DESIGNS FOR EXPERIMENTATION AND INQUIRY

Approaching Learning and Knowing in Digital Transformation

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Introduction

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INTRODUCTION

The studies collected in this volume focus on the affordances that emerge as digital devices and media technologies become more intimately intertwined with knowledge production, professional practice and learning arrangements. Drawing on a range of contexts extending from secondary schools to professional workplaces and academic communities, the chapters share a common interest in the functional and relational experiences of digital devices and media technologies among learners and experts.

By incorporating contributions from the fields of science and technology studies, sociocultural studies of learning and design studies, this volume aims to generate a dialogue that cuts across research fields at a time when the digital is becoming more salient in current attempts to redesign established practices and reshape social relations. Through this framework, digital affordances become sites for critically reflecting on how particular social and material ties are produced and what this implies for practices of learning and knowing. In doing so, the authors of this volume probe the sociality of digital things not just in terms of their material and given qualities, but also by attending to the ways in which they connect to wider socio-political projects. This in turn, raises important questions about how digital worlds are inhabited and set into motion.

This interest in generating a dialogue around digital design and learning arises at a time when the digital is becoming less connected with the production of a new virtual realm and more involved in reshaping the infrastructures of established worlds of practice. A case in point is the Citizen Science movement discussed in Chapter 9, which seeks to involve volunteers in the collection of scientific data sets. As the authors of the chapter argue, the design of digital technology becomes a site for cultivating new ideas and beliefs redefining the parameters of epistemic cultures of science. The interest in infrastructural relations across both the social and learning sciences also suggests that digital technologies need to be understood as broadly reshaping the practices of everyday life. Depending on their design,

digital devices and technology may enable or obstruct certain kinds of social relationships, while discounting others. These possibilities to influence how social life is lived and experienced demand critical analysis and inquiry because digital devices are designed for particular purposes, and with certain users in mind (see chapters 1 and 2).

A concern with the social and cultural implications of digital things unites the chapters in this volume as they examine the reinvention of practices of learning and knowing. The chapters can be read as engaged in a reflexive dialogue on the future of learning and knowing in digital transformation. For instance, the proliferation of social media platforms and associated applications inviting user generated content is leading to the complex interweaving of online and offline forms of sociality, raising new ethical concerns for research design (chapters 10 and 11). Therefore, rather than constructing alternative realities apart, digital devices can be appreciated as currently enabling and materializing novel relations across a variety of social worlds and walks of life (Ruppert, Law & Savage, 2013; Snee et al., 2015). Such developments are visible not least within contemporary social research, which having adapted its traditional methods to capture the specificities of online phenomena, is now broadly experimenting with new methods that re-purpose digital tools and media for social investigation (Rogers, 2013). Such 'interface methods' (Marres & Gerlitz, 2016) are not only serving to enable an expanding collection of new empirical investigations, but also to combine social science, computational science and engineering in novel ways (Venturini et al., 2017).

Similarly, within the learning sciences and the CSCL field (Computer Supported Collaborative Learning), the emphasis has moved from developing educational software for designing effective teaching, to co-developing more iterative and collaborative research designs (Sawyer, 2015) that invite researchers, educators and students to collaborate. The design research literature in this field is full of reports about the transformative learning of students, while learning on behalf of teachers and researchers has not received as much attention. The widespread availability of digital devices, however, has increased the expectations on 'designs for learning', which in turn challenge teachers' professional domain of expertise and range of responsibilities. Recently some studies have shifted focus to how both teachers' and students' learning is being transformed, especially through the use of social media platforms such as Facebook, YouTube, Twitter and Instagram (Greenhow, 2016; Lantz-Andersson, Lundin & Selwyn, 2018).

