6. Discussion

After the last three chapters presented the findings of each of the study's three empirical perspectives, this chapter aims to interweave and discuss these findings. A key novel finding throughout my study was that many parallels could be identified between the examined resources, the interviewed creators and the surveyed educators. Yet, while many similar themes emerged in all three stages of the empirical research, this did not necessarily entail a unanimous stance of all participants. Rather, many key themes revealed divergent opinions between the participants, which often resembled ongoing debates in the academic literature, for example on the kind of constructive actions that critical education about datafication should encourage, or the appropriate balance between empowering citizens and shifting responsibility to them. Another significant finding was that the study's findings often showed remarkable parallels to those critical-reflective academic data literacy conceptualisations that were identified as most relevant in chapter 2.2 as well as to the selected educational approaches (media literacy, (politische) Bildung, and critical pedagogy) that were analysed in chapter three. Furthermore, a number of new insights were identified, such as ambitious and political goals of some resource creators or thoughtful perspectives on datafication by educators. Overall, the study led to novel findings on the as yet under-researched field of online educational resources about datafication, the intentions and approaches of their creators, and educators' experiences, needs and wishes. All of these provided new insights and strongly informed the further conceptualisation of critical datafication literacy.

6.1 Goals for Understanding Data and Taking Action

6.1.1 Critical Understanding of Datafication

Awareness and Understanding

One key objective of the study was to better understand the goals for critical education about datafication. Here, the analyses of the online resources, the interviews with the creators, and the educator survey showed remarkable parallels. The first key

goal that was identified across all empirical stages was that teaching about datafication should aim for increased *awareness* of the use and impact of data technologies as well as *understanding* of how these systems function and how they affect our lives and society. My study's participants aimed to raise awareness of digital technologies' influences and risks and emphasised that they wanted learners to understand how technology functions, including its shortcomings. Many participants wanted to foster critical and reflective understanding rather than mere passing of knowledge, a goal that corresponds with the principles of *Bildung* (e.g., Sander 2018). Equally in line with the concept of Bildung, several study participants highlighted that they view literacy as a never-ending process which continues throughout one's life and argued that a fully literate person does not exist (see e.g., Bauer 2003; Watson 2010). This further resembles critical pedagogy and its understanding of learning as an unfinished process of "becoming" (Freire 2017, p. 57). While these arguments show similarities to key insights from the traditional educational approaches examined in chapter three, they are not common in existing critical data literacy conceptualisations.

A key finding throughout several stages of the research was that many participants shared a goal of *broad, systemic, (infra)structural understanding* of datafication, which goes beyond aspects such as digital media content, data security or personal privacy, and instead aims for understanding of technologies' underlying structures and the wider transformation of society through technology. Many participants highlighted the social, political and economic dimensions of data technologies and thus the political nature of critical data literacy – with one outlining that "this type of engagement is political" (participant 209) – and suggested a need to connect to learners' existing social and political frameworks. As argued in chapter 2.2, such systemic and political approaches to data literacy are rare in the literature, and data literacy concepts have been criticised for "not explicitely engag[ing] with questions of power" and racial and social justice (Jansen 2021, p. 8f). However, this view correlates with critical pedagogy, which defines education or literacy as an inherently political practice (Freire and Macedo 1987; Vossoughi and Gutiérrez 2016). Moreover, a small number of educational approaches about data aim for systemic understanding and for unpacking the politics of data, power, interests and ideologies through data literacy (Pangrazio and Selwyn 2019; Pötzsch 2019; Fotopoulou 2020).

The educators further indicated that fostering such deep structural understanding with learners is *challenging* due to their often *limited and instrumental understanding* of technology, their narrow concerns around internet safety only, and, for some, the fact that they enjoy using data technologies. Other empirical studies have reached similar findings, reporting that people lack the literacy or technology understanding to fully understand critical art pieces about data technologies (Stark and Crawford 2019), or that students found it difficult to think outside the box

and beyond cybersecurity, and that the "thrill" of using social media restricted learners' critical reflection (Pangrazio and Selwyn 2020, p. 11). Equally in line with the literature, some participants aimed to foster learners' *technical* understanding while at the same time promoting critical thinking (see e.g., Koltay 2015). Finally, a novel finding was that some educators aimed to teach about the ethics and laws regarding digital and data technologies.

Critical Thinking and Forming One's Own Opinion

A second key goal identified throughout the entire study was *critical reflection* or *critical thinking*. Many study participants placed a particular emphasis on critical *thinking*. This reiterates education scholarship, which outlines the development and promotion of critical thinking as a core goal for education in general (Barrow 2014, p. 257f) as well as for specific approaches such as politische Bildung (Autorengruppe Fachdidaktik 2016, p. 8) and critical pedagogy (Giroux 2010, p. 716). The latter understands critical thinking as a way of fostering a "critical consciousness", an awareness and critical reflection of one's own situation in the world (Freire 2017, p. 42f). However, also some academic critical data literacy concepts have called for critical thinking (e.g., Koltay 2015; Pötzsch 2019; Carmi et al. 2020), or have applied Freire's critical consciousness to education about digital and data technologies (e.g., Hammer 2011; Tygel and Kirsch 2016; Milan 2017; Meng and DiSalvo 2018; Markham 2019).

