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The Topologies of Data Practices: A Methodological Introduction

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ABSTRACT

This paper offers a methodological framework to research data practices in education critically. Data practices are understood in the generic sense of the word here, i.e., as the actions, performances, and the resulting consequences, of introducing data-producing technologies in everyday educational situations. The paper first distinguishes between data infrastructures, datafication and data points as three distinct, yet interrelated, phenomena. In order to investigate their concrete doings and specificities, the paper proposes a topological methodology that allows disentangling the relational nature and interwovenness of data practices. Based on this methodology, the paper proceeds with outlining a methodical toolbox that can be employed in studying data practices. Starting from nascent work on digital education platforms as a worked example, the toolbox allows researchers to investigate data practices as consisting of four unique topological dimensions: the Interface of a data practice, its actual Usage, its concrete Design, and its Ecological embeddedness - IUDE.
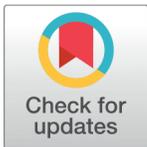
1 INTRODUCTION

This paper offers a methodological framework that allows researching data practices in education. Data practices are understood in the generic sense of the word here, i.e. as the actions, performances, and the resulting consequences, of introducing data-producing technologies in everyday situations (Smith, 2018). In the educational sector, data practices have a growing influence and scope. They can be found in, for instance, behavioral class management software (Williamson, 2017); digital assessments (Thompson & Sellar, 2018); the tracking of bodily activities and movements (Pluim & Gard, 2018); dedicated educational apps (Decuypere, 2019b); state-induced school monitoring (Hartong & Förschler, 2019); etc. Next hereto, data practices are increasingly prevalent at all educational stages – from kindergarten to the university, and spanning formal, non-formal and informal learning contexts alike. Moreover, since the onset of the COVID-19 pandemic, data practices seem to have greatly accelerated, and it is generally surmised that such practices will further

develop, substantiate and consolidate in the future (Williamson, Eynon, & Potter, 2019). However, even though data practices and broader processes of digitization are becoming increasingly prevalent, taken-for-granted and normalized, at present there is an ongoing lack of scholarship and corresponding methodological propositions that allow to critically research the concrete doings, impacts and effects of data practices on the social field in general, and the field of education in particular (Jarke & Breiter, 2019; Williamson et al., 2019).

In this paper, my goal is to sketch the outlines of a methodological framework that allows an opening up of the 'black box' of *digital* data practices in the field of education; that is, to present a toolbox that can be used in order to investigate such practices in a critical manner and to disentangle their performative effects (Castañeda & Selwyn, 2018). In line with recent scholarship on data practices, in this article I make a conceptual distinction between three crucial features of these practices. First, *datafication* points to the processual nature of data practices, and involves the ongoing 'collection of data at all levels of educational systems (…) potentially throughout all processes of teaching, learning and school management' (Jarke & Breiter, 2019, p. 1). *Data points,* second, are the concrete result of data practices: they are the 'sedimentation' or 'snapshot' of what happens when activities or information (e.g. a student's test results; a pupil's level of physical activity during the day) are captured, stored and represented (i.e., datafied) in a digital manner (Decuypere, 2019b; Pluim & Gard, 2018; Thompson & Sellar, 2018). Importantly, at present, data points are not necessarily distinguishable anymore from performed activities themselves: increasingly, the conduct of educational activities –and of social life more broadly– coincides with the direct and continuous ('live', 'real time') capturing of these activities *as* data points (Marres & Stark, 2020). Third, *data infrastructures* are information systems that permit the construction and the sustaining of data practices, enabling actors to generate, frame, communicate and represent these data points (Gulson & Sellar, 2019). Often composed as assemblages of heterogeneous nature, data infrastructures can be found in daily school practices (e.g. an ecosystem of devices, software and apps) or in individual practices (e.g. an academic's ensemble of daily used profiles, platforms and technologies), but equally in initiatives developed by national governments (e.g. school monitoring systems), and in assemblages of corporations and supranational actors that transcend the level of the nation state (e.g. the OECD's PISA studies) (Lewis, 2020; Williamson, 2017).

