

DESIGNS FOR EXPERIMENTATION AND INQUIRY

Approaching Learning and Knowing in
Digital Transformation

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Chapter 3

Digital inquiry into emerging issues of public concern

Controversy mapping in a Swedish school context

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Introduction

The background of this chapter is a general interest in understanding what it means to engage with issues generated by technoscientific innovations and learn about science-in-society in a world that relies heavily on digitized information. It touches upon broader issues such as, what current media ecologies imply for civic engagement among the young and what role education could have in sustaining a democratic society.¹ More specifically, it takes an interest in what it implies to introduce digital methods that invite the complexity of technoscientific controversies in a normative school context. In this regard, it seems fairly safe to say that we are no longer in the beginning of the digital age (Varnelis, 2008), and cannot claim we are naive in light of its consequences – for public institutions in general and for education in particular. Digital culture is a socioeconomic phenomenon as much as a social or technical one, with political and societal implications, and we begin to see the development of new societal conditions, where people are adapted to living with networked media and can hardly imagine life without them. Public debates largely take place online and access to information is no longer a main concern for those who want to join. In society, scientific findings that are still contradictory or unstable, are becoming readily available through digital media, along with other reports, arguments and knowledge claims from a range of different stakeholders. Sometimes they raise issues of concern and controversy in the everyday lives of citizens.

When such issues are raised and begin to surface as moral and normative concerns that society needs to address, education usually becomes the focal point of the discussion. In times of social, technical, economic and political change, education becomes a prism through which the future is projected – an arena for debating where we should be heading. Ever since Dewey argued for the role of education as inherently co-constitutive of democratic societies (Dewey, 1916/2016), this normative framing of schooling seems

to constitute the very basis of its *raison d'être*.² A well-rounded education has accordingly been identified as crucial for young citizen engagement, and more generally to formulate the kind of issues that need to be addressed in society.

A current and most relevant question to consider is how democratic deliberation will play out in this type of media ecology, and how people need to be equipped in order to be able to get a grip on emerging problems, dilemmas and risks; that is, prepared to exert their agency as citizens. To take advantage of the internet as a space for civic engagement through social media platforms is challenging since such media seem to lack both important civic discourse and mutual learning qualities (Panke & Stevens, 2018). Teenagers' own use of social media seems to reflect (rather than transcend) basic social divisions (boyd, 2014). According to a study conducted in the USA by Peacock & Lewitt, (2016), college students' online political discussions were mainly conducted with close others³ and focused on commonalities rather than differences. You could say they preferred to engage in close collaborative and cumulative talk, rather than public disputational forms of discourse (Mercer, 2008). The students also mentioned they prefer civil discourse with people whom they trust and from whom they can learn, not putting much faith in online debates.

In this situation, education may play an important role when it comes to building trust by inviting students to engage in and learn from discussions on emerging issues where differences of opinion, interest, knowledge and experience are seriously considered. Education from such a perspective, should provide relevant knowledge, skills and opportunities to identify and discuss current problems and issues, give access to relevant means of inquiry and learn about and reflect upon the conditions under which all people can act as political subjects (Biesta, 2007; Mamlok, 2016; Preston et al., 2018). This role of education – to equip people to be able to contribute to and exert their agency in society – has been a longstanding concern in democratic societies. What is considered to be relevant knowledge, skills and values, however, is always contested and changes over time (for such a current discussion see for example Younie & Bradshaw, 2018).

In the wake of technoscientific innovations and the issues and uncertainties they bring, the importance of science literacy has regained political currency. In the field of science education, STS instruction (i.e. with a focus on science, technology and society) was introduced in the late 1960s to prepare students to engage in discourses and decisions, primarily about environmental issues (Aikenhead, 1985; Solomon & Aikenhead, 1994).

More recently, students have been invited to engage with socioscientific issues that include scientific, societal, ethical and cultural perspectives (Zeidler & Nichols, 2009). In more concrete terms socioscientific issues are increasingly understood as directly or indirectly intertwined in the everyday lives of people, such as climate change, genetically modified crops, vaccines and genetic testing to mention but a few examples. In the field of science education, the conceptualization of SSI has typically been grounded in perspectives with a focus on individual decision making (Scott, Mortimer & Aguiar, 2006). They are introduced as issues upon which there

exist a range of conflicting perspectives and the purpose of bringing them into the classroom has been to develop citizens capable of applying scientific knowledge and critical habits of mind along with ethical awareness (Zeidler et al., 2006; Zeidler, 2014). That the issues themselves are unstable and ambiguous is more often downplayed as well as their dependence on digital infrastructures and media ecologies online. Since the very nature and existence of such issues also seem hard to disentangle socio-technically, little public attention has been paid to how they are co-constitutive of the arena where most public debates on socioscientific issues take place – the internet.⁴ This infrastructure allows people to publish and promote an endless number of websites where they can articulate their concerns as issues formulated entirely from their own perspectives. Bringing this kind of heteroglossia (Mäkitalo, Jakobsson & Säljö, 2009) into the field of education is, no doubt, challenging and there are attempts to reduce this complexity to meet normative expectations, as will be addressed below.