The study's participants further detailed how they fostered critical thinking in practice. In line with the literature, key identified approaches included educating about the risks and dangers related to data technologies, and demonstrating how *technology affects individuals and society*. Moreover, many participants emphasised to not tell learners what to think, but rather support them in *forming their own opinion*. Instead of convincing learners of a specific perspective through "persuasion and propaganda" (Gaylor interview, 2020), as one creator put it, encouraging them to reach their own conclusions through critical thinking can open learners up to new perspectives and empower them. This corresponds with (politische) Bildung and its goal of Mündigkeit (see below), and with critical pedagogy, which aims for a pedagogy *with* the learner, using dialogue and critical thinking (Freire 2017). Similarly, a small number of data literacy concepts emphasise that educators should not indicate that certain data systems are good or bad, but rather let learners experience and see for themselves how they are tracked (Fontichiaro et al. 2017, p.v; Markham 2019, p. 758), and prompt them with good questions (Markham 2020, p. 231) – approaches that the interviewed educators also suggested. Moreover, Kennedy et al.'s research found that people have (emotional) views on data practices even when they have little understanding (2021a, p. 1759), indicating that these views should be taken seriously instead of convincing learners of other perspectives.

Furthermore, the findings suggested that the ability to think critically and form one's own opinion can help with the *challenges of a fast-changing technology landscape*.

This fast pace comes with many challenges, including keeping online educational resources technically accessible and keeping the content of educational material up to date. One educator suggested that fostering learners' ability to think critically could enable them to apply "ethical thinking on unforeseeable yet emerging technologies" (participant 282). This approach is not yet common in critical data literacy discourses. However, one early data literacy publication made a similar suggestion, aiming to foster "adaptive capacities and resilience rather than teaching platforms and technical languages that are bound to become out-dated" (Data Pop Alliance and Internews 2015, p.iv). This approach is further reminiscent of politische Bildung, which fosters citizens' ability to evaluate and criticise social phenomena, even when these are changing (Autorengruppe Fachdidaktik 2016). Therefore, politische Bildung does *not define any learning objectives*, but argues that whatever challenges individuals' Mündigkeit and democratic self-determination at the time becomes a learning objective (ibid.). While this approach of adapting the topics of teaching to current social challenges is highly relevant for educating about the fast-changing world of data systems, it is difficult to implement in practice as it requires continuous updating of teaching and learning material. More research is needed about how education about datafication could learn from the decade-long experience of politische Bildung regarding these challenges.

Related to critical thinking, two further goals of study participants were to work towards people's *agency* in datafied societies and to *empower* them. While agency is not a particularly common theme in the data literacy discourse (see chapter 2.2), some critical data literacy concepts similarly aim to foster the skills "required to have agency in a datafied world" (Pangrazio and Sefton-Green 2020, p. 214; see also: Pangrazio and Selwyn 2019; Carmi et al. 2020). Empowering individuals, on the other hand, is a pronounced goal of many academic critical data literacy concepts (e.g., D'Ignazio and Bhargava 2015; Pybus et al. 2015; Pötzsch 2019). This goal is further very prominent in critical pedagogy approaches, which aim for "self-determination and civic engagement" (Giroux 2010, p. 716), and want to empower individuals to transform their societal reality (Mihailidis 2018, p. 10). Tygel and Kirsch, who developed a Freirean-inspired critical data literacy, similarly emphasise the emancipatory character of their literacy concept (2016, p. 113f).

6.1.2 Diverse Skills and Paths of Action

Empowering Learners to Become Active

These goals of empowering citizens and providing them with the ability to transform their reality leads to another key goal identified in my study: to *enable learners to take action*. Literacy is sometimes criticised as aiming 'only' for awareness and understanding, without offering constructive next steps. This was not the case for the resources, creators and educators examined in my study, who predominantly

placed a strong emphasis on encouraging learners to become active. Similarly, some academic critical data literacy scholars have emphasised the importance of including practical steps toward empowerment (Yates et al. 2021; Bilstrup et al. 2022), and have outlined that agency can also be enacted through "tactical and small forms of engagement" (Gangneux 2020, p. 461). However, as will be further discussed below, citizens' ability to protect their data is limited and if no "adequate pathways forward" are offered, such approach can also lead to frustration and resignation (Jansen 2021, p. 7; Yates et al. 2021). This risk of resignation (see e.g., Hargittai and Marwick 2016; Dencik and Cable 2017; Draper and Turow 2019) was also recognised by some of the surveyed educators, who spoke of a "dystopian pull" (participant 174) in some of their learners.

Many participants further aimed for an *informed participation in datafied societies*. They wanted to enable individuals to make "enlightened choices" (Schekter interview, 2021), and gain a "tech intuition" (participant 316) in order to make informed decisions on technology use without knowing all the details. While also some academic approaches aim to empower citizens to navigate their digital ecosystems and societies in an informed manner (Data Pop Alliance and Internews 2015, p.iv), and work towards "enlightened user[s]" (Milioni and Papa 2019), the notion of a "tech intuition" constitutes a novel and highly relevant approach to educating about fast-changing technology landscapes. Bildung similarly aims for understanding of the world and the ability to make judgements (Sander 2019), and politische Bildung promotes citizens' orientation in the world, political participation and civic involvement (Autorengruppe Fachdidaktik 2016). These objectives correlate with many of the participants' goals, which suggests that many might have called for *Mündigkeit* in regard to datafication if they had been prompted to use this term. Mündigkeit describes the ability of individuals to sustain themselves in and grapple with society, politics and economics in an informed and self-determined manner (Autorengruppe Fachdidaktik 2016). It can be seen as a prerequisite for participating in society successfully, which, one could argue, must include a certain *literacy* regarding digital and data systems in our datafied societies.