In many recent works, there is considerable crisscrossing between these different terms, and they are often used in overlapping or precisely in disparate ways. However, the majority of studies cited in this article do start from the shared assumption that data practices do not merely represent specific educational activities or results (e.g., specific performances, outputs, and so on). Rather, data practices *bring these activities and results into being.* Data practices do not consist of neutral tools that merely 'discover', 'objectify' or 'measure' educational practices and activities; rather, these practices actively set up, anticipate, enable, perform, and thus equally *govern*, specific ways of thinking about –and acting upon– education(al actors) (Gulson & Sellar, 2019; Selwyn & Pangrazio, 2018). Even though this insight is increasingly gaining traction on a theoretical level, there still remains a lack of methodological unclarity and opacity as to how to precisely trace how such 'bringing into

being' concretely happens (Decuypere, Grimaldi, & Landri, 2021; Piattoeva & Saari, 2020; Williamson et al., 2019). It is in that sense that I advocate in the next section for a relational-topological approach towards data practices that is interested in their *liveness* (Lury, 2012); that is, in how they emerge, develop and unfold. This relational approach permits, in the following section, the operationalization of the insights outlined in this introduction into a methodological toolbox that enables the empirical scrutiny of such data practices. The toolbox –coined IUDE– consists of four methodological points of inquiry: the Interface, Usage, Design, and Ecology of data practices. I conclude by briefly reflecting on the methodological and critical repercussions of adopting the proposed toolbox.

2 A RELATIONAL UNDERSTANDING OF DATA PRACTICES

2.1 Doings

Data practices are increasingly becoming the very stuff of social life, and accordingly, have become increasingly subject of critical inquiry. Likewise, the last few years have witnessed the beginning of an upsurge in critical approaches towards *educational* data practices. For instance, research has already abundantly shown that data practices are regularly surveilling students' activities and monitoring their virtual data traces (Lewis & Hardy, 2017); that digital education platforms are emblematic of –and complicit in– a neocapitalist desire to commodify education and sociality (Williamson, 2020); and that educational data and the educational sector more broadly are increasingly being corporatized and marketized (Lindh & Nolin, 2016). Whereas these topics are massively important and deserve great scrutiny, this paper starts from the contention that critical educational scholarship should not veer too soon into (meta)theoretical discussions of systemic surveillance, capitalism or control, for such a lens tends not to attend to the specific subtleties and situational effects performed by, in, and through each singular data practice (Goriunova, 2019; Ratner, 2019). In other words, and in line with an emerging body of literature in social theory more broadly, the premise of this paper is that data practices require close, conceptually rich examinations of the processes that are comprised in the construction and operationality of these practices (Goriunova, 2019; Grommé & Ruppert, 2020; Ratner, 2019).

In order to sketch the outlines of what such close and conceptually rich examinations might entail, I start from the insights developed in the seminal essay by Ruppert, Law, and Savage (2013). This essay argues for an understanding of digital data neither as the neutral backdrop of social life, nor as invoking epochal changes. Instead, Ruppert et al. argue for the crucial importance of close scrutiny of the materiality and productivity of digital devices. They state that data practices redefine how we understand social life and how we act in –and shape– different parts of that life. It is in that sense, so their argument goes, that a critical approach towards data practices should not so much be considered with tracing some sort of essence –what data practices *are*– but should rather focus on the performative effects of such practices; that is, on what these practices *do*:

> [W]e need to attend to the lives and specificities of devices and data themselves: where and how they happen, who and what they are attached to and the relations

they forge, how they get assembled, where they travel, their multiple arrangements and mobilizations, and, of course, their instabilities, durabilities and how they sometimes become disaggregated too.

(Ruppert, Law & Savage, 2013, p. 31-32)

This paper departs from this call to investigate the lives and specificities –the doings– of data practices (see equally Bucher, 2018). In doing so, and as stated, I will sketch the outlines and contours of a methodology that allows the disentanglement of the *liveness* of data practices, i.e. how such practices are happening as they are in the making (cf. Lury, 2012). This paper is thus not concerned with researching data practices in experiential terms (see Selwyn & Pangrazio, 2018, for explorations along these lines). Rather, I outline a framework to attend to data practices *in emergence*. In that sense, this framework does not offer a bird's eye view (being above or outside data practices), but precisely seeks to account for the 'fluid and heterogeneous ontology' of such practices (Piattoeva & Saari, 2020, p. 2). In other words, the framework considers data practices as profoundly relational, and aims to offer a methodology to attend to and disentangle such relational unfolding (Decuypere, 2019b; Hartong, 2020; Piattoeva & Saari, 2020).