Issues connected to how information is stored and organized and its implications for information seeking (Kuhlthau, 1993) have long been studied within the fields of education and library and information sciences, especially with a focus on assessing the credibility of information (Metzger & Flanagin, 2008; Francke, Sundin & Limberg, 2011). This interest has moved on to issues of how digital infrastructures are implicated in learning activities through the use of networked technologies (Guribye, 2015; Knight et al., 2017). Following these concerns, digital methods emanating from the field of science and technology studies have recently migrated into the field of education. In Chapter 3, the authors explore how science students in upper secondary school use digital methods to map controversies online in a co-designed

school project. By using these digital methods, infrastructural features of the web become salient to the students and, in some instances, disrupt established normative standards of critical information literacy in school.

Given this common outlook we are concerned to highlight the importance of design for articulating and triggering new social and material connections. Digital designs and prototypes are investigated in this volume as inscribing and mediating new heterogeneous relations which may or may not succeed in re-making cultures of practice. As Albena Yaneva (2009, p. 282) argues, design is 'a mechanism for energizing and setting the world in motion', acting to configure new objects together with their imagined future users and broader cultural contexts of use. Therefore, our collection of studies tells of different experimental designs and styles of inquiry intended to animate new digitally mediated worlds of knowing and learning (chapters 4 and 5).

Finding themselves in the middle of processes of digital innovation instigating new patterns of knowing and learning, our studies also depict different styles of interdisciplinary and/or transdisciplinary collaboration. Reflecting this the different chapters portray the varying entanglement and enrolment of the authors in the creation and evaluation of new digital arrangements. In some cases, the authors are themselves the designers and developers of these arrangements concerned, for example, with enacting methodological innovation within the social sciences (Chapter 7) or rendering the affordances of digital technology visible and comprehensible to new groups of users (Chapter 6). In other cases, our authors assume the role of cultural experts capable of identifying the potential need for design adaptations in digitally mediated settings (Chapter 8). In further cases, authors reflect on the visions and ideals framing various experimental designs and the alternative forms of agency and participation that can be facilitated through the re-composition of social and material relations (Chapter 9).

To capture the relevance of each chapter and discuss core issues of learning in digital transformation across both cases and fields, we have organized the volume into four sections. This serves to focus attention on key concepts and concerns widely discussed among our three research fields but here problematized further in relation to new digital practices: forms of agency (Section I), digital design experiments and learning (Section II) and mediated collaboration (Section III). An additional issue we have chosen to focus on in our volume is how to comprehend and respond to the ethical implications of conducting research on learning and expertise in digital transformation (Section IV). This spectrum provides the basis for a rich and informative interdisciplinary conversation between the three research fields contributing to this volume. It also encourages readers to question how boundaries between learning and knowing – or education and research and lay and expert – are being reconfigured not just by technological innovation but through the agency of users. Moreover, by bringing these chapters together, this volume evokes a move from focusing on digital technology per se to attending to collective matters of digital concern. We will now turn to these contributions.

Digital technologies, learning and forms of agency

The chapters in this section draw on novel arrangements in, and investigations of, current school activities and exemplify how different forms of agency are enabled through the situated enactments of digital technologies. In each of these case studies, when digital tools are part of a curricular activity, they become entangled in varying socializing projects that span multiple cultural and political domains. As such, the incorporation of digital tools into curricular practices is often caught up within wider debates about the shifting role of education in society, which in this section ranges from discussions about democratic social values to environmental citizenship. The chapters highlight the affordances and constraints of using digital tools that are more or less open to scrutiny and discuss whether they challenge or support normative expectations with regard to students' learning. Thus, while scrutinizing how digital tools are used *in situ*, they are also 'in dialogue' with wider debates concerning the role of education in addressing and countering pressing social issues. These chapters all take a sociocultural perspective on learning as their point of departure, in which cultural artefacts (i.e. human-made material-semiotic means) are implicated in the very notion of agency (Mäkitalo, 2016). The specific *mediating functions* they gain in a situated activity will have different implications for learning and forms of participation. Such a perspective accordingly rejects the dichotomy of the 'material' and the 'social'. Instead mediational means are inherently co-constitutive, in tension and dynamically interdependent with *how* activities unfold.