While the importance of empowering learners to take action was largely unequivocal, some of the findings identified were less clear. For example, some expert interviewees thought it unrealistic to change people's behaviour and were happy with 'only' aiming for awareness and understanding. Apart from that, the type of constructive actions that should be recommended was not always clear, with some conflicting findings and dilemmas emerging.

Conflicting Findings on the Need for Data Usage Skills

In the academic discourse as well as in debates among critical data literacy practitioners, one question often remains unresolved: Should critical data literacy *also foster people's practical skills of using data*? Some scholars argue that both critical reflec-

tion and practical data usage skills are needed (e.g., D'Ignazio and Bhargava 2015), or even that education about data should take place *through* using data (e.g., Pybus et al. 2015; Crusoe 2016; Gray et al. 2018). In contrast, other scholars argue that critical data literacy needs to go *beyond* skills (e.g., Markham 2019; Pangrazio and Selwyn 2019); that fostering digital skills, without also promoting critical reflection, can actually be *harmful* for kids (Livingstone et al. 2021a); and that the (unreflecting) use of digital methods in teaching can come with a "hidden curriculum" – subconsciously suggesting data as direct and accurate measurements (rather than biased, incomplete representations) and building excessive trust, thereby leading to illiteracy (Mertala 2020, p. 14). Similar debates are being held in other fields of literacy research, such as the media literacy field (see chapter 3.1).

In line with these academic debates, the participants of my study showed *diverging opinions* on the question of data usage skills. While the goal of data usage skills was less common in the resource analysis and the expert interviews, the educator survey led to a more mixed outcome, with the majority of educators indicating that in order to understand data systems, learners should use data and datasets themselves. This might be explained by the different samples, as the sampling for the survey did not specifically address educators that aimed to promote critical reflection of data technologies. However, similar to several academic critical data literacy approaches analysed in chapter two (see section 2.2.2), many educators aimed to promote critical reflection *through the use of data* and wanted to foster people's data sovereignty, the use of data for good, and the development of better technologies. Apart from that, educators mentioned practical skills that are more common in information and digital literacy than in data literacy concepts, such as basic usage skills for digital media, digital media content creation, researching skills, and the use of digital technologies for teaching.

The Dilemma of Data Protection Skills and Individual Responsibility

Moreover, the question of whether or not, which, and in what way *data protection skills* should be taught often led to *conflicting findings*. On the one hand, data protection skills were the most common type of advice identified in all three empirical stages. Many study participants argued that such skills can empower individuals, foster their confidence and make them feel safe. They further highlighted that knowing how to (better) protect one's data online can help to avoid a feeling of powerlessness or resignation when learning about data collection and data systems (as also suggested by participants in my prior study, Sander 2020c). Critical data literacy scholars make similar calls, highlighting the empowering nature of such tactics (Young and Pridmore Forthcoming); calling for "resisting" or even "emancipated" users, who resist or abandon the corporate web (Milioni and Papa 2019), or aiming – but finding it difficult – to motivate students to use alternative technologies (Pangrazio and Selwyn 2020).

On the other hand, many study participants emphasised that data protection advice is problematic – some even said pointless – as *systemic solutions are needed*. Several participants outlined that technology is so sophisticated that it cannot and should not be up to the individuals to solve issues around data, and that individual solutions "won't amount to anything" (Gaylor interview, 2021). They drew parallels to the issue of climate activism, arguing that legislation needs to step in and that more control, oversight and transparency is needed. Similar arguments are made in the literature, with scholars outlining that many difficulties in privacy protection are rooted in the "responsibilisation" of individuals (Kazansky 2015, p. 189). The fact that critical education about data can offer learners few alternatives other than opting out from digital services can easily evoke paranoia (Pangrazio and Selwyn 2020; Pangrazio and Sefton-Green 2022), when learners realise that individual data protection is only a "small bandage approach" and that collective and systemic solutions are needed (Young and Pridmore Forthcoming). Moreover, some studies show that young people are annoyed by obfuscation practices and instead see platform providers as responsible for privacy protection (Selwyn and Pangrazio 2018, p. 10) – similar to scholars who argue that responsibility is currently outsourced to the education sector and individuals, whereas it is platforms and regulators who need to act (Livingstone et al. 2021b, p. 233; Yates et al. 2021, p.xii; Livingstone et al. 2022, p. 196).

These arguments are connected to another key finding of the study: that *responsibility to address challenges of datafication should not be shifted to individuals*. Several interviewees highlighted that putting this "burden" on the individual is the "wrong approach" (Gaylor interview, 2021), and also the majority of the surveyed educators indicated that it should not be up to the individuals to protect their data. While self-data protection was a common goal of digital and data literacy concepts in the past, recent critical publications have similarly begun to criticise this shift of responsibility to individuals (e.g., Mihailidis 2018; Pangrazio and Selwyn 2019; Carmi et al. 2020; Pangrazio and Sefton-Green 2020), and called for collective approaches rather than individualised ones (Gangneux 2020, p. 462). Similar arguments can be found in media literacy discourses, with scholars arguing that media pedagogy should support self-determination, but that this self-determination should not be individualised but is dependent on a civic framework for action (Aßmann et al. 2016), and that media literacy should not be restricted to a subjective-individualistic level, but should rather be implemented at a supra-individual, societal level and should foster public discourse (Baacke 1997).

However, finding this *balance between empowerment versus a shift of responsibility* is difficult. The majority of resources analysed in the content analysis only provided individual data protection advice, thereby indirectly shifting responsibility to the individuals, and some even directly urged individuals to take responsibility of their data. Moreover, nearly a quarter of the surveyed educators took this perspective.