2.2 Flatness

In adopting a relational understanding, I am interested in how data practices make specific types of education operational, and how digitalities and infrastructural qualities move, track, trace, loop, fold, border, and envelop educational actors. Importantly, being primarily interested in pursuing such a relational understanding, the paper makes no conceptual (and no methodological) distinction between what would allegedly be 'real' and what would be allegedly 'digital'. Reminiscent of actor-network theory, the central interest here is flat, and disentangles how associations between various sorts of actors proliferate and/or potentially fade in the process (Latour, 1986). This means that the methodology presented here explicitly aims to avoid the (rather uncareful) assumption that the 'digital' realm would somehow aim to emulate, copy, or represent, the 'real' and/or 'physical' realm of education (Bratton, 2015). This assumption is quite common in critical scholarship of data practices, and is evidenced in, for instance, the deployment of concepts like 'data doubles', 'digital representations', 'data traces', and so on. Such concepts share the representational assumption that there would be a correspondence between the digital and the physical realm, and more particularly assumes an invoked idea of singular indexical correspondence; i.e., the idea that data points (such as the digitally recorded activities, performances and behaviors of a student) have a direct relationship with, and give straightforward access to, 'real' people (i.e. real students). However, in data infrastructures there is no absolute representational correspondence between data points and (collectives of) humans –rather, data points are constantly aggregated, compared, sorted, distributed and re-arranged (Goriunova, 2019). A digital representation –a data point– is in that sense 'always provisional and corresponds only partially with the type of category in which it is included' (Lury & Day, 2019, p. 20). I consider data infrastructures, thus, as without unity, but rather as distributed *and* dis-

tributing; as 'never static but always changing and always in motion' (Lury & Day, 2019 –equally Lury, 2012). This implies that, among others, that methods that seek to capture the liveness of data practices need to 'continually make available the possibility of changing relations' (Lury, 2012; Ratner & Gad, 2019).

2.3 Topology

The framework I propose, makes use of topology as a lens that allows scrutiny of the relationality of elusive assemblages such as data infrastructures. Topology, here, is invoked as a *methodological* lens that shapes how concrete *methods* (presented in the next section) can be employed. Methodologies are to be contrasted with methods: whereas methods are understood here as more straightforward 'instruments' or 'tools', methodologies are to be conceived as theoretically informed and reflexive *practices* that are partly assistive in creating the very phenomenon they observe (Law, 2004; Lury, Tironi, & Bernasconi, 2020). In order to investigate data practices, I contend that both are crucially needed (see conclusion).

Reminiscent of a broader relational turn in social and cultural theory, topology offers a vantage point that allows educational researchers to investigate data practices as the continuous changing of relations and relational assemblages more broadly (Decuypere & Simons, 2016b; Gulson & Sellar, 2019; Hartong, 2020; Lewis & Hardy, 2017; Lury, Parisi, & Terranova, 2012). In its most basic form, topology refers to the study of shapes –'shapes' understood here as sets of (changing) relations between various actors of different kind. As Thompson and Cook (2015, p. 734) state, '[t]opology explains the contemporary patterning, flow and articulations of forces, power and subjectivity in specific terrains', such as the terrain of education. Topology, thus, starts from relationality and how these relations (patterns, flows, articulations, orderings) have particular productive effects (van de Oudeweetering & Decuypere, 2019). Furthermore, topology is primarily interested in the *intensive* (qualitative, topological) qualities of relations. For instance, rather than assuming that space and time are positioned in an *extensive* (quantitative, metrical) grid of Euclidian coordinates and in chronologically enfolding successive moments, in topology space and time are actively produced and brought into being. In doing so, the lens of topology allows and at the same time requires a willingness to 'think about spatial and temporal change in an altogether different way' (Allen, 2016, p. 1).

What does this imply for researching data practices? First and foremost, it implies that the methodological toolbox presented here allows us to see data practices as complex assemblages that have no unifying essence, but that are instead continually being put together (Sellar, 2015, p. 769). Topological methodologies aim and allow to scrutinize the shape (or form) of data practices, and more particularly how this shape preserves key properties –and/or loses other properties– when it is undergoing continuous transformations (Martin & Secor, 2014). This insight is crucial for the study of data practices, because their elusive nature means that methodologically 'fixing' such practices into one stabilizing essence would fail to grasp the very thing that characterizes them (Piattoeva & Saari, 2020). Instead, topological methodologies are interested in how data practices are *formed* and constituted, how they *transform* (adopting altogether different forms); *deform* (chang-

ing internal dynamics); *perform* (giving actors within the practice a dedicated form); and so on (Decuypere, 2019c).

