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researching in/visibilities and data practices in education

Irina Zakharova and Annekatrin Bock

What is made in/visible in datafied educational settings? How are in/visibilities entangled with data practices in schooling? In this contribution, we provide an overview of recent literature on digital technologies and datafication of education and consider four kinds of interrelations between in/visibilities and data practices: decontextualisation, in/visibilising of data work, black-boxing, and fore- or backgrounding. Scoping some examples of research that capture aspects of invisibility and visibility, we reflect on conceptual and methodological underpinnings of how to study in/visibilities and data practices in education.

Keywords: critical data studies, data practices, datafication, educational technologies, invisibility, methodology

Datafication of education

Datafication as a 'metatrend in the context of digitisation' (Breiter & Bock, 2023, p. 5) is understood as 'the transformation of social action into online quantified data […] allowing for real-time tracking and predictive analysis' (Van Dijck, 2014, p. 198), that 'introduces new means to measure, capture […] and represent social life in numbers' (Jarke & Breiter, 2019, p. 1). In that manner, datafication in education (Bock et al., 2023; Selwyn & Gašević, 2020) is increasingly shaping the futures of education. Education organisations such as K-12 schools rely heavily on big amounts of data being made available through school information systems and educational software to fulfil their educational mandate. To produce and make use of educational data, many actors are expected to engage in various data practices. Data practices are required, for instance, to organise teaching and learning processes, e.g., in the form of timetable planning, to measure, evaluate, and visualise learning outcomes and organisational data (e.g., rankings, learning assessment charts) (Hillman, 2023; Krein & Schiefner-Rohs, 2021; Oosterhoff et al., 2023), and as a basis for educational decision making in and out of the classroom (Bradbury, 2019; Grant, 2022; Hartong et al., 2021; Selwyn et al., 2022; Troeger et al., 2022).

For example, education agencies draw on data from schools, such as the number of cancelled classes or the number of students and teachers, to evaluate the quality of education or distribute financial resources. Parents of prospective schoolchildren might consult rankings of schools published by educational agencies or the media when choosing which school to pick for their child. A data-driven school ranking, however, might rely on a limited number of data points so that, i.e., extracurricular activities become written out and do not flow into the assessment, therefore presenting certain schools in a more negative light than their actual schooling practice. Moreover, e.g., in Germany much of the data used by schools and education agencies are inputted into school information

systems by school secretaries (Zakharova & Jarke, 2022). It is required to enroll children into schools or assign them to classes. Secretaries, however, are not always considered as data workers by software producers and have little control over the systems they use in their everyday work. So, research on datafication of education shows that while data have become an inherent part of (organisation of) educational processes, it is often unclear to many involved actors how which kinds of educational data are produced and used *in practice* (Bock et al., 2023). These moments, in which various constellations of actors and their data-enabled relations produce in/visiblities in educational settings, are why we attend to studying data practices.

As data move from a school secretary to the principal to education authorities, they pass various publicly and commercially provided information systems. As they move, data change their types, forms, and formats – e.g., from a note that a math class was cancelled in the tenth grade to an aggregate summary of all cancellations of math classes in a year in a given school. Data also change their meanings – from a simple act of organising the timetable and sending ten-graders home instead of a math class to a politically-laden indicator of educational quality. The situatedness, fluidity, and vagueness of data make it difficult to empirically grasp them with what could be called 'conventional' methods or approaches (see Law, 2004). Educational actors might lack information about their own and others' data practices or ascribe divergent meanings to the same data. For example, some aspects of data production and usage practices in educational contexts often remain opaque due to educational technology design, while others are being invisibilised alongside with some actors' precarious working conditions (Decuypere et al., 2023; Yu & Couldry, 2022; Zakharova & Jarke, 2022, 2023). The question for educational researchers interested in data, then, is how to approach this methodologically, when data practices are related to in/visibilities in practice. In this contribution, we consider what is made in/visible in educational settings and elaborate on methodologies for studying data practices in relation to in/visibilities.

