Groves, 2012). On the other hand, the constant tracking of children, teenagers and young adults on digital educational spaces, has been seen as a form of exerting power by taking decisions over their behaviours, motivations and patterns of success according to technocratic expectations (Chi et al., 2018; Lupton & Williamson, 2017; Prinsloo, 2020). In the aftermath of the pandemic, education pivoted online resulting in the so-called «pandemic pedagogies»: the massive and naïve adoption of private platforms offering rapid and engaging solutions to the educators, which entailed not assented students' data marketization (Williamson et al., 2020).

In these terms, the imaginaries around data are clearly conflictive and fragmented, posing several questions to the educators around their own professional and pedagogical practices. In this complex panorama, our research aimed at exploring teachers' perceptions about data practices and the relevance of data literacy, as a baseline to design professional learning approaches that are tailored to the teachers' understanding and knowledge needs around the complex phenomenology and imaginaries of data. Using the metaphor *Mind the Gap!,* our ultimate goal has been to highlight the differences between the theory and praxis in order to identify educators' professional development needs. Indeed, the literature shows a relevant lack of attention to complex approaches to educators' data literacy.

Our study explored teachers' perception by using a mixed-methods constructionist inquiry developed in three phases, embedded into a transnational project involving Finland, Italy, Spain, and the UK. Across three phases of engagement with teachers at schools and professional learning contexts, we attempted to explore their discourses around data in education and the society, to spot the learning needs towards a clearer panorama of teachers' professional development to achieve and teach critical data literacies.

2. Background

Education has developed several responses to the evolving phenomena of quantification, metrics, and data in society, with implications for the teaching practice. The skills required to work with math concepts and very basic statistical elaborations as part of basic education and life skills have been a part of the educational debate since the '60 of the last XX century (Risdale et al., 2015). However, the digital revolution encompassed new and diversified data practices, requiring increasing attention (Maybee & Zilinski, 2015). In an attempt to embrace positive representations about the value of data in society, educational research about data literacy covered several areas such as reading and interpreting statistical representations (Gould, 2017); interacting with dynamic data visualisation (Wilkerson & Laina, 2017); adopting essential tools to generate graphs and tables (Chi et al., 2018); or navigating and retrieving open data within the classroom and beyond, such as projects including civic monitoring (Coughlan, 2019). Conversely, the problems of data extraction, privacy, ethics and algorithmic manipulation have been investigated through the lens of critical theories, emphasising the downsides of digital data practices in our contemporary society (Pangrazio & Selwyn, 2019, 2020). Media education has also delved into the problems of citizens' manipulation through data embedded in the news, mass media and, more recently, in social media (Knaus, 2020). Recently it has been pointed out that the focus on technical

data literacy skills (Raffaghelli & Stewart, 2020) as well as the lack of integration around the several approaches towards data literacy (Raffaghelli, 2020) are a relevant challenge in promoting a holistic and critical approach to data.

Through these different strands of research data literacy has entered into the policy-making agendas, such as in the case of Canada, the US, or the EU (European Commission, 2020; Risdale et al., 2015; US department of Education, 2020). Nonetheless, existing frameworks place knowledge in diversified ways, and the terms adopted encompass polysemy (Raffaghelli, 2019).

In spite of the rich debate on data literacy in relation to learners' skills, educators' data literacy seems to be less developed into an integrated and complex perspective of data (Marín et al., 2021; Pangrazio & Selwyn, 2020). Some have claimed that data literacy should be integrated into the general concept of educators' professional competence, which includes, *inter alia*, their professional practices and identities in the context of a datafied society and education systems (Vanhoof & Schildkamp, 2014). A very specific focus on teachers' data literacy relates to their ability to deal with data management to inform their teaching and institutional activities (Mandinach & Gummer, 2016). However, other areas of teaching practice remain less explored (Raffaghelli, 2019). The insufficient coverage of the topic could be due to the fact that there are different orders of problems relating to data in education and society. These can be found at the juncture of data as societal and cultural problem, data as content of education and data along the pedagogical practice (Raffaghelli, 2020).

In a completely different strand of reflection, in their survey relating to social media data privacy with pre-service teachers, Marin et al. (2021) found that while the educators acknowledge the educational and distractive potential of social media, they are less aware of data privacy issues. They also reported teachers' comfort with companies' use of personal and students' data and faith in governments' capacity to apply regulations to the sector. Moving a step beyond characterising practices and opinion, Stewart (2020) explored the way of transmitting the hidden aspects of the "Terms of Use" to the educators through a transformational approach including pre-service teachers. She reflected on the difficulties encountered to disentangle legal and technological aspects and the way this could be enhanced by the educators.

In an effort to map the several skills required to be data literate as an educator, Raffaghelli (2019) explored 19 frameworks of data literacy and proposed a theoretical scheme based on the Digital Competence Framework for Educators (Redecker & Punie, 2017). Since the papers were classified taking into consideration the type of focus on data within educational activities, an overall picture on how data literacy was studied as well as the type of expected applications emerged. In this regard, "Data in Teaching and Learning", more connected with achieving basic to higher levels of data science (extracting, processing, generating complex visualizations/graphs), was a prevalent focus with 7 cases; however, another equally significant focus (6 cases) was "Research Data Management" which defines data literacy as the ability to data management as a process of data curation, treatment, presentation and sharing along academic activities (students' research projects to researchers' advanced stages of activity). These two prevailing approaches were followed by data literacy seen as an instrument to "Empower Learners" (4 cases). The empowerment has a place as a form of "meta-learning", that is, using data to understand processes into which the learners are engaged, from political and socio-cultural activities to pedagogical processes (the case of learning analytics' usage). Lastly, 2 studies on data literacy frameworks were characterized as "Edu-

cational Data Management" since their focus related teachers' data-driven practices to improve the quality and effectiveness of school education (K12).