In Chapter 1, *Concepts, materiality and emerging cognitive habits: The case of calculating carbon footprints for understanding environmental impact*, the authors explore how the design of a carbon footprint calculator, which is brought into a school context, co-determines students' ways of reasoning about the environmental impact of everyday activities. This artefact is specifically designed to foster an awareness of the amount of greenhouse gases that are emitted through our daily actions. It provides access points to a measurement that would otherwise be hard to grasp without extensive education. By design, it hides and stabilizes the negotiations and complex computational models underpinning the measurement of a carbon footprint to provide visible results. The affordances that emerge as this tool is used in classroom activities lie in its capacity to make the students socially accountable *in situ*, for their individual decisions about complex environmental issues.

Chapter 2, *Learning as gap-closing: Investigating digitalized dialogues*, attends to the issue of unequal participation in classroom interactions and addresses how student agency and learning can be improved by establishing new ground rules for classroom discussion. Drawing on earlier research on classroom interaction patterns, the authors introduce a free micro-blogging tool called Talkwall, which has been designed to change the communicative ecology and facilitate a dialogic pedagogy in the classroom. The authors discuss how the tool is used to involve and support student learning and agency in group interactions, and attend to the communicative challenges Talkwall creates. Hence, while the micro-blogging tool has been developed to meet a range of challenges, the authors are well aware that new ones will emerge as digitalized dialogues appear in the public classroom space of Talkwall.

Chapter 3, *Digital inquiry into emerging issues of public concern: Controversy mapping in a Swedish school context*, takes an interest in understanding the role of education in a society that increasingly needs to consider the unstable features of technical innovations and science-in-the-making as part of schooling. It addresses what it implies to engage with issues generated by technoscientific innovations and raises questions of how people need to be equipped to exert their agency as citizens in a world that relies heavily on digitized information. It empirically explores how digital tools from the field of science and technology studies are introduced, and experimentally adopted by students, and how they engage in mapping the controversy of HPV vaccine online in a school context where the natural science curricula normatively frames their activities. In this case the digital infrastructure of the web is being implicated in students' activities as it is both pedagogically drawn on, and made visible through the semi-open design of the tools.

Digital design experiments and learning

While the chapters in the previous section explore how the design of digital tools is transforming learning in formal educational contexts, this section examines how digital tools and software are intertwined with the development of design interventions and knowledge. Qualitative explorations of the professional work practices of artisans and designers have been examined within the social sciences as sites for understanding a range of complex social issues, including embodied learning processes and the role that sociocultural artefacts play in reproducing as well as transforming expertise (Schön, 1983; Ingold 2013). This includes the use of digital tools and technology to reflect on how relationality influences design processes and ways of knowing (Akama, Moline & Pink, 2017; Galloway, 2017). In the cases explored in this section, readers are introduced to three different sites where digital tools and devices are being employed to generate new insights into how cultural artefacts affect embodied ways of knowing and acting in the world. In the process, the authors in each of these chapters revisit a range of social and technical assumptions about how knowledge frameworks shape expert's engagements with digital technologies and the effects these interactions have on their creative processes and thinking about design and digitally mediated modes of expertise. In this way, the chapters in this section share a common interest in how the design of digitally produced prototypes and modes of inquiry generate learning opportunities that can expand expertise.

The use of digital modelling technologies to explore design ideas in ways that open up spaces for both contributing to professional learning and producing design interventions within the field of architectural education, is the subject of Chapter 4, *Prototype driven learning and inquiry: A case study of architectural design and conceptualization*. In this chapter, a team of architectural researchers collaborate on the design of a sustainable roofscape that will be exhibited in a university gallery. But in order to create this exhibition, the researchers must first carry out a series of experiments that probe the boundaries of contemporary thinking about sustainable

design. In the process, the research team draws on both digital and non-digital tools and resources as a way to explore design ideas and generate further experimental techniques. These prototype driven experiments allow the researchers to engage in reflexive analysis that informs their understanding of the effects of digital methods, while also enabling them to draw their embodied understandings of architectural practices into question.