These conflicting findings resemble the academic discourse on (critical) data literacy, which, despite the concerns of individual scholars outlined above, overall, still places a strong emphasis on fostering individual skills. Studies have further shown that citizens are so used to individualised approaches to manage the risks of digital data and to remain 'safe' that they view privacy as their own individual responsibility (Shade and Shepherd 2013), and are rarely able to "reimagine data use in more collective, more open and/ or more subversive terms" (Pangrazio and Selwyn 2020, p. 11). This highlights the importance of including alternative and collective forms of action when educating about data, such as those discussed in the next section.

Going Beyond Skills: Alternative and Collective Paths of Action

A novel finding of the study was to identify a number of alternative and collective paths of action as goals for educating about datafication. By far the most common approach in this context was the goal of enabling learners to *take political or societal action*. This approach occurred in small numbers in the analysis of the resources but received strong agreement in the educator survey. Moreover, many of the creator interviewees wanted to support such paths of action, for example by encouraging learners to contact political parties, take part in public debates, or even contribute to a critical data movement. In this context, this study further found that several study participants aimed to provide learners with a *data language*, a shared vocabulary about data that enables them to better articulate their concerns and be heard and seem legitimate in public debates.

These highly motivated and political goals are not common in existing critical data literacy conceptualisations, but resemble "re-active data activism", that aims to educate about data technologies as well as fight against the datafication and its problematic implications (e.g., Milan and Gutiérrez 2015; Milan and van der Velden 2016), albeit possibly with a more disruptive focus than my study participants' goal of citizens enacting their democratic rights. Some participants further aimed to support learners in *actively shaping the digital society,* and argued that to be a citizen in datafied societies means to engage in participatory processes about the control of data extraction, monetisation and usage (209). This perspective is reminiscent of academic definitions of "data citizenship" (Carmi et al. 2020, p. 3) or being a "digital citizen in a datafied society" (Hintz et al. 2019, p. 19) and of Shade and Chan's "digital privacy policy literacy", which promotes citizens' participation in privacy policy-making (2020, p. 336). Similarly, media pedagogy as defined by Aßman et al. aims to help citizens comprehend digital structures and shape them democratically (2016). These goals are closely connected to a hope of *achieving change through education*. This hope was expressed by several participants who aimed to mobilise learners to take political or societal action, to participate in society in an informed manner and to shape this society. Such perspectives reiterate the Freirean understanding of literacy, which sees education as an emancipatory process that can help individ-

uals transform their limiting reality and change social conditions (e.g., Freire and Macedo 1987; Wringe 2012; Freire 2017).

Further alternative actions fostered by study participants included encouraging people to *imagine different data futures*. Their objective to foster an imagination of alternatives in order to motivate learners and steer them away from a resigned attitude resembles Jasanoff and Kim's notion of "sociotechnical imaginaries" that highlight "the capacity to imagine futures" as a crucial element in social and political life, and for formulating and reaching goals (2009, p. 122). The study participants implemented this approach into practice for example by offering learners different data future scenarios – including dystopian and utopian options – or encouraging them with the slogan "To change the future, click here" (Do Not Track, R9). Some – few – academic concepts take similar approaches, aiming to open up people's "infrastructural imagination" of how datasets are created, used and organised through "data infrastructure literacy" (Gray et al. 2018, p. 3), or fostering people's "critical imagination" in data activism projects (Milan 2017, no page number). However, fostering such imagination in practice can prove difficult as learners, such as in my previous study, find it difficult to imagine negative consequences of data disclosure beyond personal safety or cybersecurity (2020a; similar findings by Pangrazio and Selwyn 2020).

Finally, the study participants and the examined resources aimed to foster people's *networks of literacy*. Scholars have emphasised the importance of people's social networks for fostering literacies (Yates et al. 2021), and have highlighted that once people start asking critical questions, this critical awareness starts a "chain reaction" that spreads to their friends and families (Markham 2019). Several such attempts were identified in my study, for example by providing awareness-raising exercises people can do with their friends, public speaking material, or workshop and teaching material that can be used to educate others. Moreover, many educators indicated learning about new topics and resources from their colleagues, and the interviewed creators highlighted empowering people to educate others as one of their goals. Many creators further reported interest from educators in their resources, and one called an educational use of their resource a "dream use case" (Younge interview, 2021). However, they also emphasised that small projects like the ones examined in this study, which often originate from civil society, are not enough and that a *systematic education strategy* for critical data literacy is needed. Similar calls were made by the educators, who nevertheless expressed gratitude about the existing resources (see section 6.2).

6.1.3 Key Insights on Goals for Critical Data Education

Overall, many significant parallels were identified between the study's empirical findings on goals for teaching about data and key theoretical findings from the sec-

ond and third chapter. These novel insights strongly informed the critical datafication framework developed throughout this study, and they demonstrated how much can be learnt from analysing the practical data education that is already taking place in different contexts. A crucial finding was the strong dominance of *critical and reflexive goals*, aiming for critical and systemic understanding of datafication. In particular, the goal of systemic understanding of the (infra)structural changes in society through datafication provides a novel perspective that does not get much attention in academic data literacy discourses thus far (see chapter 2.2). The content analysis similarly demonstrated that many existing resources did not meet the qualifying criterion asking for a critical perspective. From anecdotal experience, it is likely that a similarly strong focus on instrumental, practical data literacy approaches as identified in chapter 2.2 might be found in a wider scale analysis of educational resources and practical education. A systematic review of literature on higher education data literacy approaches already confirmed this (Raffaghelli and Stewart 2020, p. 446ff).