Therefore, there is a compelling need to rethink and further develop teachers' initial and continuing training to embrace critical data literacy in a *datafied* society, considering it as embedded in complex digital contexts that change swiftly. This is in tight connection with redefining Teacher Education in the light of those competences to be included in providers' curricula, so as to ensure preparation for present and future global challenges.

3. Methodological approach

3.1 Context

Our study took place within the context of a transnational endeavour, the DETECT (*DEveloping TEachers' Critical digital Literacies*) project. The project's rationale is aligned with a range of policies that focus on the importance of digital literacy at national and supranational level (Carretero Gomez et al., 2017; JISC Programme, 2015). The project's main aim is to explore and develop conceptual and educational tools to develop critical digital literacies within a school context and empower educators so that they can take informed decisions and generate creative practices. Data literacy was indeed part of the set of critical digital literacies identified by the consortium from the beginning of the project, through a systematic review of the literature followed by a Panel Experts (Coulter et al., 2016) and teachers from the partners' schools for refinement and liaison with practice (Gouseti et al., 2021a). From there, the partnership attempted to cater the project's message to external educators in the EU to promote further debate and validation of the conceptual and educational tools developed.

3.2 Research Design and Method

In this context and for this specific study, we aimed to explore to what extent teachers' perceptions and dispositions toward data literacy align with the relevance and the complexity of the topic as identified by research and policy making documents. We consider that teachers' perspective and/or lack of perspective is a key indicator to understand their professional learning needs and hence, to plan teachers' education interventions. This would help to to bridge "the gap" between the research and policy making around data literacy, and the actual, mainstream in teaching practice. Finally, the teachers' voice around data literacy in a context of critical digital literacies might also bring relevant information to set more focused and relevant agendas of research and practice.

Therefore, and over the basis of the research problem and state of the art, we formulated the following research questions (RQ):

- RQ1: What are teachers' perceptions on the relevance of data literacy as part of a set of critical digital literacies to live and teach in a changing digital landscape?
- RQ2: To which extent the teachers' perceptions over data literacy embrace a critical perspective?

To address the RQs—and given our context of opportunity as researchers committed to the educational practice through transnational collaboration—we considered a constructionist, mixed methods approach to build understanding on CDL and build common tools for an educational intervention. As an approach, it searches to build trustworthiness reflecting the subjective experiences of the participants through joint meaning making processes and outcomes between researchers and participants (Lincoln et al., 2011). Moreover, the research outputs should demonstrate tactical authenticity, providing means to empower the individuals. The transnational collaboration engaging teachers from the inception of the project, as well as the process of co-creating concepts and instruments are clear/central elements in our approach. In this regard, exploring the presence, value, and relevance given to particular categories of analysis (like data literacy) was part of the constructive process.

The research unfolds in three phases of development of an approach to conceptualise critical digital literacies, a process from which we report the data literacy dimension in this paper. The participants in this study vary across the three phases but include members from the DETECT primary and secondary school partners (five schools from Finland, Italy, Spain and UK) for the first and second phase; and some external educators from all Catalonia for the third phase. Therefore, a convenience sampling method was applied for each of the phases (Arthur et al., 2012). Ethical permission was granted by the relevant HEIs (Hull, Florence and the UOC) and cities (Espoo) in the different countries and national guidelines regarding ethical approval were adhered to throughout the study. It is relevant to underline that in this study, we refer to geographical locations, not to "national contexts". Our schools are unique cases which refer to local and institutional cultural contexts. Indeed, five schools, which were partners in the project's consortium, took part in the constructionist approach: three secondary schools in Italy (Tuscany, Prato), Finland (Uusima, Espoo), Spain (Catalonia, Barcelona); and two primary schools from the UK (England, London) and Spain (same region). The national label has been adopted as a synthetic form of referring to each specific case. As for the primary/secondary level, we refer to the educational stages coincident with the ISCED 1,2 and 3. The primary or elementary school will cover the students' aged 6–12; and the secondary, those aged 12–18.

In the following sections, we detail such phases including the participants, instruments and procedures.

3.3 Phase I: The SELFIE survey

The EU SELFIE self-reflection tool (https://ec.europa.eu/education/schools-go-digital/about-selfie_en) was adopted as a means of evaluating how partner schools used digital technologies for teaching and learning and how digital technology use was perceived by teachers, students and school leaders. All partner schools signed up for the SELFIE tool and completed the relevant questionnaires.

The SELFIE survey includes the following main areas: Leadership, Infrastructure and Equipment, Continuing Professional Development, Teaching and Learning, Assessment Practices, Student Digital Competence. Each area includes several mainly Likert-scale (1= strongly disagree, 5 = strongly agree) questions through which the respondents evaluate their own and the schools' digital practices related to each area. Since the SELFIE is a self-evaluation tool, the original data from individual respondents is not available for researchers. We used the average sco-

res to represent and synthesise the school's situation, with no statistical purposes. Moreover, the SELFIE collects data from school leaders, teachers, and students. We only report teachers' and leaders' data in this paper.

Another relevant characteristic of the SELFIE is the possibility of tailoring the survey over the basis of agreed dimensions that the schools are willing to explore and the possibility to include up to eight additional questions. During three meetings between researchers and teachers we added eight questions aimed at exploring critical aspects of technology use in the participant schools. Apart from questions relating non-discrimination, external collaboration, critical thinking, cyber-bullying, user access security and technology exposure, there were two questions connected to data:

1. In our school, we discuss how data is collected, tracked and shared through the digital platforms and applications we use. (Data awareness)
2. In our school, students learn how to keep their personal data safe online. (Data literacy)

The full table of results can be accessed in DETECT's project report (Gouseti et al., 2021b).

3.4   Phase II: Focus Groups

Drawing on the findings of the literature review and the SELFIE reports semi-structured, focus group interviews were conducted with teachers from the five consortium schools in Italy, Finland, Spain and the UK in order to gain a more in-depth understanding of the particular needs of the target group in relation to the topic of critical digital literacies.