To do so, we provide an overview of recent literature on digital technologies and datafication of education and consider four kinds of interrelations between in/visibilities and data practices: decontextualisation, in/visibilising of data work, black-boxing and fore- or backgrounding. An elucidation of these four kinds of in/visibilities goes along with a scoping of some examples of research that helps capture aspects of invisibility and visibility theoretically and methodologically. We conclude with an outlook on the further development of research approaches to in/visible data practices.

Studying *in/*visibilities and data *practices*

Current research on digital data is widely concerned with identifying and understanding the hard-to-see aspects of datafication processes (Zakharova, 2022). A growing body of work elaborates on diverse methodological approaches to researching and conceptualising data practices: "wide data analysis" (Manovich, 2017), big-thick-blending of data (Bornakke & Due, 2018); "data fusion" (Manovich, 2013) or the "engaging in digital practice" (Rieder & Röhle, 2017). It specifically suggests adapting established *methods* and thinking of creative ways or new *methodologies* to research invisible or invisibilising data practices (e.g., Bornakke & Due, 2018; Rogers, 2017). Yet others, for example, Neumayer et al. (2021), interrogate visibility as a process and ask how invisibilities are created in research. Neumayer and colleagues developed a four-dimensional framework of the agents and processes making data in/visible, including such dimensions as people and intentionality, accessibility and form, technology and tools, and lastly, meaning and imaginaries. This framework sensitises us towards multiple socio-technical arrangements in which research on

digital data takes place. It provides a context for careful consideration of in/visibilities stemming from design of research processes. In a similar vein, Fahimi et al. (in press) reflect on uncovering in/visibilities by using different kinds of methodologies (such as mapping and tracing of data journeys), tools, and interventions (e.g., filing freedom of information requests to access data). Here, in/visibilities are emphasised as political and in relation to power to conceal or foreground certain things or the lack thereof. These methodological considerations take up and develop further the arguments widely elaborated by scholars critically interested in data and software: to pay attention to the contexts and interpretive practices of data production (generation and meaning ascription) alongside with data usage (Kitchin & Lauriault, 2014) or software design, development, and maintenance processes (e.g., Chun, 2005; Galloway, 2006; Manovich, 2013).

In the context of education, scholars also seek to understand and critically reflect on the manifold entanglements of in/visibilities and data practices (e.g., Bock et al., 2023; Macgilchrist, 2019). For example, Fenwick and Landri (2012, p. 6) point out that certain educational practices produce in/visibilities: "important everyday learning achieves an unusual visibility when it is appreciated as material enactments: this visibilisation throws up critical questions about how 'pedagogic authority' codifies and values some knowledges and overlooks others". Drawing on that, we could say that digital data and data practices in education are, too, intertwined with in/visibilities of certain kinds of knowledges, learning outcomes (e.g., through software dashboards), power relations, values etc.

In this contribution we are, therefore, interested in the relation of data practices and in/visibilities in the empirical field of education. Based on an overview of literature in critical data studies in education, we derive four kinds of such relations: decontextualisation, in/visibilising of data work, black-boxing and fore- or backgrounding. In what follows, we discuss these four in/visibilities in relation to data practices, how they are studied methodologically, and the possible conceptual underpinnings of such research.

Building on the body of work in critical data studies, we identified the first way in/visibilities are produced in relation to data practices in educational settings as *decontextualisation*. Decontextualisation addresses how the complexity of the empirical site is being reduced as it gets datafied, e.g., school life is translated into digital data and these data require re-contextualisation to be further used. In this sense, anything that is not translated into digital data can be invisibilised and written out. The practices of recontextualising such digital data, then, might lead to foregrounding only certain aspects of the invisibilised context. For example, Hardy & Lewis (2018) discuss this in relation to school performance data and argue that while digital data might make certain students – in this case, the average-performing ones – more visible to the educators, these students become visible as data points that can be improved rather than as learning subjects. Similar observations have been made by other researchers of data in education, e.g., Bradbury (2019), Selwyn et al. (2022) and Grant (2022). Methodologically, the authors draw on studies of policies defining which aspects of education are important, artefact analysis of documents used in schools and observations of how school actors negotiate the recontextualisation of digital data.