The educational challenge of managing the abundance and bias of information

There are multiple ways for educators to support students to engage in a broader set of digital activities that bridge in-school and out-of-school learning experiences and civic engagement (Erstad et al, 2016; Gleason & von Gillern, 2018). For those engaged with SSI within the school context, a range of challenges have emerged that are related to the dependency on digitized information (Lemke, 2006). Although powerful search engines and multimedia resources are available for use in most educational contexts, the very easiness of using them can be daunting and become more of an obstacle than a resource for both teachers and students in reaching pedagogical aims (Linn, Davis & Bell, 2004) and many schools have tried to ban access and filter sites in order to prevent students from encountering unsorted or misleading information (Zeidler & Nichols, 2009).

For teachers, it is demanding to keep up with science-in-the-making, since the results are inconclusive or contradictory, conclusions are contested and implications are largely unknown. As all kinds of stakes, positions and seemingly unwarranted arguments around such issues are readily available to students online, teachers often try to reduce complexity, by suggesting a couple of websites that the student should visit to inform themselves.⁵ Students may try out a few search terms and then briefly check the first couple of pages of results the search engine arrives at (Mäkitalo et al., 2009) or navigate their way through a vast number of web resources, to arrive at something of relevance for the school task at hand (Furberg & Ludvigsen, 2008; Knight et al., 2017). In the process they need to manage a range of different perspectives that are voiced online and scrutinize them for their value (Knight and Littleton, 2015; Solli, Hillman & Mäkitalo, 2017). How the issues appear online will depend on both the *social bias* of the students themselves in terms of what search terms they use and what they judge are relevant facts (Hsu et al., 2014), in conjunction with the *technical bias* of the search engine which

reduces complexity through its selection and ranking algorithms. So, along with a deliberate pedagogical reduction of the complexity of such issues, students' normative selection and technical ways of sorting what may be relevant, are in play.

Recently, however, other ways of approaching such challenges when exploring issues online have been suggested. The ideas we are referring to have emerged from the field of Science and Technology Studies and Bruno Latour's didactic version of Actor-Network Theory developed to train college students to investigate and map current socio-technical debates online. The digital methods applied are referred to as controversy mapping (i.e. the cartography of controversies) which is a set of techniques to explore and visualize issues, and where the promotion of scientific and technological literacy becomes directly combined and associated with skills and competences in the manipulation of digital data. What is further interesting with this kind of approach from a pedagogical perspective on young citizen agency, is that the methods force students through a set of stages where masses of digital data of all kinds need to be managed and worked-on, and where the infrastructure of web engines are semi-open and potentially revealing, triggering questions and critical scrutiny. Thus, "the cartography of controversies has never meant to facilitate investigation, but to make it slower and harder" (Venturini, 2010, p. 259).

This chapter derives from insights gained in a collaborative project in a Swedish school incorporating teachers in different subjects working under the curricular umbrella of "Science in Society", and researchers from the fields of science and technology studies (STS) and sociocultural studies in education (SCS) (Elam, Solli & Mäkitalo, 2019). The students were engaged in digitally exploring, mapping and discussing current controversies and issues, using software that allowed them to follow the digital traces of others' – but also their own – activities online. From a set of empirical examples, we will tease out what we find to be interesting underlying tensions of what counts as relevant knowledge in this context, displayed through the alternative ways of approaching issues of legitimacy and relevance, that are negotiated and displayed as students are set to investigate SSI through these digital methods. However, we will first set the stage by elaborating a bit more on what public engagement could mean in a digital culture, drawing on ongoing discussions in the field of science and technology studies where the public, in Dewey's sense, plays a vital role.

Public engagement, networked publics and issue formation

An interesting current discussion on public engagement, which is grounded in Dewey's pragmatism and relevant to our discussion of current educational treatment of technoscientific issues, has emerged in the field of science and technology studies (Marres, 2005, 2007). In this discussion, questions have been raised about the nature and role of public engagement in a networked digital culture (Birkbak, 2013; Marres, 2015). The notion of the *networked public* makes relevant "a linked set of social, cultural and technological developments that have accompanied the

growing engagement with digital networked media” (Varnelis, 2008, p. 2). A conclusion to be drawn from these developments is that the concerns that can be raised in terms of public engagement in deliberation and discussion, look quite different in a networked public. Let us just mention a few of the most prominent contradictions and dilemmas identified.

With increased aggregation of information and powerful search engines, information access is no longer the most prominent problem for participation in ongoing discussions and debates. The widespread *accessibility of information* creates immense opportunities for public participation but has also triggered a concern of the right to be forgotten coupled with issues of privacy. Access may accordingly be a concern for those who refrain from using the web as a site for political engagement and discussion, such as the college students in Peacock and Lewitts’ study (2016). The issue of trust is prominent when it comes to accessibility – who may trace your opinion and networks and for what purposes may become a serious concern. Especially when the users of that information are not transparent to those affected and exposed.⁶

Another problem that has been discussed as incorporating two sides, is that the internet gives people on the fringes of society an *opportunity to participate*, to engage in communities and make their voice heard. On the other hand, there are also concerns raised with regard to virtual “echo chambers” on the internet, where claims are never scrutinized or called into question (Birkbak, 2013) and prejudice may flourish, hampering open public deliberation and weighing of different perspectives and concerns (Panke & Stephens, 2018). This is also triggering a discussion of the role of education, values and ethics in relation to what can be viewed as both negative and positive freedom in the digital realm (Mamluk, 2016).