An email invitation to participate in a focus-group interview was sent to all the teachers of each partner school in the UK, Italy, Finland and Spain. The interviews, a total of 7, were organised and conducted by the researchers in the respective local HEIs between March–June 2020. The interviews explored the participants' opinions about critical attitudes towards the use of digital technologies in schools and the draft version of the developed CDL framework. Figure 1 introduces the framework, where it is possible to see that data literacy became one of the relevant dimensions. The descriptions adopted for each of the dimensions are published in the project's report on the CDL framework (Gouseti et al., 2021a). The interviews were conducted both face to face (Primary and Secondary in ES) and online (UK Primary, IT and FI Secondary) due to pandemic-related restrictions. The interviews were audio recorded and transcribed verbatim. The corpus in national languages was then coded, using as tree-code the same CDL framework sub-dimensions.

Figure 1. The CDL framework and the place of data literacy within.

The CDL framework's categories were used over the basis of reflective analytical classification of the text, over the basis of a thematic analysis' approach (Braun & Clarke, 2006). The project's empirical report introduces the procedure (Gouseti et al., 2021b) which was mainly based on the analysis of a multilanguage corpus (Catalan, Italian, Finnish and English) formed from the verbatim transcription of seven focus group. A representative sample of coded excerpts (n=117 out of 666) was hence extracted and translated, to allow the researchers' cross-validation. This process took several consensus meetings and led to a percentage of code adjustments of nearly 15% (13 codes over 117) which was applied to a final analysis of the corpus in original language. The resulting codebook with examples of the excerpts in English and the code groundedness (number of quotations linked to a code) are included in the project report with empirical results and open data (Gouseti et al., 2021b). In this paper, we report both quantitative representations based on the code groundedness (capturing in a snapshot the relevance given to a topic in the teachers' discourse) and qualitative excerpts on the data literacy topic. The quantitative snapshot aims at showing a comparative position of data literacy with regard to the rest of the CDL framework categories; the qualitative excerpts on data literacy, deepen on the meaning making process.

3.5 Phase III – Member checking

To ensure the trustworthiness, a process of member checking with the representatives from the partner schools and an expanded group of Catalan educators was adopted (Birt, Scott, Cavers, Campbell, & Walter, 2016). Also known as participant or respondent validation, member checking is a technique for exploring the credibility and authenticity of the results. It consists of returning data or excerpts or maps created during the inductive process of analysis, to further check the accuracy of the interpretation and the resonance with the participants' experience. In our case, we developed the member checking process as a space to reflect on the adherence of the CDL framework to the teachers' characterisation of their practices around critical situations when using digital tools with students. We undertook member checking in two particular occasions: a transnational event embedded in the project activity in November 2020, and an open workshop held in Catalan at Barcelona in February 2021, eight to eleven months after the focus groups.

The first member checking occasion was the Learning, Teaching and Training Activity organised within the "DETECT project". The activity aimed to raise educators' awareness and provided training in relation to critical digital literacies. It was a research-based activity aimed at enabling the participants to develop an in-depth understanding of the different dimensions of the CDL framework and their role in supporting teaching, learning and professional development. During the event, 11 participants from Finland, Italy, Spain and the UK worked collaboratively online in transnational teams. The activities consisted of:

1. A presentation of the focus group results by the research coordinators and
2. good examples of practice from the partner schools over the basis of the CDL. The teachers took part in an exercise where they had to consider the least and the most relevant and practised teaching activities around the CDL framework.

Three groups were invited to produce several grids with this approach, considering the following questions in the discussion: What is really central? What is not important? What is taken care of already? What needs attention? and What surprises or remains unclear? Also, in this case, we report some excerpts of the transcribed sessions and a synthesis of the elements collected in the grids, to place the role given to data literacy by the participating teachers.

The second member checking occasion was the ACTIC congress (II congress on Digital Competence, https://actic.gencat.cat/ca/congres/), as a national instance to share the advances relating to Digital Competence in Catalunya and Europe. The congress was celebrated in February 2020 (practical workshops) and the main conference, which included the practical workshops followed also in March. The UOC team organised one workshop and replicated it four times. During each of the sessions of one hour each, the local DETECT team engaged educators from several education levels in an online discussion and interaction analysing which were the most relevant areas of the CDL framework; also, the teachers commented on the relationship between the framework and its applicability to understand the critical issues encountered by them while using technologies with their students. We adopted an online environment based on GMeet as web conferencing system, and Mentimenter for interactions. Specifically, we refer to these last as an activity based on asking questions which can be immediately answered and displayed via webapp, triggering the presenter's interpretations and the participants'

comments via chat or voice at the web conferencing system. The participation was given on a voluntary basis and informed consent interaction was displayed and ensured that all the participants could enjoy the exercise and respond also using the chat in the case they would not want to appear in the Mentimeter counts. Some data was missed due to this approach (the participants selected which questions they were willing to take part in). After 20 minutes presentation on the framework and the project, the interactive part of the session explored:

a) Levels of the education system they worked at, and experience. We did not categorise data by gender or other type of information which would profile participants since this information was not relevant for our exercise;
b) which CDL dimensions they deemed relevant to support the most critical situations when using technologies at school;
c) whether these same dimensions were applicable to facing the pandemic pedagogy;
d) if participants considered they had relevant teaching experience in relation to any of the CDL dimensions;
e) to which extent the CDL framework addressed participants understanding of critical uses of technology at school.

Also in this case, the role of data literacy was identified. Overall, a group of 49 educators participated at the ACTIC workshop. Not all of them participated regularly in the several Mentimenter interactions, so we report the total number of responses at each interaction. The group was composed as follows: 4 trainers in industry; 19 teacher educators; 16 adult educators (secondary school), three primary and seven secondary school teachers. The group of 49 participants displayed a high level of expertise (37 with more than 11 years of experience). It must be underlined that the type of audience in the ACTIC congress is mainly composed by teachers that have relevant leading roles around educational technologies in their contexts of professional practice.