These studies also illuminate how educators' work becomes more visible to school administrators or education agencies through data practices (Grant, 2022). For other educational actors such as e.g., school secretaries, however, data work creeps into their everyday work tasks but often remains unacknowledged by colleagues, authorities, or technology providers (Zakharova & Jarke, 2022). This *in/visibilising of data work* addresses how work required to fill digital data with meanings and to translate them between different educational actors (e.g., educational authorities and teachers) is

rendered visible and accountable or not (see also Gorur & Dey, 2021). One way to theoretically conceptualise this is through feminist theories, in which in/visibility is tied to power and precarious work remains invisible, as Zakharova and Jarke do in their empirical study. Another way could be to use the topological conceptual approach and digital methods as tools of intervention. For example, van de Oudeweetering et al. (2023) visualise the practices of feedback in MOOCs in university settings, illustrating the careful and tedious work of instructors that departs from but goes beyond the use of digital dashboards for data analytics and is not necessarily visible for all.

Another strain of recent research attends to the complexity of socio-technical arrangements in which mechanisms of invisibility and visibility are made to work. In terms of in/visibility, we suggest to address it as *black-boxing*. It sheds light on how the design of educational technologies, policies, and politics regulating data practices conceal some data practices from certain actors and configure what is known about digital data and their meanings. For example, taking the visualisation of invisible practices as a point of departure for their conceptual analysis, Jarke and colleagues (2023) use data journeys as an analysis method for exploring data-based school management and administration. At the core of the study is an analysis of different visions of educational software, including the visions of software designers, combined with insights from actors within and outside schools, allowing for the reconstruction of data practices not visible to school actors. Hillman (2023) specifically studies kinds of data tracked and gathered through educational technologies to emphasise the role of policy and governance in producing in/visibilities. She argues, for example, that much of the data about students or even educators and schools is siloed and owned by technology providers, not always accessible even for oversight. While pursuing different goals, what is common to these studies is not particular methods but conceptual and methodological attention to non-human actors – e.g., technologies and data – alongside human actors such as software providers.

Finally, some scholars of datafication in education increasingly turn to studying software design via dashboards, visual narrations, walkthroughs, and other methods of interrogating visual artefacts involved in or produced through data practices (Jarke & Macgilchrist, 2021; Ratner & Ruppert, 2019; Troeger & Bock, 2022). These studies highlight how interfaces of technological systems or data visualisations either allow or constrain certain actions and agencies by making some elements of the interface visually more prominent than others. A typical example would be a traffic light colouring used in a learning management system to indicate different levels of task completion or educational 'risks' which induce certain assumptions of urgency or success (Zakharova & Jarke, 2023). Drawing on the work of a technoscience scholar, Lucy Suchman (2007), we suggest addressing this relation between data practices and in/visibilities as *fore- and backgrounding*. Suchman argues that technologies overall are perceived through staging: fore- and backgrounding of certain aspects and practices that represent technologies in a particular way. "Our task as analysts is then to expand the frame, to metaphorically zoom out to a wider view that at once acknowledges the magic of the effects created while explicating the hidden labors and unruly contingencies that exceed its bounds", Suchman (2007, p. 283) contends. We find a further conceptual underpinning for this rendering of in/visibility by Galloway (2006, p. 320) and Chun (2005), who describe how software 'hides' material human actors and technologies (hardware), whereas the intangible data and their representations (in the form of texts, ranks, or visualisations) appear on the surface. For example, an analysis of the five most broadly used learning management systems (LMS) shows that these LMS render invisible learning and any aspects of students' lives relevant to learning which take place outside of the digital system (Zakharova & Jarke, 2023). Mostly, only students' behaviour registered through the LMS, such as time spent in the system, is made visible to teachers via dashboards and data visualisations. Through the lens of fore- and backgrounding, it is possible to

address analytically both how visualisations of digital data foreground certain aspects of learning – namely, learning within LMS, and move to the background the human and material aspects of learning that take place outside the LMS.