Third, even though *biased information* has always been discussed as a concern in public media and impartiality has long since been problematized, we now see that new kinds of biases need to be taken seriously into account and scrutinized. Though we know that search engines are largely biased towards commercial sources through selection and ranking algorithms, there are also other, sometimes less obvious, digital biases in the form of media-technological dynamics (Marres, 2015). As Marres elaborates, any digital analysis of emerging issues on for instance Twitter, will be dependent on platform definitions of what constitutes “a trend”. Such technical definitions create “trends” that do not necessarily resonate with or would even be recognized as central by those concerned with an issue. Social media platforms tend to piggyback on socially and culturally recognizable notions such as “friendships” or “promotion cultures”, by which attempts are made to attract and “lock” users into using them – creating “networks of people” by technical means. The bias of prominent infrastructures and platforms is accordingly that they both feed upon and establish the dynamics of the *networked public*. This, according to Marres (2015), should not encourage us to leave the digital out of the analysis of more “substantive issues”, but rather engage in developing methodologies that help us critically scrutinize the *digital bias* of emerging trends and issues. In the current media ecology new ways of *infrastructuring* what is culturally familiar to us, will most likely continue branching.

In Dewey's original sense (1927), *publics come into being* in response to human activities that they are negatively affected by, but that they have no direct influence over. A public is accordingly generated as negative consequences mobilize people to articulate their problems as issues of *public concern*. As technoscientific innovations have come to penetrate the everyday lives of people and many issues of concern will emerge as indirect consequences, Dewey's notion of the public becomes very relevant in a networked society. The public, accordingly, is not conceptualized as an abstract entity that selects its candidates to represent its concerns. Rather publics are *enacted* and mobilized *to engage with their concerns* (Marres, 2007; Birkbak, 2013).⁷ This view relies on a pragmatic understanding of transaction and resonates with Dewey's discussion on the role of education; and what people living in a networked culture need "to be equipped with" to be able to engage in emerging issues of concern. More precisely, how can they use the internet as a resource for exploring, re-presenting and discussing ongoing controversies?

Controversy mapping and the notion of agency in sociocultural theory

In line with similar principles of civic engagement and active participation in society Bruno Latour, as we have already mentioned, introduced a set of digital tools to become "instrumental" in mapping networks of actors who are socio-technically entangled in a controversial issue online. Such mapping tools have also been launched as potentially productive in facilitating public involvement in issues that bring concerns into the lives of citizens. So far, however, the involvement in controversy mapping has mainly engaged policy makers, journalists, media and issue experts; a relevant but highly select set of partners (Marres, 2015; Venturini et al., 2015). The public, in Dewey's sense have so far not come closer to using them, even if they are presented as readily available.

From a sociocultural perspective they are rather seen as highly complex artefacts; more likely to resist any simple adoption (Wertsch, 1998, 2007). Introduced in a school setting, they are also expected to bring resistance as they make salient inherent attempts to shape already established social practices and objectives. Alien designs for practice – in whatever material-symbolic form – often create tensions or disruptions *in situ* that distance the minds and actions of people. They need to be *appropriated* to gain relevant meaning and function in their situated context of use and are always repurposed and co-designed to fit their circumstances. As they begin to *mediate* social activities, however, new generative conditions unfold that invite further action and new forms of participation (Säljö, 2009, p. 204). The conceptualization of *agency* in this chapter, accordingly makes relevant the meaning potential of artefacts in the form of earlier tensions, disruptions and situated forms of accountability that provide the relevant conditions for learning. It aligns quite well with Dewey's notion of transaction.

With these insights, generated from science and technology studies and sociocultural studies as a background, we will now turn to our empirical case

study of 11th and 12th grade science students, who engaged in controversy mapping as a form of digital inquiry within a project on Science in Society, that was three weeks long and embedded as part of ordinary curricula and school activities. Our aim is to exemplify and discuss what we identified as basic tensions when introducing these digital methods in an ordinary school context.

Disrupting and displaying: controversy mapping goes to school

In Swedish schools, teams of teachers responsible for different subject areas sometimes collaborate around SSI, often in the form of project work which usually lasts several weeks. By introducing controversy mapping as a form of digital method for inquiry that takes a different route to SSI-themes, we were interested in tensions that emerged in the process. The school projects where we introduced controversy mapping were planned and adjusted in collaboration with teachers and implied a set of basic tasks for groups of students in 11th and 12th grades. While the later parts in the process were more or less equivalent to current forms of project work in school, the beginning (steps 1–3) were entirely new to the students and created many instances of interest to this chapter.