4. Results

4.1 Phase I: SELFIE

The SELFIE survey was circulated to the DETECT school partners comprising of two primary schools (from Spain and the UK) and three secondary schools (from Finland, Italy and Spain) and responses from 106 teachers, 16 school leaders (as well as 344 students) were collected. The results were conspicuous and complex. In this regard, we report mainly the results of the self-generated questions, showing the differences by school's geographical localization (ES, FI, IT, UK) and level (primary, secondary) as displayed in the composited Fig.2/3 (spider charts). It emerges here that, on a scale from 1 to 5, both data awareness and data literacy are marked between 3 and 4 by all the teachers independently of the school context (geographical/level). There is a slight difference between the self-confidence between the knowledge/understanding around data awareness and data literacy, particularly for the primary school teachers. We also notice that the teachers from the Catalan context (ES) tend to score higher in the secondary schools' case, but these being self-reported measures, this only expresses self-confidence, not actual knowledge and skills. Overall, the more critical areas relate to the time expo-

sed to the technology (or the feeling of missing the control of children and young people exposure) and the external collaboration with other schools, which has logistic implications.
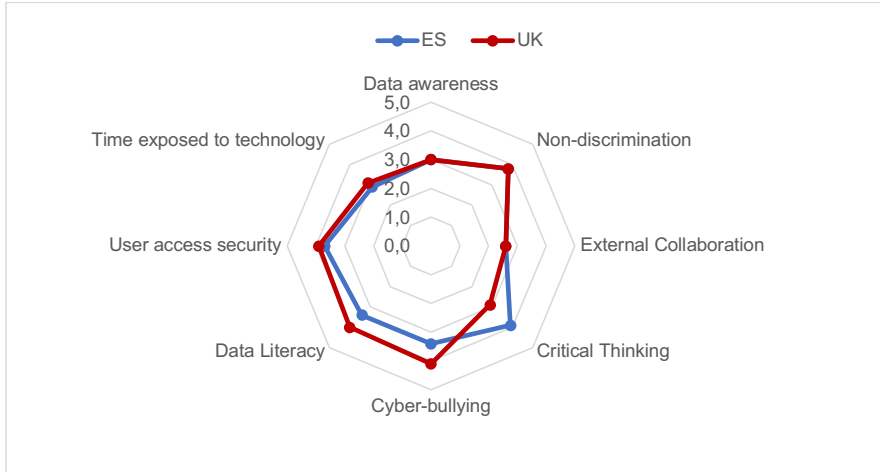
Figure 2. Results of the statements added in the SELFIE survey for the DETECT project from school geographical localization and school level (primary schools, *N* = 20).
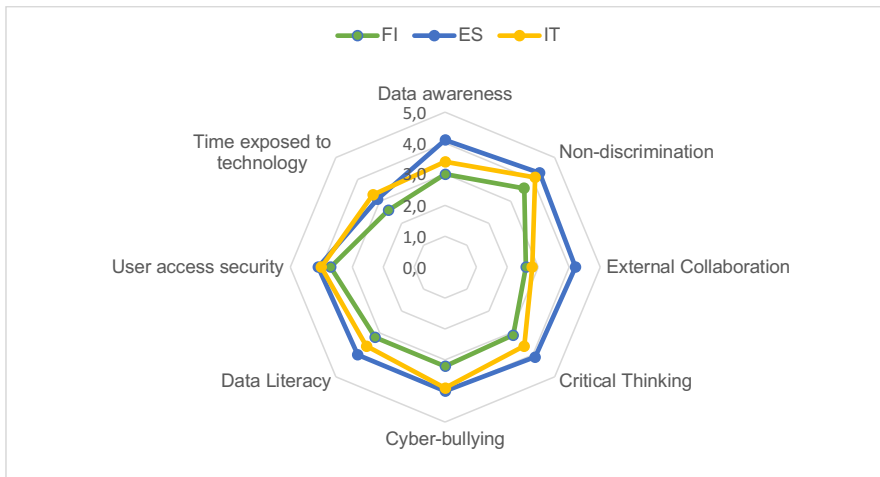
Figure 3. Results of the statements added in the SELFIE survey for the DETECT project from school geographical localization and school level (secondary schools, *N* = 76).

In a nutshell, the teachers appeared rather confident in the area of data literacy (including personal data awareness, though this is more critical for the primary school teachers) with regard to all the other dimensions. Apparently, the teachers' concerns about the critical approach to technologies were focused on other, more evident problems.

4.2 Phase II: Focus Group

A total of seven focus-groups interviews took place with a total number of 39 participating teachers (7 from Finland, 6 from the UK, 9 from Spain and 17 from Italy). The overall cited empirical report (Gouseti et al-, 2021b) shows the number of mentions in each CDL category from each country and highlights how the framework facilitated focusing on specific transversal issues across European schools. Overall, the teachers considered that the CDL framework captured all relevant aspects of critical digital literacies in the school context and did not feel the need of adding new dimensions. Moreover, different sub-dimensions of CDL were reported to be more prevalent for each national group.

Figure 4. Pictures from the focus group for the Catalan case.

Here we report to *figure 5* and *6* summarizing the code's groundedness. The figures display the percentages (number of codes per dimension over the total number of codes), to allow comparisons between the categories of analysis (school level and school's geographical position).