Concluding thoughts

Taking a closer look at the invisible data practices that are entangled with datafication in education helps us to carve out "ambivalences, tensions and ruptures" (Breiter & Bock, 2023, p. 2) that become visible *in-situ* of educational data practices. The notion of in/visibility is helpful to connect data with other elements of the socio-technical educational arrangements, which *contain* these data (in the schooling domain, this can be school reports with data on students) or which *consist* of them (such as education statistics), which *exist in the context* of these data (depending on the language skills data students receive special courses or not) or which are there so that *the data exists* (such as Excel spreadsheets, tables, school information systems etc.). The four kinds of in/visibilities discussed here provide responses to the questions of what and how is being translated into digital data in education and what and how is known about education (or learning) through data practices. At first glance, that approach may seem technology-deterministic. However, what we are aiming to demonstrate here is how data and technologies, together with material artefacts and human actors, mutually constitute themselves and each other's in/visibilities. At the same time, previous research by one of the authors shows that in some cases, invisibility in relation to data might also be welcomed by educational actors and allows them more agency and flexibility in deciding which data to make visible to whom, why, and when (Zakharova & Jarke, 2022).

Against this background, we discussed here four kinds of relations between data practices and in/visibilities which are tackled differently by educational scholars. They draw on different conceptual approaches, from critical data studies to feminist theories, to topological lens, to design studies and on varying methods – from traditional to new and digital ones like walkthroughs or data journeys – to study how data practices relate to in/visibilities. Therefore, we envision further methodologies that look at the 'in-between', the tensions and fractures in which the invisible can be made visible. Among the questions exploring these practices and relations in greater depth are the following: What is or *is made* invisible in the educational setting? What educational agencies or actors are included in or excluded from the datafication processes? Which technologies, practices, or values are prioritised, and which are marginalised through these processes? Our contribution illustrates how different scholars interested in datafication of education respond to these questions.

Drawing on our brief scoping of this research, we suggest that future studies on the datafication of education should foster research that draws on software studies to investigate the role of software (Manovich, 2013), critical data studies to engage with implications of massive datasets in the educational domain (Boyd & Crawford, 2012; Jones & McCoy, 2019; Kitchin, 2014), and studies on the materiality of data to define the physical limitations of data practices (e.g., Pink et al., 2018). The proposed connection of different approaches aims to turn the focus from the context of invisible data use (Breiter et al., 2018; Hutchinson, 2016) to the context in which data is produced and made in/visible by different actors. While our concern here has not been on the role of researchers in in/visibilising certain aspects of educational practice, we acknowledge alongside other scholars like Neumayer et al. (2021) and Zakharova (2022) that research methods also have a performative role. Hence, this paper contributes to the discussion of education research methods in times of deep mediatisation, digital transformation and datafication, specifically addressing research on the human and beyond-human components of invisible data practices (Bock et al., 2023; Breiter

& Hepp, 2018; Fahimi, in press; Rieder & Röhle, 2017). First promising examples of empirical studies could be outlined in this scoping piece, which will hopefully be followed by further exciting approaches and in-depth discussions in the future.

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Irina Zakharova

Irina Zakharova is a postdoctoral researcher in the working group Sociology of Digitalisation at the Leibniz University Hannover. Her research lies in the fields of Data Studies and feminist Science and Technology Studies. She is particularly interested in data practices in public service provision in the welfare states, knowledge production in a datafied world, and datafication of school education. Currently, she is editing a special issue on "*Care-ful Data Studies*" for the journal *Information, Communication and Society* together with Juliane Jarke.

Annekatrin Bock

Annekatrin Bock is a professor of media studies with a focus on the digitisation of education at the University of Vechta and the academic director of the media competence centre in Vechta. Her research is informed by educational media research, school and classroom studies, as well as media reception and appropriation research in media and communication studies. Her current projects deal with media transformations such as datafication, critical app studies and the future of schooling.