1. The students searched and scraped the internet on a controversial issue. A semi-open web crawler developed for this purpose, was used.⁸ It traced the students' online searches and collected information on the URLs of the visited webpages (so called "IN Sites") including the hyperlinks and web resources connected to them through their out-links (called "NEXT Sites"). The students deleted what they considered irrelevant URLs (called "OUT Sites"). The remaining information was saved as a data corpus.
2. The students then imported the data corpus into a network visualization software⁹ where an algorithm¹⁰ processed the data; showing its graphical spatialization live on the screen.
3. The students then continued exploring, deleting and ordering the visually displayed data, making readable maps of the connected, that is, "networked actors".
4. The students shared and discussed their controversy map with groups of peers.
5. The students prepared a "press conference" by focusing on the different actors' arguments.
6. They participated in the "press conference", animating the major actors of the controversy.
7. In a teacher led seminar, they reflected on the controversy and could take a personal stance.

Instead of being introduced to or reading about the controversial issue, the concept of controversy was introduced and discussed with the students, along with hands-on introduction to the digital tools. They started web searching their chosen controversy (step 1) and they were given written and oral instruction step-by-step on how to work. They were instructed to use specific search terms to target the issue and surf the web; to only visit websites and not read them. This is an

instruction that is quite unusual in a school context, where careful reading and critical scrutiny of information sources online are articulated in curricular goals and established norms of school practice. What was unknown to the students at the very beginning was that this search needs to be done in order for the software to trace and harvest data from the websites they visit.

The goal of the task was formulated in quantitative rather than qualitative terms; they should have collected information from at least 50 websites each, using the web crawler. This instruction, in turn, meant that they needed to pay attention to, and coordinate their own actions to be *on par with* the web crawler's display of collected data. As has been mentioned, not only the URLs of the websites that they visited, were automatically traced and collected but also hyperlinks and web sources connected to them and all such data were made visible to the students. When they had collected enough IN Sites, the task was to reduce the amount of data gathered by deleting from the list what could be identified as irrelevant URLs in relation to the controversy (step 2). The number of websites each group relied upon was about 4000, so the students needed to go through a series of steps to reduce this complexity.

Simultaneously, they needed to account for their decisions of selecting or deleting URLs in a separate document to be able to describe their method of constructing the controversy map.

Based on explicit oral and written instructions, the students then saved their group's collective data corpus on a web platform, provided by the local school. They imported the data body to Gephi, the visualization software. Gephi uses the structured information to process the data and display it visually as a network of nodes and edges. The nodes represent the websites, and the edges the hyperlinks connecting them (Figure 3.1).

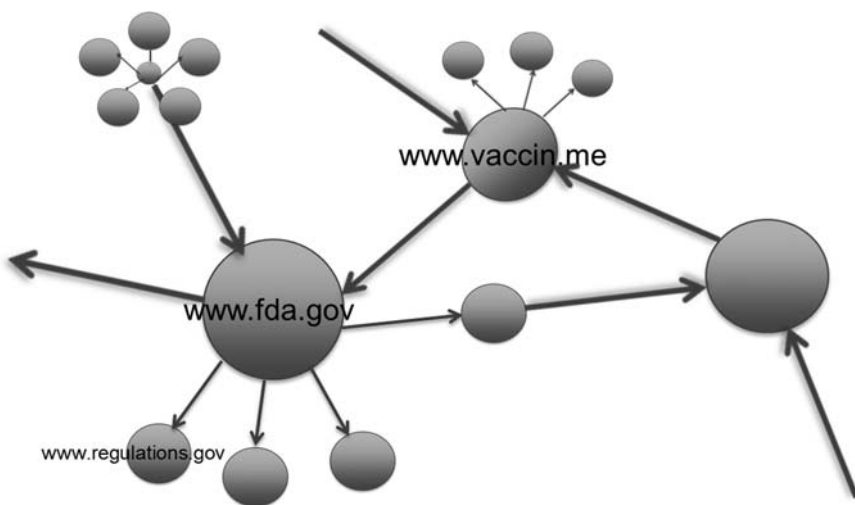


FIGURE 3.1 Illustration of how websites and hyperlinks are represented in Gephi.

The students then continued to explore the different nodes, further highlighting or deleting what they considered to be relevant or irrelevant to the controversial issue, now guided by the graphical layout (step 3).

In the third step of the process, some students used design features provided by the Gephi software such as size and colour, to identify and categorize the nodes and their connected links into a map of “networked actors” (Figure 3.2), which then would be used to explain and discuss the controversy with peers (step 4). At this stage, it was fairly obvious to the students that they were engaging in a controversy they themselves had co-created by digital means. To sum up, the technical features of the software allows students to take advantage of the infra-structural features of the internet to generate, sort out and display online data, which provides the means to then explore how controversies are *socio-technically* constructed (Solli, Mäkitalo, & Hillman, 2018).

In the following we will present some empirical instances that emerged as tensions during this process. Such instances were identified from video recordings of groups of students as they worked with their controversies. Screen-capture software was used to record activities on one of the laptops of each group. The tensions were displayed by disruptions in ongoing work, such as hesitation or silence in a sequence of interaction flow or expressions of confusion or irritation with what was noticed or read on the screen. Such instances resulted in requests for clarification, seeking support from peers or asking the teachers for help. We are interested in exploring these tensions as instances of ambiguity and accountability, triggered by socio-technical interdependences. We also interpret from these instances underlying tensions of what normatively counts as relevant knowledge in this context, displayed through alternative ways of approaching issues of legitimacy.