In Chapter 5, *Imagining, designing and exhibiting architecture in the digital landscape*, the subject of digital design is reflected on in the context of architectural museum exhibitions. The authors of this chapter are inspired by the pervasiveness of the digital in architectural work and its role in the conceptualization of design ideas and practices. But as they argue, the role of the digital in architecture exhibitions has only recently begun to be explored among art historians and museum specialists. In an effort to better understand the effect of digitally produced architectural prototypes on museum goers, the authors draw on three exhibition examples. In each of these examples they show how digital methodologies are intertwined with traditional practices in ways that inspire different kinds of temporal effects and narratives about architectural expertise. In this way, this chapter explores how digital techniques influence not just architectural practices, but also the work of museum curators and the experiences of museum goers.

Chapter 6, *Thinking through the databody: Sprints as experimental situations*, reflects on the experiences that an interdisciplinary group of scholars had as they collaborated on a data sprint. The term data sprint is used to describe how these collaborators went about collecting digital data from a group of theatre patrons. In collecting this data the researchers sought to identify patterns and insights that they could use to show theatre sponsors how their products and advertisements overlapped with the interests of the theatre's clientele. However, soon after this project began, the researchers found themselves questioning their own assumptions about how data sprints work. This, in turn, led them to reflect on their own methodological processes, which they realized were further complicated by their disciplinary positionalities and differences. In turn, the data sprint became a learning experience for understanding how the digitally circulated data that the researchers were working with, was itself an active participant rather than a passive resource for carrying out the sprint.

Investigating digitally mediated collaborations

The chapters in this section serve to illustrate the great variety of collaborative arrangements that can be currently found fashioning the affordances of digital methods and devices. As both functional and relational attributes, the affordances of digital technology can be understood as relying upon combined processes of technical and cultural invention giving rise to new prospective communities of digital practice. By participating in such processes of invention in the course of their research, the authors of the chapters can be seen to assume particular roles and identities in relation to them. They articulate emergent interests, concerns and sensibilities regarding how the social shaping of technology and the building of digital community might be most productively and legitimately pursued.

In Chapter 7, *Transdisciplinary potentials: Arts-based methods, social science and digital bodies*, the author tells of her investigations of methodological innovation in the digital arts and the social sciences. This has involved a focus on the creative deployment of digital technology to explore the broader non-linguistic meaning making capacities of bodily interactions. In advance of such an expanded multimodal research gaze, the chapter describes how the author has worked to initiate new conversations between various groups of social scientists and arts-based researchers investigating and theorizing the body in digital environments. By moving between these groups in search of 'thematic synergies', the author is dedicated to opening up further spaces for methodological experimentation in advance of an avant-garde of multimodal research practice.

Chapter 8, *Culture and collaboration in digitally mediated settings*, portrays how technical and cultural invention are tightly entangled in the realization of the affordances of digital technology. Reporting on multi-sited ethnographic research carried out on the collaborative design of fossil fuel plant technology by engineers located in four different countries, the author presents and outlines a role for herself as a cultural trouble-shooter. She discusses how such an individual can make a vital contribution to global work teams by offering valuable insights into how local culture invariably permeates technical work complicating the digitally mediated sharing of professional knowledge and expertise. Partially connecting to the previous chapter's concerns, the author emphasizes how engineering knowledge never simply boils down to the 'maths' and how multimodal forms of interaction, including embodied signals and cues, remain vital for learning and communication among the engineers she has studied. Therefore, cultural expertise is discussed as an important collaborative resource when deciding what mix of media technologies to draw upon in the construction of different shared global workspaces. By the same token, the chapter can also be read as a plea for greater humility in the design of complex collaborative endeavours and respect for the persistent intricacies of cross-cultural communication even in what can appear the most rationalistic and objective fields of cooperative endeavour.