Second, topological methodologies allow to unfold how space and time are productive effects of data practices. Since topological methodologies employ a more plastic sense of space and time, they allow to put spatiotemporal formation under scrutiny and make the construction of specific sorts of spaces and times a focus of inquiry. In topological studies, space and time are effects of data practices; *a posterioris* rather than a prioris (Lury et al., 2012). Studying differentially enacted forms of time and space is important when studying data practices in the making: it allows us to investigate how such practices ongoingly expand, how space and time are emergent becomings, and how they thereby create highly contingent sorts of (de-)stabilization and (im)mutability (Ratner, 2019). Topological methodologies, thence, allow to consider at once how data practices *shape* spaces and times as contingent effect as well as how they *order* such spaces and times. Moreover, they start from the general idea that spaces and times constitute each other and are, in that sense, always implicated in one another (Decuypere & Vanden-Broeck, 2020; Lingard & Thompson, 2017).

Third, topological methodologies allow us to understand not only the factual state and nature of data practices, but over and beyond that, topological methodologies equally investigate *how* data practices are constructed and come into being (cf. 'liveness'). Topological methodologies not only enquire about the relationality of data practices; they equally investigate *how* such relationality is brought about concretely. Indeed, when something becomes part of a data practice, this is always related to decisions made about what is (or should be) inside and what is (or should be) outside of such practices, and what can and what cannot cross over within these practices (Prince, 2017, p. 337). This insight is important in as far as it urges topological methodologies to be attentive to how data practices are evolving –rather than only giving an overview of what relational features are present there (Hartong, 2020; van de Oudeweetering & Decuypere, 2019).

The consequences of all this –a focus on forms; an interest in relationally shaped spaces and times; and an analytical gaze that focuses on both the how and the what of data practices –is that topological methodologies allow (more precisely: *require* and *urge*) suspension of commonly invoked binaries. Instead of thinking along and operating within such binaries, topological methodologies consider the near and the far; the global and the local; the social and the material; what is mobile and what is continuous; what is digital and what is human; what is connected and what is separated; etc., together –without privileging one over the other (Allen, 2016; Decuypere & Simons, 2016b; Gulson & Sellar, 2019; Prince, 2017). As relational effects, sizes, scales, spaces, times, and forms are all conceived as 'arrested snapshots of intensive topological becoming' (Martin & Secor, 2014, p. 426).

3 TOPOLOGIES OF DATA PRACTICES: INTERFACE, USAGE, DESIGN AND ECOLOGY (IUDE)

So far, this paper has stressed the relational nature and interwovenness of data practices –thereby destabilizing the common idea of data infrastructures as merely technical and always partly inscrutable assemblages (see Bratton, 2015). This section operationalizes the topological methodology substantiated in the previous section, by outlining the contours of a toolbox that can be employed when studying data practices in education. Importantly, this toolbox should not be conceived as a generic one-size-fits-all solution to the methodological quandary of how to scrutinize data practices adequately: the toolbox is no jack-of-all-trades, and each inquiry will necessitate the tailoring and the adaptation of the toolbox to the situation at hand. In addition, the way I position the toolbox here is crucially informed by the insight that *topological methodologies are complicit in the creation of what they observe* (cf. supra). This implies that the determination and subsequent individuation of distinct data points, infrastructures and processes of datafication is an *accomplishment* of specific data practices as much as it is an accomplishment of the concrete methods adopted (Lury, Fensham, Heller-Nicholas, & Lammes, 2018). That methods enact our world, and hence co-determine not only the (sort of) answers research collects, but equally centrally frame the (sort of) questions and problematizations that can be posed and that are considered to be worthwhile and of interest, is a long-standing insight in the STS tradition (Latour, 1986; Law, 2004). In the context of educational data practices, Sellar recently stressed exactly this point by arguing that the methods we adopt do not –in a forceful way *cannot*– make us stand outside of that what we observe:

> To research data infrastructure is to research the development practices that are, even as we survey them as 'objects' of study, reconfiguring the very conditions of this study; data infrastructure is not simply a set of material supports 'out there'; it is an assemblage of practices that is, among its multiple and diverse effects, reshaping academia.
>
> *(Sellar 2015, p. 773)*