Within the overall picture, we note again how low data literacy is considered against other relevant categories. In particular, we observe some clearly expectable results like diversified primary and secondary schools' focuses and concerns about technologies, like technology use and digital teaching and learning although these two topics were more relevant from some of the cases than others (Italy and Finland). Some specific categories could be also linked to the school contexts, such as information literacy for the FI and the IT schools; 'digital well-being and safety' for the UK school; and digital communication and collaboration for the ES cases. We also see that for primary schools, "digital well-being and safety", and "digital communication and collaboration" are the key concerns. Data literacy appears as a relevant category only for the secondary schools jointly with other CDL's dimensions such as digital content creation and digital citizenship.
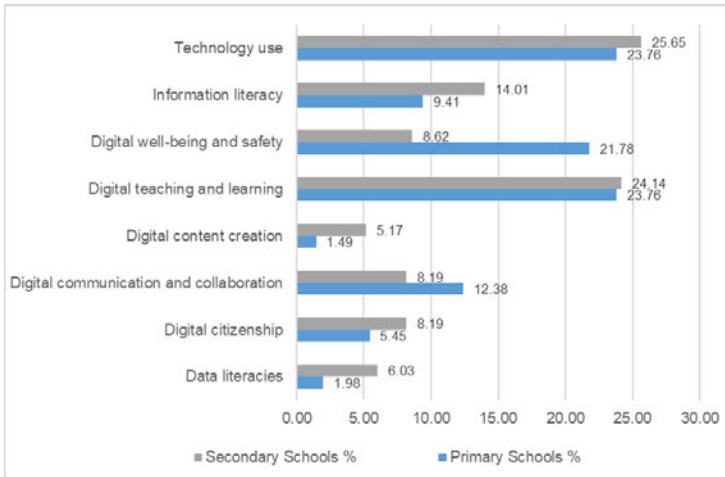
Figure 5. Code Groundedness divided per school level.
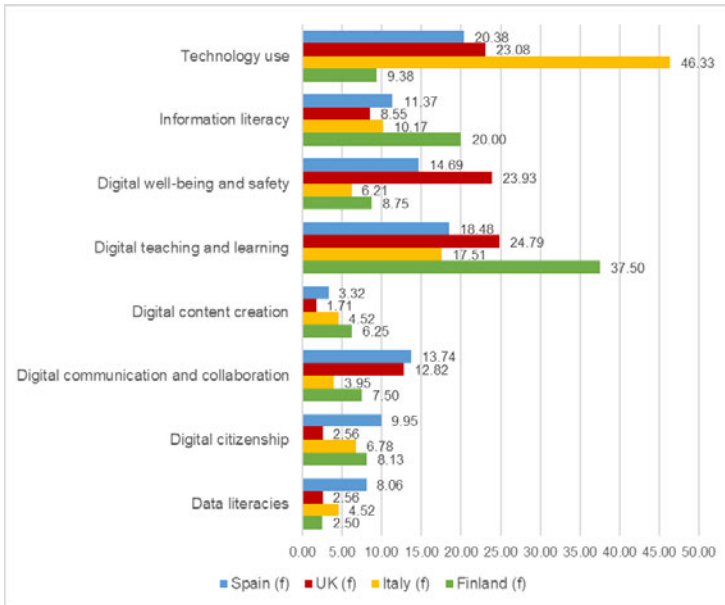
Figure 6. Code Groundedness divided per school geographical position.

In this overall landscape, digital collaboration practices (external collaboration, feedback to other students, co-creation, online collaboration, networking), digital citizenship and particularly data literacy were less discussed as categories.

When analysing the interview findings in relation to the data literacy sub-dimensions, it appears that the primary school teachers in England were to some extent concerned about data protection and safety [DPDS], as the following excerpts demonstrate:

Teacher 2 (FG1).UK [DPDS]: *"I was just thinking we haven't talked a lot about things that are there for the pupils as we do try and do lots of work on internet safety, and that's also relevant to adults as well, especially now we're working from home and we might be talking to each other about pupils and things like that, so we have to think about data protection."*

Teacher 1 (FG1).UK [DPDS]: *"I think it's [the google classroom] quite a good, safe place to practise digital literacy because we can see everything that they're doing basically, through the GSuite, or at least somebody can (Teacher 3)."*

Researcher 1: *"I guess Google owns a lot of that data, but…"*

Teacher 2.UK: *"Yeah, there's nothing, I mean, it's their comments, but we don't put any, like, personal information about the children there."*

Teacher 4 (FG2).UK [DPDS]: *"I can see on there [the framework] there's the software risk. So, you're talking about them with viruses and things like that and data protection. Is that what that means in terms of what you put out there of your own personal information or what you download onto your computer?"*

The excerpts, however, refer to a partial understanding of how data gets captured by the private platforms adopted in education. It appears that for the teacher, educational data (texts and clicks) which are captured could not affect students' privacy. Moreover, the ease of the private platform use supports the confidence regarding their appropriate approach to data handling. Still, this is contrasting with an initial concern relating to the way pupils and parents might behave with data beyond the educational platforms. Therefore, social media platforms are seen as much less safe. The role of the interviewer in triggering some reflection around the problem is also evident, but the teacher maintains the same approach.

This is in contrast with the following overall reflection reported also by teacher 3:

Teacher 3.UK [DPDS]: *"I think the teaching assistants, people who have not had to use computers so much in their job, I think that they are lacking in critical data literacy, and if we went to teaching more subjects through computing then they wouldn't be very good at being able to support the class, so I think teaching assistants' critical data literacy is a bit of a weakness."*

On the whole, this group of teachers appear confident on the levels of information they have around critical data literacy. Nevertheless, when the interviewers scratch the surface, their ideas show that there is probably information missed on the way data is captured and used by platforms.