If Chapter 7 is concerned with the methodological potentials of transdisciplinary collaboration, and Chapter 8 with the cultural complexities of transnational collaboration for shaping the affordances of digital technology, then Chapter 9, *The epistemology of mobilising citizens in the sciences: Tensions in epistemic cultures of contribution and ideals of science*, addresses another variety of digitally mediated border crossings. These are crossings between science and society relying on digital technology to fashion the figure of the citizen scientist. Assuming the identity of empirical philosophers of contemporary citizen science practice, the authors associate the growth of new volunteer communities participating in scientific research online with the fashioning of new epistemic cultures of contribution to science. In similar style to traditional practices of science communication, these new cultures of contribution can be seen as opening up science to broader public participation while simultaneously acting to demarcate science from society anew. Achieving openness while assuring demarcation in the cases discussed is presented as equating to a question of experimental design informed by

rejuvenated ideals of logical empiricism. The chapter reflects on such ambitions and ideals by pointing to the tension inherent in designing online protocols to discipline volunteers into seeing things with the same eyes as professional scientists, while accepting the possibility that volunteers may still be able to show sufficient independent initiative to identify anomalous data currently beyond classification. Given this tension, a broader set of ideals and values might clearly inform the experimental design of citizen science practice.

Ethical digital inquiry and design

The chapters in the final section provide a general discussion of current guidelines for internet research ethics and highlight temptations and pitfalls in both the design and implementation of such studies. Two different examples are then drawn on to further discuss how to design empirical studies that take ethics into serious consideration in digital inquiry. The section provides a discussion on different forms of digital research where there is a potential for personal harm. In doing so the authors provide suggestions for how the research process can be organized to anticipate and deal with ethical issues as they arise.

In Chapter 10, *Everything old is new again: The ethics of digital inquiry and its design*, the authors address how the emergence of new affordances in internet facilitated research of social media sites and the rise of 'Big Data' have led to new sets of ethical issues and challenges. A crucial problem for most software in data collection consists of the default setting to collect as much data as possible. While this may be tempting from a methodological perspective, it may also produce ethical dilemmas of unforeseen proportions. Unlike conventional survey methods, data gathered from online environments are entangled with information about people's everyday lives, which is difficult to disconnect from the study at hand. Generated through transdisciplinary collaboration a principle of data-minimization is suggested and exemplified. This strategy implies that one should only retrieve the data needed to pursue a specific research question.

Chapter 11, A *'situated ethics' for researching teacher professionals emerging Facebook group discussions*, addresses emerging ethical considerations from a research project based on data collected from a large profession-oriented, semi-public Facebook group. To study how teacher professionals engage in social media for sharing experiences and advice, a corpus of data was collected through the Facebook Graph Application Programming Interface (API). In this case study, ethical considerations were conceptualized as dependent on the contingent powers of the analytical focus, methods and members involved in the activities under study. The authors provide empirical examples of the classical ethical issues of integrity, privacy and informed consent relating to the 'situated ethics' in the project and problematize the ways through which researchers co-produce the surveillance inscribed into the technological platforms studied through the methodologies used.

As with the previous sections, this section illustrates the altered premises of pursuing research digitally, by taking ethical concerns and design considerations into

account. As implicated by digital infrastructures across all domains of professional practices, taking on an ethical responsibility when intertwined with the particular social and material ties of different social media platforms, will require extensive learning efforts on behalf of the social science researcher and/or close research collaboration with professionals from other fields. By showing how digital researchers can include in their research design the writing of their own programs and scripts, this section demonstrates how it is possible to minimize the dangers of surplus data, and to modify the data collected in such ways as to render it less identifiable.

In summary, the chapters of this book when read together highlight emerging experiences of what digital transformation brings to practices of learning and knowing. By providing concrete cases from secondary schools to professional workplaces and academic communities they aim to articulate a set of 'in motion' transdisciplinary approaches that can move this joint cross-bordering endeavour forward. In other words, this volume seeks to generate new affordances for establishing future collaborative designs for research and professional practice.

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