This, Sellar argues, has profound implications with respect to how to *critically* investigate data practices:

> [T]here is no position of exteriority from which to undertake critique. We cannot stand outside of a social order or system to undertake a disinterested critical analysis; all critique is, in the end, immanent to the systems (…) that we analyse and our critiques contribute to the unfolding of these systems. It is therefore better (…) to approach our critical contributions in the spirit of positively modifying the ecology of practices in which we are situated, rather than taking up critical postures that rest assured in strategies of debunking, demystification or disqualification.
>
> *(Sellar, 2015, p. 774)*

In a similar vein, the topological toolbox presented here does not aim to debunk, demystify or disqualify the operations taking place in data practices. Rather, it seeks to positively interrupt unreflexive dealings with data practices, and to explicitly frame our present ways of dealing with educational data practices as in need of adequate methodological scrutiny, interruption and modification (Decuypere & Simons, 2016a; Gulson et al., 2017; Sellar, 2015). It is in that sense that the methods proposed here are explicitly intended to resist common objectifying habits that treat data practices as 'out there' and as an 'it', and are rather directed at seeing and disentangling the liveness of data practices: how they happen and immanently-topologically unfold (Piattoeva & Saari, 2020).

In order to research this liveness, it is important to stress that even though data practices are elusive and open-ended, they do cohere and converge as *practices*. That is to say, data infrastructures, processes of datafication and resulting data points do form coherent and interdependent wholes ('practices') that are co-constituted through multiple topologies and that produce in their turn multiple, incongruous, topological effects (Bratton, 2015). In other words, I consider data practices as consisting of multiple topologies –i.e., dimensions or surfaces that generate and drive their own spaces and times– that continuously overlap and enfold each other (Lash, 2012; Thompson & Cook, 2015; van de Oudeweetering & Decuypere, 2019). In that regard, I propose investigating data practices by means of four specific dimensions or methodological entry points, i.e., the *Interface*, *Usage*, *Design*, and *Ecology* (see Figure 1). For instance, interfaces generate their own space and time, and these spaces and times are not necessarily fully coterminous with the space and time created once students start to make use of a particular interface (Thompson & Cook, 2015).
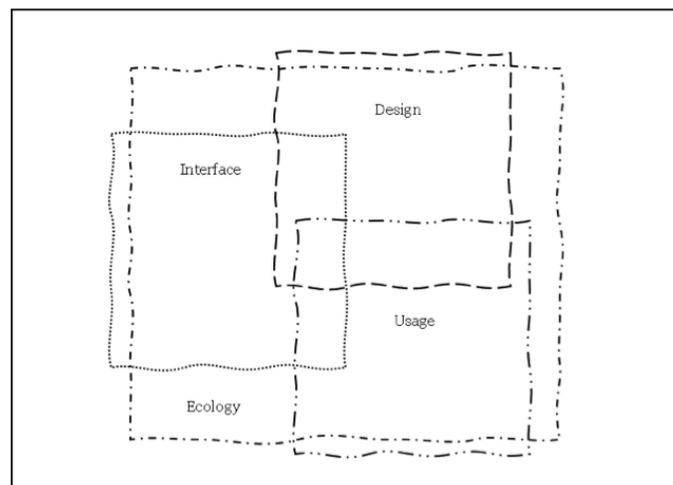
Figure 1 Four topologies of data practices, together constituting the IUDE-toolbox. As evidenced by their capricious shapes, data practices are in constant flux and characterized by processes of constant (de-) formation. The dotted lines signify that each topology can be approached through a variety of entry points, whereas the overlap between the different topologies signifies how each topology is partly (un-/en-) folded in the others.

For the sake of clarity and to maintain a steady focus, in what follows I draw on nascent work on *digital education platforms* as one particular sort of emerging data practices that is increasingly gaining prominence in all areas and stages of education (Decuypere et al., 2021). Platforms, here, are understood as data infrastructures that set up sociotechnical relations and that allow users of various kinds to interact with each other (Plantin, Lagoze, Edwards, & Sandvig, 2018; Srnicek, 2017). Importantly, this is not to suggest that the IUDE-toolbox is limited to the scrutiny of such platforms. Rather, I use the data practices invoked by and through digital education platforms as a concrete 'worked example' that illustrates how the toolbox can be fruitfully deployed to inquire about topological multiplicities –in this case, to research what happens *on* platforms, what users concretely do *with* these platforms, what is happening *behind* the platform's interface, and conclusively how research equally needs to incorporate what is ecologically situated *beyond* a concrete platform.