The focus appears to change when approaching the secondary school teachers' group, across geographical contexts. For example, the Catalan (ES) teachers refer practices relating the concept of data analytics [DA], at the crossover with data protection and safety:

Teacher 1.ES [DA]: *"In 'What Makes Us Human,' which is a two-week third-year 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…"*

Teachers from Finland, Spain and Italy also make some reference to the use of big and open data [UBOD], but again here the conceptual borders are blurring

and tend to cross from the idea of private platforms data trace activities to the technical abilities to deal with data, as the basis of data science. Moreover, as the Teacher 2.ES emphasise "maybe something is missing":

> Teacher 1.FI [UBOD]: *"There is this word big data [in the framework]. It is a good example for our subjects, physics, chemistry, in which it comes down to us. For instance, the methodological institute has opened a large part of its data for open use. In the near future, instead of searching from books, we fetch information from the pages of these well-known institutions and continue pondering further. I think that it sounds great, but I definitely need some training in it."*
> Teacher 1.IT [UBOD]: *"When I think about 'big data,' I think of Facebook rather than the statistical data, and about the use of this personal data."*
> Teacher 2.ES[UBOD]: *In the third year of ESO (secondary school) there is also a statistics project. In addition, all postgraduate TGI projects have some database components. In the first cycle it is given a bit, we only do a little data collection, for example, to look at length and proportionality, we look at foot length and height, and from there they can look at the correlation. But maybe it would be missing…*

Some quotes referred to data visualisation [DS] too:

Data visualisation was also discussed by some of the teachers. However, as the excerpt below demonstrates, there are no references to the problems of data interpretation and the biases in the way data is used to create graphical representations embedded in data stories, which is a critical component of recent data practices.

> Teacher 2-FI [DS]. *And starting from … I speak about graphs. If they [students] can read a graph a little bit, so much that if some graph appears in some media, they have some understanding of what it is about. So that they will not be fooled.*
> Teacher 2-FI [DS] *I am working with my students on how to read a graph, thus on how to read this visual information, in relation to my subject (Math).*

4.3 Phase III – Member checking

DETECT LEARNING, TEACHING AND TRAINING ACTIVITY. During the several activities organised for the three-day LTTA event, the debate around data literacy was scarce and there were only two instances when the topic came up: one was a written post at a Padlet connected to a reflection work on the pandemic, and the second was a debate connected to teachers' practices presentation. The findings from the analysis of the several activities replicated what had been reported along the other phases of this research. Nonetheless, when the topic appeared (as in the interview prompted by the researcher), it was a focus of interest and debate. In the following, we quote a dynamic connected to the third day, relating to a debate on data privacy after the UK teachers' presentation:

> Researcher 2 [00:55:12]: *"I was thinking about the coding activities because I think this is the technical side of data literacy somehow in the sense that they see how the data is assembled in unconverted coding is used to some extent to manipulate information and do things. But what happens when we introduce wrong data to the coding. And this is a more critical side of what happens when the coding is applied to the wrong things."*

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Teacher5.UK (primary school) [00:58:02]: *"(yes)… They (the pupils) sometimes find it really funny that the squirrel keeps jumping into the sea rather than trying to fix it. So it gets the acorn. And so maybe raising their awareness of like, oh, actually, maybe it could be used in a bad way. And the bug itself might not be the bug. Actually, somebody's using it appropriately."*
Teacher3.ES (primary school) [01:00:29]: *"There's bad consequences: It's not me. It's the artefact, that's the machine. Yes, it's very complex."*

ACTIC CONGRESS. The participants answered that teaching and learning digitally required critical skills (21/49) above the dimensions of content creation (6), information literacy (9) and data literacy (12) and digital communication and collaboration (14). Nevertheless, there were some dimensions that also got some more attention, like the critical use of technologies for problem solving (16) Digital Citizenship (21) and Well-being and safety (16).

When the question was whether these same dimensions (encompassing skills and knowledge) were necessary during the pandemic, 42 teachers shifted their opinion as follows: teaching and learning digitally critically (13/42) content creation (9), Information literacy (4) Well-being (7), data literacy (4), critical use of technologies for problem solving (19) Digital Citizenship (2) Digital communication and collaboration (13).

Nonetheless, we asked whether the teachers had experienced teaching in such areas (we collected 28 responses to this question). The answer was: I didn't develop any project (8/28) teaching and learning digitally critically (7) content creation (7), Information literacy (5) Well-being (4), data literacy (3), critical use of technologies for problem solving (4) Digital Citizenship (5) Digital communication and collaboration (5). Finally, we asked which type of approach they preferred to improve their learning relating to critical digital literacies. We collected here 18 responses relating to the teachers' preferences as follows: learning through examples of practice (4.3 mean score/5 Likert scale of preference); self-paced learning (4.1/5); online synchronous workshops (3.1/5); conceptual definitions (3.1/5).

Finally, we asked the teachers to which extent the DETECT framework was helpful to address their understanding of the areas of educational intervention to develop a CDL and the answer from 37 teachers was 54% (19) "agreement", 30% (11) "Full agreement" and 15% (5) "I don't know".
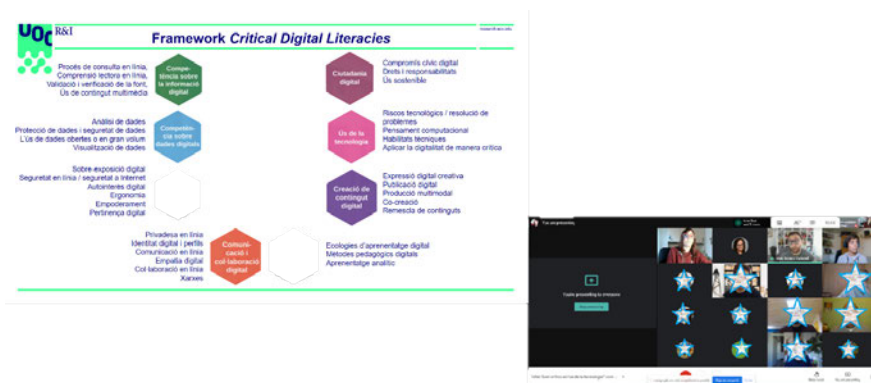

Figure 7. A screen capture of the Member checking at a continuing training activity.