FIGURE 3.2 A student explores the nodes representing different actors in the controversy.

Emerging tensions: instances of ambiguity and accountability

We will focus on a group including Paul, Anne, Matt and Lina, working on the controversy of HPV vaccine. In this group instances of ambiguity and accountability first emerged as quiet complaints among peers, as soon as instructions had been given and they started their web search.

Resisting the logic of the web crawler

Paul and Anne are oriented to the task as instructed by the teacher. They immediately start searching information about the HPV vaccine on Google. They know they need to make sure that they have at least 50 IN Sites each in the group. What that really means, however, is not entirely clear to them yet as part of the process is black boxed and not visible to them. The hidden features of the software are however annoying to them:

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- | | |
|----------|---|
| 1. Anne: | How many do you have now? |
| 2. Paul: | I think I have nearly reached fifty or something |
| 3. Anne: | That's what I thought, but then I cleared them up, cause I got- ... I thought I only visited the sites ... uhh the links that I got when searching on Google but it still said Facebook and things like that in my IN Sites and Twitter and so on |
| 4. Paul: | ((scrolling the screen on his laptop)) |
| 5. Anne: | it feels like I don't read very carefully ... I just check if it looks good or okay ... its like you're only fishing kinda |
| 6. Paul | Yeah ((inaudible)) and I went in and checked some of them and they seemed to be more like rubbish |
| 7. Anne: | you know, I think its irritating that it doesn't- uhh it doesn't feel like you get into-
If I go into a site and I don't want it because its nothing .. its not relevant .. but then it doesn't appear at the top or the bottom in this eh here where the IN Sites are |
| 8. Paul: | Yeah and then its got a really weird name too one that you don't- there are plenty of weird names so you really don't know which ones they are |
| 9. Anne | No you really don't know if you should delete them or not here one comes up, and now like- I go into websites now .. but they don't show up as more IN Sites |
-

While following the task as presented by the teachers, the process of searching and collecting data is soon disrupted by hesitation as the web crawler presents the students with what seems to be problematic and worrying to them. As they elaborate on this it becomes obvious that they are subjected to following a process they are not alone in managing: "I thought I only visited the sites ... uhh the links that I got when searching on Google" (3). The entanglement with the web crawler makes the students aware they are not alone and in charge of the results of their own queries. This becomes obvious to them as URLs from other sites such as Twitter and Facebook keep

showing up in the web crawler. Anne tries to delete them on the basis of not being relevant, while Paul monitors the process by checking some of them in terms of quality and concludes that: “they seemed to be more like rubbish” (6). Anne and Paul also seem to attend to critical conditions set for the task, such as limited time and the fact that they are to end up with at least 50 IN Sites each. In anticipation of the kind of “cleaning up” of the data they will end up doing, they also identify other difficulties such as whether it will be possible to “sort out” what is relevant from what’s not, as the URLs have “plenty of weird names” (8). We also notice that Anne and Paul take on responsibility for the kind of data the web crawler collects and that they are going to work with. They are clearly orienting to their inquiry as accountable for the quality of the information they collect. In this initial step of the whole process, the students accordingly work in conflict with the very rationale of the tool – resisting its logic – trying to stay in charge of an algorithmic process with which their own actions are socio-technically entangled.

Another way to approach this task as a responsible student is to ignore the step-by-step instructions and go on doing what you see as more fit to the curricular goal of the overall activity. Matt takes another route to the task. He seems dedicated to reading into the controversial topic online, rather than searching and scrolling through websites (an activity which he is clearly not favouring). Reading directly into the controversy online, however, is clearly disturbing to him. It creates tension and he turns to his peers:

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- | | |
|----------|--|
| 10. Matt | Its so- its so like hilarious these sites with vaccine issues for they always say like: “they vaccinate completely healthy children” they- they just say that as something- just use it like that to scandalize it ((he looks at Paul while animating a “so what?” expression on his face)) like “-Yeah” |
| 11. Anne | “-its because they will continue to be healthy!” |
| 12. Matt | Exactly! because you don’t want this disease to get in there in the first place |
| 13. Paul | Here I’ve got one ((reads with scepticism:)) “The truth about Gardasil” |
| 14. Matt | ((somewhat annoyed:)) Oh the truth! okay! The National vaccination centre is the same they’re not National- they’re not an authority |
| 15. Paul | ((reads aloud with animated voice)) “-There is no treatment for these girls as they suffer in silence” ((turns to Anne:)) do you suffer in silence? |
| 16. Anne | ((pitiful tone:)) “yes” “yes” ..[No |
| 17. Paul | [Then you do, but you don’t say anything |
| 18. Anne | ((teasing Paul)) I said yes ..you don’t know |
| 19. Paul | ((looks at Anne and smiles)) |
| 20. Anne | No |
-

At this instance Matt is critically reading into the opponents’ arguments and position with regard to the HPV vaccine. He enacts an imagined dialogue where the opponents to the vaccine use a formulation he noticed is being recycled online and which, from his view, is an attempt to defame the proponents of the vaccine (10). This kind of positioning in the controversy is co-opted by Anne as she finishes Matt’s utterance (11), and is soon also taken up by Paul who ironizes a

message as he reads it out loud from a website: “The truth about Gardasil” (13). Matt not only aligns with Paul’s contribution but upgrades it (14), establishing a firm critical stance to the controversy in the group (15–20). Paul then continues, by reading aloud he mocks the sentiment of the opponents to the vaccine: “-There is no treatment for these girls as they suffer in silence” (15).