Moreover, the findings showed a *significant focus on alternative and collective paths of action* for learners. This demonstrates that online educational resources can also go beyond fostering data protection tactics, which has been identified as the dominant approach in this study's content analysis as well as in other studies (Young and Pridmore Forthcoming). Thus, these findings advance previous research in the field and are particularly encouraging as suggestions for collective action allow for a balance between providing constructive advice to avoid learners' resignation while not making learners feel as if it was their responsibility to address the systemic issues around datafication.

6.2 Findings on Resources and Contexts of Teaching

Educational Settings and Challenges for Teaching about Data

The empirical research in my study further led to novel findings on existing online educational resources about datafication and the contexts in which critical data literacy is already being fostered. A wide range of diverse online critical data literacy resources was identified, and the survey demonstrated that topics around digital and data technologies are already addressed in formal and informal education settings, such as schools, universities, teacher training and civil society workshops, and in diverse subject settings from IT through communication and journalism to political literacy. This corresponds with scholarly calls for interdisciplinary approaches to critical data literacy and an implementation of such literacy education in formal as well as informal settings (e.g., Aßmann et al. 2016; Gray et al. 2018; Pangrazio and Selwyn 2019).

Nevertheless, many research participants agreed with scholars that more needs to be done to improve the teaching of critical data literacy. They highlighted a lack

of support and IT infrastructure in their institutions, a challenge also identified by Pangrazio and Selwyn (2020). Several surveyed educators further called for a change in curricula in order to include critical perspectives to data technologies. Similarly, already in 2016, Aßman et al. urged that media pedagogy – which, as they argue, should include critical education about big data and data analytics – needs a permanent and sustainable place in curricula (2016). More recently, scholars have argued that school curricula about digital technologies should be more critical (Polizzi 2020a).

Findings on (the Use of) Educational Resources

In light of these challenges and gaps in curricula, many surveyed educators found their own, creative solutions in order to teach about data, such as searching for material online, exchanging ideas and resources with colleagues, or even creating their own resources. Divergent findings were identified on the educators' satisfaction with their access to information and teaching material, with some participants finding it difficult to find good material, highlighting that school-specific, easy-access and up-to-date resources are needed, whereas others were satisfied with their access to material and even spoke of an "abundance" of resources. Several participants wished for a central collection of resources that would make it easier for them to find the right resource for their learners, and many indicated online resources such as the ones that were examined in my study as useful to them.

These novel findings, together with the fact that the content analysis identified a large number of educational resources that foster critical education about datafication without requiring any prior knowledge, suggests that there are already many resources that are useful for educators who are interested in fostering critical data education. Moreover, the analysis demonstrated the diversity of these as yet underresearched resources in terms of their creator background, country of origin and format. Particularly the latter revealed new information on unusual formats and design approaches. Moreover, a large amount of material designed specifically for teaching was identified. This reemphasises the need to better connect these existing resources with educators interested in teaching about data. Yet, one gap remains: as the study only examined resources that are available online (with only few intended for print-out or in-person use), no claims could be made about the formats, content or goals of analogue resources, or about the daily practices and exercises used by educators teaching about data. This is a limitation of my study. An analysis of analogue resources and further approaches educators take in their practical teaching about datafication would be highly interesting for future studies.

However, one significant finding in relation to analogue resources did emerge in the study: the vast majority of educators and also some creators stated that analogue formats are useful for teaching about digital and data technologies as well. This approach tends to be overlooked by most academic critical data literacy

concepts, which often instead suggest educating about data systems through the active use of data (e.g., Pybus et al. 2015; Crusoe 2016; Gray et al. 2018). However, it is in line with other scholars, who emphasise that education about digital and data technologies does not have to take place digitally, and that also creative and unusual approaches, for example theatre plays, should be promoted (e.g., Pötzsch 2019; Windeyer 2019; Carmi et al. 2020). Furthermore, studies have shown that embodied, tangible, sensory experiences of data are easier to understand for students than digital approaches (Bilstrup et al. 2022, p. 234), and that gamified online tools might even, especially for young kids, be too thrilling to evoke critical reflection (Pangrazio and Selwyn 2020). Moreover, scholars have highlighted that the (unreflecting) use of digital methods can come with a "hidden curriculum", leading to illiteracy (Mertala 2020). These risks might constitute a limitation of my study's findings, as most resources take digital and playful approaches, and analogue and in-person approaches were not examined. However, this perspective is controversial, as study participants and scholars also highlight the importance of fun and interactive approaches to learning about data (see below).

Challenges and Difficulties of Online Critical Data Literacy Resources

Throughout the different stages of the research, the study identified three key challenges regarding the creation and use of online critical data literacy resources. First, the *funding* of online critical data literacy resources was identified as problematic. Interviewees reported difficulties in finding funding and several of the surveyed educators called for more funding for resources and alternative educational formats. An essential problem was the project-character: funding is usually provided for short-term projects. This leads to time pressures and often means that maintaining or updating the resources is not included in the funding.

Closely related to this, the second challenge was the *sustainability* of online educational resources. With the fast-changing technology landscape, both the content and the technical structure of the resources outdate quickly and need to be maintained and updated regularly. However, in most cases, no permanent funding is available, so maintenance is either unpaid and undertaken in the creators' free time or does not take place at all. Suggested strategies included keeping the resources' content more generic or viewing them as "unupdateable" and focussing on archiving them and creating new resources instead. However, who should be responsible for such archiving work and for providing more permanent funding requires further thought, both from sides of the creators, but also from academia and public and educational institutions.