5. Discussion

Our three, integrated phases exploring data literacy within a context of other critical digital literacies yielded a composited picture relating to the teachers' beliefs and practices which resonate with findings in the literature. We explored two research questions.

In response to RQ1 (*Which are the teachers' perception on the relevance of data literacy as part of a set of critical digital literacies to live in a changing digital landscape?*), we observed that across the several geographical contexts (ES, FI, IT, UK) and school levels (primary, secondary) the teachers appeared rather confident on their knowledge and skills when a rather impersonal survey was circulated at their schools (the SELFIE). This might be interpreted as a sort of indifference toward what appeared to be "abstract ideas": data protection and safety, or more critical perspectives relating to reading, interpreting and producing data. In fact, against more urgent problems like managing the excessive time spent with technologies by children and young people; or the need to innovate in practice by networking with other schools or classrooms, data literacy appeared as something already under control. This is a phenomenon consistent with what Selwyn (2020) showed in an ethnographic study with three schools in the Australian state of Victoria. He pointed out that the teachers were more frequently dealing with small-scale data which was the result of improvisation and highly contextual responses to bureaucratic tasks. The more sophisticated ways of approaching data, which are the domain of data science and data analytics, appeared mostly unknown. Moreover, the manual work was also far from acknowledging the complex assemblages (something referred to by Selwyn, 2020, as "sociology of numbers") throughout critical lens. This might explain the teachers' initial self-confidence in dealing with data awareness and data literacy categories.

With regard to the RQ2 (*To which extent the teachers' perceptions over data literacy embrace a critical perspective?*) through the focus group interviews we uncovered discourses and narratives around data which can be interpreted as less informed, or not entirely clear. Along the quotations reported, the teachers went on expressing their idea that Google was a "safe" platform and only reflected on the nuances of "safety" as an idea when the researcher introduced a divergent discourse (i.e., Google might be capturing data for purposes other than the private educational sphere led by the teacher and the school). However, concurrently with the educators' approach to social media and the pro-social web (Manca & Ranieri, 2013), the teachers deemed the social media spaces more unsafe and prone to capture data for purposes other than the educational. The problem of the digital platforms' invisibility and surreptitious way of offering glittered educational environments and tools with no evident information around the data usages and a huge probability of data monetisation has been highlighted in the literature. As reported by Williamson et al. (2020) «it appears clear that certain actors in the ed-tech industry are treating the crisis as a business opportunity» and «the marketing of these products to teachers, by email and online on social media, has been intense» (Williamson et al., p. 108). More specifically, Gleason and Heath (2021), by doing a techno-ethical audit of Google Classroom, disclosed the way injustice was embedded in such tools . In an opposite direction to the teachers' feelings relating to the positive affordances, they express that, for example, «in Google Classroom, there are relatively few opportunities for justice -oriented, participatory citizenship that empowers ordinary people to make meaningful personal, social, or institutional change» (Gleason & Heath, 2021 p. 7). Moreover, the idea of safety is also con-

trasted by the fact that, «Google data scrapes children's data from their educational services, too» (Gleason & Heath, 2021, p. 6). Taking into consideration the literature, our evidence appears to highlight the pressing need for teachers to develop skills to go beyond expert usage of functional and well-performing platforms and become more aware of data issues in using such platforms.

At the same time the secondary school teachers considered technical data literacy approaches, but only one of them placed questions around the good coverage of "data problems" in society. Also, in this case the teaching practices around data focused more on a technical perspective than a critical reflection around the role of algorithms and data visualization features that play a role in the manipulation of messages. This might also be the effect of a technocratic approach to education, in search of covering abilities needed in the job market. The findings in the literature by (Raffaghelli & Stewart, 2020) have highlighted that the concern on the development of data science and data management skills is a driver of the educators' data literacy. As they point out in their research (Raffaghelli & Stewart, 2020), the strong emphasis on how to navigate datafication effectively, without examination of the assumptions and norms that data practices represent and reinforce within education institutions, is a problematic default approach. Removing the pedagogical and ethical complexities of data from the view of decision makers and stakeholders fails to support the development of critical data literacies in response to the emerging unknowns of surveillance, datafication, and machine learning systems currently faced. Therefore, in spite of the key literature being developed in relation to ethics and critical approaches to data and data literacy (Pangrazio & Selwyn, 2020), teachers' practice should be supported through professional development pathways to fully embrace such an approach.

Wrapping up the RQ1 and RQ2, the member checking activities supported the prior assumptions by showing once again the need for "pulling" teachers reflection, and their unexpected directions in their way of understanding data. Nevertheless, it is relevant to say here that after almost nine months into the pandemic and the advances on the reflection around data in the mass media, the participants were more prone (particularly in the LTTA) to move into a direction of re-thinking coding (technical skill) through exercises that enabled the students to think about their role in "controlling and guiding" the machine. It is relevant to express at this point that control and responsibility in usage are the very basis of ethics in AI (Kerr et al., 2020). At the ACTIC activity, which was a non-formal professional learning context itself, the contrast between how the teachers perceived the CDL framework in an ideal teaching situation and what was relevant during the pandemic was telling in relation to the data literacy position. During the pandemic, more than ever, data literacy was behind other relevant dimensions, and considered a sort of sophisticated area of knowledge.

Data literacy, indeed, might be seen as an abstract, interesting but rather "futuristic" set of skills which is difficult to relate with the actual and more pressing problems experienced by the teachers in classrooms. In this regard, if the teachers experience data in their professional activity as a sort of "small" data handled at the school level and through digital infrastructures that are often far from the integrated complex settings required to run complex algorithmic operations, they will consider data as a problem «in the ether» and still the domain of the academic critiques of educational «datafication» and «dataveillance» (Selwyn, 2020). This type of perception blocks active teachers' approach to professional learning around data in the society and education, encompassing less creative and agentic teaching practices.