Matt is clearly annoyed *throughout the whole process* by the critics of the vaccine. At other instances in the material he clearly states that they just don’t get it, that the vaccine is established on the market because it has been well tested and approved, and that there are known side-effects, but they are not nearly as serious as the consequences of the HPV virus. As this approach, taking “evidence” and what is seen as established and tested scientific facts about the vaccine, as his standpoint, their next conundrum emerges as the Swedish teacher approaches the group.

Challenged by ambiguity: Incorporating the known and the unknown

To arrive at an evaluative stance at this early stage in the process, is not supported by the working methods and tools for controversy mapping, quite the opposite. Also, the teachers working under the logic of these methods may intervene and re-open the controversy when there are tendencies of closing down *ongoing issues* of public concern:

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- | | |
|--------------|---|
| 21. Teacher | So what’s the issue with the vaccine? |
| 22. Anne | It’s just that people think it’s dangerous |
| 23. Teacher | But if I say what’s the controversy then? |
| 24. | ((silence)) |
| 25. Matt | Uhh the controversy is just like uhh....((rubs his cheek, stays silent)) |
| 26. Teacher | Are any of you vaccinated? |
| 27. Matt | I’m not |
| 28. Teacher | No you don’t have to be I was thinking about the girls |
| 29. Anne | I am |
| 30. Teacher | You are and you’re not? |
| 31. | ((Lina doesn’t know and they discuss when they had their vaccinations, then Paul mentions the side-effects.)) |
| 32. Lina | But the controversy is that you can- that you can- |
| 33. Anne | It feels like these are people who are against vaccines in general |
| 34. Teacher | But are there any dangers with the vaccine? ...there are side-effects |
| 35. Lina | Yeah there’s like- it’s like vaccines in general ..it’s the- what the other party oppose, but there are- |
| 36. Teachers | That’s the case with all mass vaccination programs that there are... or is it worth it to vaccinate and then risk that a few will have terrible side-effects and that will have their lives – not destroyed maybe but will have their quality of life affected negatively |
| 37. Anne | For society it is |
| 38. Teacher | Then you have the individual perspective and the societal perspective – cause for society it is, because it saves a lot of money if fewer get cervical cancer, that’s why they vaccinate |
-

The group is somewhat disrupted in having established common assumptions when the teacher asks what the issue is about and challenges them to explain the controversy. The students turn silent, hesitate and struggle with the question. The teacher suggests ways of moving forward, asking questions about reports of serious side-effects, and by formulating the controversy in terms of taking the individual or the societal perspective on the issue, suggesting that the issue could be seen as a more general conflict of economy versus quality of life. While the controversy certainly can be formulated otherwise (especially from Dewey's perspective on publics and their issues), the students are here suggested a way out in terms of how to handle the issue of HPV vaccine *as* a controversy.

As the Swedish teacher continues Anne and Matt try to challenge the teacher's account by drawing attention to lack of evidence (data), and they are again challenged by the teacher who brings in time as a critical component to consider when it comes to evidence:

39. Matt	((annoyed tone:)) But this it's not-
40. Teachers	But for the individual that gets this disease- I mean that get these
41. Lina	That <i>can</i> get it
42. Teacher	For that person it's not worth it you could say
43. Lina	So that's the controversy then
44. Matt	But hey its it's not compulsory
45. Teacher	No, but is it clear that there are serious side-effects?
46. Anne	No it's not I read somewhere yesterday that there are like 70 million people that have been vaccinated ... of course some will have serious diseases but it's not necessarily tied to it ... and people like ((snaps her fingers quickly:)) "that's why" directly!
47. Matt	And there is no like data on this there is no pile of people who we can say have-
48. Teacher	No but it's not been ongoing for very long either... but in this ((inaudible)) they have said that this thing with epilepsy is due to some substance in the- not in the vaccine itself but in the vaccine that - it's not established yet scientifically but-
49. Lina	This has been going on for like ten years with HPV I thought I read it somewhere
50. Teacher	It's fairly new ten years that might be right but to mass vaccinate is newer but it has been around before
51. Lina	Ahh okay
52. Teacher	So do you really know about the long term effects of this that's another thing to consider

As the Swedish teacher dismisses the challenge from Matt, she again brings in the issue of unknown long-term effects, and then leaves the group to continue their work. Matt and Anne, however, still continue to align as proponents of the HPV vaccine.