Finally, the third challenge identified was the dilemma of *evaluating a critical data literacy resource's success and reach* while at the same time protecting the user data. One issue is that it is difficult to evaluate a resource's 'success' in terms of learning outcome as most resources are used independently by learners and their use is not

monitored. Moreover, many creators deliberately did not want to collect their users' data in order to keep their integrity and 'practice what they preach' in regard to data privacy. However, for this reason, they were often unable to see how many people used their resource, for how long, or who these users were. Similar conflicts were discussed in Stark and Crawford's analysis of artists working with artificial intelligence (2019). Given these difficulties and knowledge gaps, the usage practices and the 'success' of online critical data literacy resources urgently requires further research.

6.3 New Insights on Strategies for Teaching about Datafication

All three stages of the empirical research in my study further led to novel insights on strategies and methods for fostering critical education about datafication. Besides some conflicting findings, many parallels emerged in the three empirical stages, highlighting best practice strategies recommended by different types of critical data literacy practitioners, which often reiterated approaches from traditional education scholarship.

A Literacy Resource for Everyone is a Literacy Resource for No One

A key insight identified in the literature on critical data literacy as well as in this study's interview and survey findings was that there is *no one-size-fits-all approach* to literacy. The surveyed educators strongly agreed with this and highlighted the importance of considering the different contexts of teaching and cultural backgrounds of different learners. Many of the interviewed creators similarly strongly emphasised the importance of target-group specific resources and detailed how they adapted their resource to their audience. This highlighted new approaches on how to develop target-group specific resources, such as *adapting a resource to the narratives* its target audience already holds about digital technologies and data and *finding their "hook"* – the aspect of data technologies that interests them. This could, for example, be people's sense of justice that encourages them to fight against discrimination, their concern for their kids' safety online, their aversion against economic monopoles, or simply their wish for privacy.

However, while some clearly argued that a "product for everyone is a product for no one" (Jansen, additional material interviews, 2020), others nevertheless addressed broad audiences in their resource (e.g., all Germans). The importance of adapting educational approaches about data to different audiences, considering people's different capacities, being sensitive to diversity and thus developing specifically tailored literacy programmes is also repeatedly emphasised in education literature (e.g., Brüggen 2015; Aßmann et al. 2016; Pangrazio and Selwyn 2019; Carmi et al. 2020). Scholars have further pushed for thinking about literacy as a

social practice that is dependent on context and individual, and to thus consider the multiplicity of literacies (e.g., Fotopoulou 2020; Pinney 2020).

The practical implementation of these considerations, however, seems to be less straightforward. Several interviewed creators reported that it can be difficult to reach the intended audience of a resource, and the majority of the resources analysed in this study addressed broad, general groups, such as the general public or all adults and young people. While some addressed specific audiences such as journalists, activists, policymakers or educators, this nevertheless suggests that more online critical data literacy resources should be developed that take the needs, wishes and existing narratives of specific groups and communities into consideration.

Choosing Interactive, Easily Accessible and Involving Formats for Literacy Resources

A key finding that emerged throughout my study was that *interactive formats* are popular and work well for fostering critical data literacy. About half of the examined resources included interactive elements and both the interviewed creators and the surveyed educators praised active and exploratory approaches and saw them as a great way to engage learners. Such "applied and participatory approaches to learning" about data are already suggested by Illiadis and Russo's introduction to Critical Data Studies (2016, p. 5). Some interviewees further argued that a critical data literacy resource should be an "experience" or a conversation with the learner, which should lead to an "essence" or a new insight. This is not a common theme in critical data literacy discourses, but a recent data literacy publication similarly found that connecting "experiential activities" with reflection worked well in supporting students' engagement with data privacy (Agesilaou and Kyza 2021, p. 464). Apart from this, the participants emphasised that resources should be easily accessible, both in terms of technological accessibility and content. They recommended to always consider people's convenience, to not use too much text, to modularise the provided information into chunks, and to take a step-by-step approach – starting from easy-to-understand basics and slowly working towards more complex information. However, they also highlighted that it is often difficult to find a balance between an easily accessible and a technically accurate resource.

In order to capture people's interest and entice them to want to learn more – even about the more complex aspects of datafication – many creators and educators in my study suggested to *foster people's personal involvement*. Both groups reported difficulties in engaging learners and moving data issues into their "circle of worry" (Gaylor interview, 2020), because people suffer from "issue fatigue" (Yusuf interview, 2020). As a solution, they aimed to make people realise that they are personally affected by issues around datafication, and to connect to their own real-world experiences with data technologies. Similar approaches are suggested by critical peda-

gogy, which confronts learners with real-world problems (Freire 2017, pp. 54; 69), and by some critical data literacy concepts, which suggest using data or examples from the learners' experienced world to let them see the implications of data systems on their lives for themselves (D'Ignazio and Bhargava 2015; Tygel and Kirsch 2016; Markham 2019; Agesilaou and Kyza 2021; Bilstrup et al. 2022). A popular strategy by both the creators and the educators to achieve this was to use real-life examples and stories. Not a single educator disagreed that real-life stories can help learners understand complex issues, and also many creator interviewees strongly emphasised the importance of stories to foster a narrative, communicate complex issues, and to help learners to critically reflect and form their own opinion.