Indeed, issues such as the increased platformisation and datafication of contemporary schools over the past decade connected to 'tendencies towards pervasive data extraction and surveillance» (Perrotta et al., 2020) can be deemed still a problem of data infrastructures development, an item in the political agenda or a space for activism, rather than a specific professional concern for teachers and policy makers. This is well depicted by the very little use of Open Source software as key to maintain data sovereignty (Hummel et al., 2021). Though the teachers might develop professional skills to raise awareness, showing the children, young people and families the problem of data trace and reuse for commercial uses, the social media platforms, as far as the educational platforms used (and maybe imposed) at institutional level leave little space for teachers' agency. As it was reported by Pangrazio and Selwyn (2020), it is also challenging to step aside data surveillance when the social life of young people happens within the social media; as it is difficult for an educator to make choices that align with ethical concerns as "solo player". In a similar vein, Buckinham (2018) suggests that when dealing with media literacy and the phenomenon of misinformation and fake news regulations must accompany educational efforts .

Overall, our results are consistent with the idea that datafication as a societal problem and the required educational interventions, which in time can only be based on appropriate teachers' professional development, are still a matter of concern. Data discourse has entered the contemporary schooling system through several channels, potentially producing disorientation and misunderstandings. The very enthusiastic approaches relating to data management as the source of educational quality (Mandinach, 2012; Vanhoof & Schildkamp, 2014), are a matter of critique which assumes the perils of an external, private governance of education (Williamson, 2016). Moreover, the students' active engagement with a range of digital media make them particularly vulnerable in relation to personal data collection and profiling (Pangrazio & Selwyn, 2020). The teachers have to also face contradictions such as recent tools to track data and adopt them to develop AI systems (World Bank, 2019) or national documents advocating for the need to 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). In turn, this raises concerns in relation to this fragmented panorama and its connections with political and institutional performative responses to what it is the kernel of surveillance capitalism.

6. Conclusions

Our research clearly establishes a gap in the teachers' response to data literacy, contrasting the apparent relevance given to the topic in the research literature, probably more linked to advanced cases. Also, our research highlighted the difficulties in disclosing the critical side of data practices by our participants. Our reflections come from a mix of evidence collected within the broader panorama of critical digital literacies, where data literacy received little attention by teachers. Although the broader intention of the DETECT project and the various data collection activities was not on educators' data literacy, the overall picture on critical digital literacies and the particular place and emphasis given to data literacy by the research participants identifies this gap.

This study makes' space for a relevant set of recommendations for policy making and practice, which are connected also with future research. Mainly, there is

a pressing need to question the rhetoric of technical data literacy. While this set of skills is relevant and can contribute to the digital economy that has come to shape policy making and school agendas, it is extremely limited in capturing the complexity of the digital scenarios of datafication we live by in society. Embracing the critical perspectives around the digital is particularly relevant when coming to data skills. The direct implication of this situation is the need of re-discussing the educational practice and agendas, particularly relating the relevance given to metrics and measurements in a culture of "evidence-based education" which had already had their detractors (Biesta, 2007). Nonetheless, a recurring issue is that initial and continuing teacher training relating to digital literacies has been largely based on policies very much emphasising the power of technologies to develop the skills required in the labour market. Only recently the failures of such an approach has been acknowledged (Sancho-Gil et al., 2020).

In this regard, teachers' learning will depend very much on the space for professional coaching, experimental projects and discussion around what data is and data can be, in deep relationship with external experts which are developing research and practice at the cutting edge. The teachers must be given the space to reinterpret the value of data and to discover the complex debate in the society with no slogans supported by private interests and political techno-solutionism. Very recently, several national institutions and projects are delivering recommendations for the teaching practice around digital safety and data protection like the Interamerican Development Bank for Latin America (Del Pozo et al., 2021; Department of Education of UK, 2018; US department of Education, 2020). Nonetheless, these recommendations and instructions require professional development settings such as school projects, interventions, special units and self-paced online training.

Moreover, it is important to promote educational and civic activism on policy-making to shape agendas for teachers' professional development that make space for placing data literacy within media literacy and information literacy, which would lead to disentangling private and political interests in data platforms, exploring the data assemblages and semiotics across data stories in the mass media and social media, and cultivating creative skills around data. As Tygel and Kirsch (2016) pointed out a critical pedagogy relating to data literacy requires a technical, aesthetical and political integrated reflection.

To this end, educational interventions have to cultivate better technical understandings around data since emerging data practices combine statistics, coding and aesthetical work done through graphical skills in unexpected directions. But here is where the "maybe there is something missed" (as perceived by the teachers in our interviews) part begins. For example, understanding the "grammar" of data practices will prepare the educators to discuss and unravel the influence of a dashboard aesthetics on the behavioural manipulation and the political interests. As it has been emphasised by popular data literacy (Barghava et al., 2015) and data feminism approaches (D'Ignazio & Klein, 2020), this must be done in a space of collaboration with the holders of key know-how (data-scientists) through the participatory design of data practices, representations and stories. Within this ecosystem, the teachers will be able to cultivate the appropriate pedagogical reflection on what worked well with their own students. Needless to say, such approaches are highly contextualised and connected to the school and its community.

Therefore, what could be seen as a methodological weakness given the "bricolage" of the evidence collected in our study, becomes the strength: an explora-

tion that places data literacy ostensibly in contrast with other more urgent needs from the teachers and schools' point of view, unveiling the distance between the everyday life and the academic critique. Furthermore, identifying this "grey zone" also suggests the pressing need to reflect about the way the private platforms grip work since the unknown, the inertia, the impossible, put the teachers in the condition of having little choices. As Markham (2018) contends, future research steps demand participatory action research and design-based research triggering social transformation by exploring the tensions and contradictions that data creates in the schools (and society) through a contextualised educational praxis.

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