At a later stage in their work the chemistry teacher approaches Lina and Paul working alone in the group exploring websites and their aligned stakeholders as they have imported the data to Gephi:

1. Teacher	Your topic is?
2. Lina	Vaccine
3. Teacher	Have you heard the news?
4. Paul	Well yeah we read on DN ¹¹
5. Teacher	Yeah that the EU commission had uhh confirmed that there were no side- no documented side-effects of this
6. Lina	But that's really strange because we have found lots of pages that says the opposite
7. Teacher	mm? but you* have to always ask yourself what kind of pages are they, cause I have also heard about these diseases but you can still get them and if you- there is a, I'm not saying how it is, but I think there is a risk that you* associate that disease with an intake of this vaccine half a year ago, but you may fall ill anyway, so in order to show side-effects you have to be able to say that in a population who takes this vaccine it's more common with these side-effects, and I I think that's maybe what the EU commission have done I don't say they are right but it's what they have been looking at saying that's it's not more common
8. Lina	Mm ((Paul nods)) yeah so it feels ehh, but at the same time the pages that says it's like this "do not vaccinate" they have not had like an authority to back them up, and ehh then it it says in many places that it's quite uncommon ((yes)) that you get serious side-effects so it feels like ahh...
9. Teacher	You could say if you want to know what's true- you need to know how much more common it is among those who take the vaccine, and then they say you can't say it is more common ((no, no)) but we all want to have a reason for why we get ill if we get a disease we want to know why did I get this disease, so people seek- and we would probably also do it if you get something you'd probably ask yourself if you have done something, like taken a vaccine, that you associate it with that, that's the problem, that's why my child got sick that's why I got sick
10. Lina	And then they must write about this about the medication, like about Gardasil, that they have to document it, like, that this has happened

The chemistry teacher invites Paul and Anne to reflect upon the latest news about the vaccine, published in the Swedish newspaper DN. On the one hand the newspaper reports on results from the EU commission that supports the group's evaluative stance towards the controversy, on the other hand they have now been forced to read a lot of webpages reporting on unknown side-effects of the vaccine, which Lina remarks upon in her response. The teacher acknowledges that there are at least two sides to this, that they are not only relevant but also comprehensible as regards the controversy, but she also gives legitimacy to a scientific stance when it

comes to drawing conclusions about side-effects. What is further interesting is that she distances herself twice from the claims made by the EU commission that have been reported, thus keeping the controversy open to further inquiry and debate.

Only, much later on in the process, we can see how Anne runs into a Swedish news site that not only catches her attention but seems to affect her personally:

11. Anne	Oh how scary! Now! ...now the first cases in Sweden's been reported of side-effects of the vaccine and this was on the... 16th of September! ... that's scary!
12. Paul	But it feels like people have made it up before, like you said

The fresh reports about side-effects of the vaccine in Sweden bring the issue much closer to home. Anne is also the girl in this group that has taken the vaccine, which probably plays a role as reading the news instantly shifts her stance to the controversy – recognizing that it is an *unresolved issue of public concern*. That this issue just might become a matter of concern to herself, personally, is now probably something she well realizes. Paul on the other hand seems not affected at all by the news. He distances himself and reminds Anne of her own earlier argument. However, from this stage in their work, it will not be as easy to just distance themselves from “people” in general as this category may well come to include themselves. Taking the perspectives of those who may be negatively affected is accordingly something that is not entirely dismissed but also needs to be considered. To achieve and maintain this kind of openness to the complexity of the issue, the digital mapping methods and tools have been productive – especially for accepting its unfinished and uncertain character. Without the possibilities of *using* rather than just *relying* on the infrastructure of hyperlinks and URLs for the purpose of digital inquiry, the issue would have been much easier to close down – not acknowledging the issue as a *controversy* of current concern.

Discussion

This chapter has presented a case generated from transdisciplinary design and collaboration among researchers from the fields of science and technology studies and sociocultural studies in education, with the aim of exploring what learning about science in society means in a world that relies heavily on digital information and its infrastructural features. Specifically, the chapter aimed to provide concrete insights to what it may imply to engage with controversial issues generated by technoscientific innovations in a school context. The digital methods were challenging in many respects, but also instrumental for the students in getting get a grip on ongoing controversies online. They did provide means to digitally explore, scrutinize and account for the *socio-technical formation* of controversial issues, which we will come back to. The designed features of these digital methods were also instrumental for our analytical purposes of exploring some of the tensions that technoscientific issues in a networked society will most probably bring to school. In the following, we will reflect upon some of the tensions we have come across and touched upon in this chapter.

The methods we introduced worked against the common inclination of both teachers and students to reduce the complexity of the issues that technoscientific innovations bring and limit the discussions of science-in-society in the school context. As has been mentioned, socioscientific issues in school are usually arranged to develop citizens capable of *applying* scientific knowledge along with critical-ethical perspectives. Such arrangements meet curricular goals that articulate the ability of students to separate scientific from non-scientific claims and arguments thus privileging already established facts as products of science. As we have seen in our empirical examples the students we followed did not only anticipate such normative expectations as assessment of their school performance, but clearly also themselves evaluated their actions by norms that privilege scientific, evidence-based arguments. In light of the current societal debate on “fake news” and “fake facts” such curricular goals and values in school seem more important to defend than ever. However, and as will be argued in the following, the skills and competences that people will need in a networked democratic society, have to *extend* such goals.