Some creators further recommended *using personas* that lead through the resource, including *real-life dilemmas* and developing resources with a *real-life impact*, and one educator highlighted the use of *story building games*. Moreover, real-life examples were included in two-thirds of the examined resources, suggesting that this strategy is already practiced by many resource creators beyond the interview sample. Thus, these findings reemphasise the value of real-life examples and stories, which was already identified in previous studies (Fontichiaro et al. 2017; Markham 2019; Sander 2020c). In addition, several participants highlighted the importance of *considering representation* when using personas and stories, as the learners should be able to identify with the people represented in the resource.

Should Learning about Datafication Be Fun Instead of Scary?

A final key consideration of the study concerned whether fostering critical data literacy should take a positive, fun and entertaining approach, or rather shock learners with the dangers of technology in order to gain attention and reach personal involvement. Overall, the majority of the findings seemed to recommend *colourful and fun resources*, which are *approachable, playful and entertaining*. The creator interviewees highlighted that people should *enjoy* the experience of using a critical data literacy resource – including the interactive tasks the resource asks users to take – and that particularly for adults, learning must always be fun. This is confirmed for example by literature on the use of serious games in education, which outlines the "motivating and engaging experiences" learners have in serious games (Anastasiadis et al. 2018, p. 139) as well as by data literacy scholarship, which recommends using gamified approaches and creative play scenarios to foster engagement (Agesilaou and Kyza 2021, p. 464; Ahlborn et al. 2021, p. 34). Yet, as outlined above, other studies have also found that gamified approaches can be "too fun" to evoke critical reflection (Pangrazio and Selwyn 2020, p. 11).

Apart from playful approaches, appealing visualisations were recommended by the study's participants. This reiterates literature highlighting the importance of materialising data and of using images and multimedia content (Pangrazio and Selwyn 2020; Alegre 2021). The surveyed educators strongly agreed that appealing

visualisations can help learners to engage emotionally, confirming the findings of Kennedy and Hill (2018). The creator interviewees further highlighted that visuals offer another way of understanding for learners, and they warned against stereotypical illustrations, such as locks or zeros and ones. Instead, they recommended tangible and relatable visualisations of data systems, such as the data octopus or "data monster" that were identified in the resource analysis (see chapter 5.1).

Overall, many of the participants seemed to be convinced by visual, entertaining, positive and encouraging resources. Several participants further warned against overly pessimistic approaches, arguing that people will not want to think about issues that are too negative, and that even if their attention is caught, people stop learning when they are scared. This perspective seems supportive of literature on resignation, which has highlighted that some people feel resigned and powerless about the collection and use of their data (e.g., Hargittai and Marwick 2016; Dencik and Cable 2017; Draper and Turow 2019). However, other studies on critical data literacy have recommended that educational interventions should evoke negative emotions to let learners experience their own powerlessness and "how data can be used in ways that are also undesirable for them and their peers" (Bilstrup et al. 2022, p. 233). In my study, some creators similarly argued that *fear can also be helpful* as it gets people's attention and people could get to a "story of hope through a story of fear". Others stated that it depends on the individual whether a pessimistic, shocking approach or a positive, fun approach is more helpful. This corresponds with findings from my own small prior study with university students, which found that some participants saw using fear to learn about data as "not the right approach" and one even began to feel resigned through learning about the wide-reaching implications of data systems, whereas others wanted to be "scare[d] into it" (Sander 2020c, p. 13). The surveyed educators in this study showed equally divergent opinions on this approach, with the majority agreeing that shocking learners can be a beneficial approach to make them realise that they are affected by a certain societal issue, but some (strongly) disagreeing.

How negative and positive emotions affect learning about datafication thus requires further research and the question of whether critical data literacy efforts should evoke negative emotions or rather focus on fun and positive approaches cannot be settled based on the findings of my study. However, in my study, warnings against pessimistic approaches and praises of positive, encouraging and fun approaches overall prevailed. This finding – in combination with other scholars' findings on people's resignation towards the use of their data – suggests that until more research has been conducted, critical data literacy practitioners would be well-advised to refrain from overly pessimistic and scary approaches.

6.4 Insights for an Extended Framework for Critical Datafication Literacy

Overall, the empirical research in my study provided many novel insights on the goals and strategies of those that already practice critical education about data – be it through developing online resources or through their educational work in formal and informal education settings. Key findings included the diversity of educational contexts in which critical data literacy is already fostered, and the variety of online educational resources about these topics. Moreover, significant parallels between the analysed resources, the creators' and educators' perspectives, and the academic literature were identified. This included existing academic research on critical data literacy, but also more established educational approaches, such as media literacy, politische Bildung and critical pedagogy.

The controversies and divergent opinions between the study participants further resembled unresolved academic debates on how best to approach critical education about data technologies. Yet, in some cases it seemed as if the practitioners were several steps ahead of the academic research on critical data literacy, already implementing many insights from traditional educational approaches such as media literacy, Bildung and critical pedagogy, which are only rarely taken into consideration by current critical data literacy concepts. This was demonstrated, for example, through a strong focus on systemic approaches to critical data literacy, on dialogical and experiential methods, and on encouraging citizens to take collective action. These findings advance existing research on the goals and practical implementation of critical data education and confirmed the original intention behind my study: that much can be learnt for the conceptualisation of critical datafication literacy from more established educational fields, but also from practitioners of critical data education. The following paragraphs detail key insights of the study and how they influenced the development of this study's novel critical datafication literacy framework.