To exert agency as citizens, some educative experience of the internet as a space for civic engagement should be provided. As a hands-on experience of collecting, sorting, exploring, scrutinizing and visualizing large sets of online data, controversy mapping as a method provides ample opportunities to learn from and discuss some of the functionalities of the media ecology of networked societies. The methods are designed, in Dewey’s terminology, to scrutinize *issue formation*, that is how emerging matters of concern are brought to public attention. As such, they highlight technoscientific innovations and the risks they bring as *not yet resolved issues*. This, we argue, is just as important as an educational experience of learning about science-in-society since it invites discussions about *science-in-the-making* (i.e. research as a process). We saw this kind of discussion in the example where the chemistry teacher engaged in explaining what methodological principles would be needed to guide the research process to arrive at a result from which it would be possible to argue for the probability that the HPV vaccine causes serious harm. We have also seen the Swedish teacher pointing to the inherent uncertainties in research as a collective endeavour, and the difficulties of arriving at consistent conclusions at the early stages of a mass vaccination programme.

Instead of reducing online information search and simplifying such issues beforehand the digital methods used for controversy mapping do not discriminate but invite complexity by incorporating trace data that reveal how different websites and sources online are linked to each other and to the search terms the students themselves used. Their accountable actions consist in a) discussing the procedures by which they have generated and reduced their data set, b) valuing the importance and relevance of different sites and sources they have selected to understand the controversy, and c) deciding how it can best be re-presented and explained to others by visualizing such data. By engaging in controversy mapping which uses semi-open software for pedagogical purposes, the infrastructures of the web such as URLs and hyperlinks are open for analysis as *networked features*, but they also provide some experiences of what it implies when algorithms process information and

the data sets that the students work on. The semi-open web crawler, for instance, rendered visible *the work* of the harvesting tool, which was impossible to ignore for the students who framed their activities within a normative school context where their own selection and scrutiny of online information is articulated as especially important. The productive side of such contradictions is that it generates something to discuss and problematize. The subjective experience of what web crawlers do is important, since it makes evident that they are entangled in the information search and taking part in co-creating the “networked data” on the issue under study. How that data is used to re-present the issue by the students then became an obvious concern to them. Another equally important side to this is the awareness of web crawlers in general and their own traceability online. This invites discussions and reflections on what human–technology interdependencies characterize a “networked society” and in what ways one’s activities online are potentially visible to others whom are usually not as transparent.

What we have seen can, accordingly, be refined to an educative experience (Mamluk, 2016). Although controversy mapping as a form of digital inquiry challenges any investigators with a high level of complexity – both when it comes to the “substantive issues at stake in the controversy as well as the performative role played by mediating technologies in the enactment of these controversies” (Marres & Moats, 2015, p. 1) – it can also be productive in connecting new forms of technical mediation with improved critical information literacy and discussions on civic engagement in a networked society. Marres’ project, to carefully scrutinize how issues go digital, attends to how cultural relationships of the past and the future co-exist and transform our ways of living. This resonates well with the Deweyan notion of continuity and connectedness in growth, where new objects and events are connected to earlier experiences (Oliverio, 2015, p. 58). Finally, there are also educational implications of this approach in the light of Dewey’s view of the public and its problems in an educational context. The visualization software provides possibilities to process large data sets, it gives students digital pathways and means to navigate and explore emerging issues online, but at a distance. This gives them ample opportunity to both engage with and distance themselves from “the voices of others”. To sufficiently map and explain the controversy, the students need to bring the *concerns of those others* into the discussion. It forces them to zoom in and take part in the stories told – not rule them out to begin with. Providing such possibilities of open deliberation along with critical scrutiny is an important element of young civic engagement and participatory design of future societies and cultures.

Notes

- 1 In framing these issues the chapter includes a broad range of references from internet studies, science and technology studies and educational research on students’ learning through digital tools and social media use.
- 2 The purpose of which is to shape our conditions for living and the cultural mind sets for generations to come.
- 3 They primarily mentioned family and friends.

- 4 The awareness of how personal information on platforms such as Facebook, Skype and Instagram is used by third parties, has not until recently reached the level of public attention, even though information sharing has been their business model since the start and is regulated by agreements.
- 5 In Sweden, websites to public authorities are common.
- 6 A recent example of this problem that gained public attention was the use of Facebook data by Cambridge Analytica.
- 7 As Marres (2005) puts it: no issues – no publics.
- 8 At this time, Navicrawler, a semi-open web crawler was used as an add-on to Mozilla Firefox. More recently Hyphe has been launched (<http://hyphe.medialab.sciences-po.fr>), which offers a more encompassing resource for the whole mapping process.
- 9 See Gephi: www.gephi.org.
- 10 See Jacomy et al. (2014).
- 11 Dagens Nyheter (DN) is one of the larger morning papers in Sweden.

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