A first key insight that emerged was that there is *no single critical education about data*. Already the theoretical chapters of my study identified a variety of different literacies about digital and data technologies with many different approaches and goals. This diversity was confirmed in the empirical research. The content analysis of resources identified many resources that educated about aspects of digital and data technologies but did not foster critical education about datafication in the sense of my study. Similarly, the educator survey identified a variety of approaches and goals for teaching about digital and data technologies. This reemphasises the need for a clear terminology and more thorough critical data literacy conceptualisation, as "education about data" can include various topics and approaches which serve heterogeneous goals.

Diverging perspectives were identified in particular in relation to which practical skills such literacy should foster. The question remains about whether prac-

tical usage skills of digital and data technologies are necessary for critical education about data. Apart from this, data protection, or: "digital self-defence", advice emerged as a dilemma: while improving people's skills to better protect their data was the number one constructive action that was recommended throughout all three stages of the research, many participants further voiced the need to go *beyond* individual data protection skills and highlighted the limitations and risks of digital self-defence. This is in line with scholars who criticise this "small bandage approach" and argue that cybersafety approaches can actually be seen as contrary to those of critical data education (Pangrazio and Selwyn 2020; Young and Pridmore Forthcoming).

Based on these insights, an extended framework for critical datafication literacy should thus recognise the *value of data protection skills* in empowering people and instilling confidence in them, while at the same time recognising its *pitfalls* – in that it might suggest that digital self-defence steps are able to solve the systemic issues around datafication and can make individuals feel responsible to solve these issues on their own. Rather than placing a focus on the skills to better – more safely or responsibly – use digital and data technologies, critical datafication literacy should focus on fostering people's *awareness* and *understanding* of the datafication of our societies and support collective forms of action (see below).

In addition, it became clear throughout my study that a key goal of critical datafication literacy should be to foster people's *critical thinking* about data technologies. Instead of aiming for the passing of specific knowledge about data technologies, critical datafication literacy should aim to enable citizens to develop systemic understanding of the datafication of our societies, to think critically about datafication, and to form their own opinion about how and where they want data technologies in their lives and societies. As this study's findings highlighted, this is the only way through which they can – learning from the field of politische Bildung – become *mündige citizens in datafied societies*. In times of fast-changing technologies with wide-reaching implications that may change in unforeseeable ways, the best way to reach an *informed citizenry* is to empower people to develop a "tech intuition" (participant 316), as one educator put it. While details about specific data practices can serve as examples in critical data education, such knowledge will outdate quickly, whereas understanding of the general workings of data systems and their implications and risks; the ability to think critically; and to form one's own opinion can be applied to new and emerging platforms and systems. In this context, critical datafication literacy can learn much from the field of politische Bildung, which does not define any learning objectives, but argues that whatever challenges citizens' democratic self-determination becomes a learning objective (Autorengruppe Fachdidaktik 2016).

Besides empowerment and Mündigkeit in continuously changing datafied societies, another key goal of critical datafication literacy based on this study's findings should be to *enable people to take different forms of action*. The emphasis here lies on "enable" and on "different forms". Regarding the latter, a key theme in the findings was

that critical data education should not merely foster people's data protection skills, but also encourage them to take *societal, political and other collective forms of action*. Literacy's *potential for change* was repeatedly emphasised, along with the goal of encouraging learners to *imagine different data futures* and to *actively shape their (datafied) societies*. However, it should be noted that despite these novel approaches, fostering learners' skills to protect their data nevertheless constituted the most common approach in this context.

The other key term, "enable", emphasises that – in line with the goal of citizens forming their own opinion – it should be up to the individual to decide whether or not they want to change their behaviour or take other forms of action. Thus, it could be said that the goal of critical datafication literacy as developed in my study is to create *enlightened users*, who have the opportunity to become *resisting* or even *emancipatory users* according to the user types of data activism projects identified by Milioni and Papa (2019). While an enlightened user is conscious of the way digital systems shape their experiences and create power imbalances, a resisting user goes one step further and tries to actively fight back and rebel, for example through obfuscation (ibid., p. 6). The emancipated user, finally, abandons the corporate web altogether and only uses alternative tools (ibid., p. 7). While it is questionable to what extent the latter position is truly possible considering the wide-spread use of commercial data systems in many areas of life, these user types nevertheless constitute a useful typology for differentiating goals of critical data literacy approaches. Based on my study's findings, however, it seems imperative that the step towards resistance or emancipation should not be something individuals should be persuaded of, but rather a decision that is taken based on people's own deliberations.

Finally, the question of the practical implementation of critical datafication literacy remains. As my study's findings have repeatedly emphasised, *networks of literacy* matter, but there can be *no one-size-fits-all approach to literacy*. When taking this perspective seriously, no specific advice for how best to practically implement critical datafication literacy can be included in a literacy framework, as the practical implementation should differ based on the different learners one is dealing with. However, such translation of abstract objectives of a literacy concept into "a practical model that can be operationalised by educators" is, as argued by Pangrazio and Sefton-Green, challenging (2020, p. 215). While not universally applicable, the findings of my study can help with this challenge as they highlighted the variety of approaches that are possible in critically educating about datafication and identified key best practice strategies recommended by critical data literacy practitioners. This knowledge is further mobilised for educators in the online resource "Teaching about Data" that was developed together with Privacy International in the knowledge mobilisation project as part of this study (Privacy International et al. 2022; see also appendix IX).

A conclusion of key findings of my study, a summary of the key pillars of the framework for critical datafication literacy that was developed throughout the study, a reflection on the study's limitations, and final concluding remarks can be found in the next chapter.