3.1 Interface (on)

As an instance of data infrastructures, platforms are necessarily infused by interfaces that make the platform visibly appear to its users. A first dimension of the toolbox is then directed at everything that materializes on a platform's interface: text, pictures, videos, hyperlinks, etc. Interfaces are, in that respect, probably one of the most evident starting points in investigating data practices, since they allow us to disentangle what happens –in our case– *on* the platform. Interfaces materialize particular statements and particular visibilities for actors within data practices, and as such allow us to inquire into the 'conditions of possibilities' for users and user practices (Dieter et al., 2018). As a concrete materialization of what happens in data infrastructures, the interface –as a somewhat stabilized end point projected on a screen– offers a unique insight into what could be called the *environment of expected use*; that is, in how the platform interface is anticipated to be received, what typical user behavior is anticipated to be (and desired), and how user activities are regulated through the interface's (facilitating or constraining) materialized design (Decuypere, 2019b; Hartong, 2020; Light, Burgess, & Duguay, 2018).

The focus on the environment of expected use –what I call here 'on the platform'– is informed by the general idea that '[e]ven though many platforms (…) have the sheen of being formally neutral, they remain uniquely ideological in how they are structured and composed, and in how they thereby plan to convey specific messages and frame specific sorts of worlds' (Decuypere & Landri, 2020, p. 4). Reflecting the aforementioned argument that the toolbox aims to disentangle what platforms (and their components, such as interfaces) *do,* rather than focusing on what they *are*, the interface topology is analyzed in view of the specific operations that such interfaces perform. Notably, it is the very diagrammatic quality of interfaces (i.e., their combination of textual and visual elements) that makes these operations legible, interpretable and subject of analysis with regards to the sorts of (ontological and epistemological) claims they make about educational realities (Drucker, 2020). Without offering rigorous guidelines, one can think here about the various ways in which the interface *classifies* and *hierarchizes* (e.g., data points); how (and what) it *measures* and how (and what) it *compares*; how realities are *portrayed* and *named* (e.g., as/in data points);

how various elements in these realities are being drawn into a singular plane by *enlisting* them; what is being *numbered* and *calculated*; what is being *visualized* (and how); etc. Such operations are not innocuous practices, but on the contrary –as sites of projection– enact concrete topological spaces and times that produce new and powerful (ideas about) ways of being a teacher or student, as well as new educational practices and new problematizations of what education c/should be about (Sellar, 2015, p. 770; equally Allen, 2016; Lury et al., 2012; Piattoeva & Saari, 2020).

Concrete methods to investigate interface topologies are gradually emerging, even though the need to test, twist, tweak, adapt and invent methods when and as needed, remains (Gulson et al., 2017). Amongst the methods that have already emerged, we can identify the *walkthrough method* as one of the most promising techniques allowing the unfolding of highly intricate details about the interface/platform in question. The walkthrough method analyses interfaces to illuminate how designers intended these interfaces to function, and thereby allows us to critically examine how an interface works 'at face value'. By not focusing on concrete, but rather on implied usage, the walkthrough method allows analysis of the various sociotechnical artifacts that are present in data practices and to substantiate the various affordances (and constraints) a user is expected to encounter (Decuypere, 2019b; Light et al., 2018). Whereas the walkthrough method focuses on navigating the entirety of an interface, other methods allow a focus on specific manifestations of platform interfaces, such as the *diagrammatic* operations performed (i.e., how visual and textual elements interact and relate with one another) or precisely the *technical* operations performed (e.g. algorithmic agency, and more notably how algorithms enact specific relational effects) (Bucher, 2018; Decuypere, 2019a; Romito, Gonçalves, & Feo, 2020). A last increasingly common method is to analyze the interface for the type of user that is implied in platforms; that is, how platform interfaces *configure* specific types of users. Even though platforms should not be considered as stringent masterplans, they do allow –and at the same time draw boundaries around– specific user activities and nudge users in specific directions, behaviors and delineated sorts of activities. In that sense, some methods seek to show how a platform's interface contains a specific *grammar of action* that aims to configure users in highly determined ways and to 'ensnare' them in the overall interface design (Agre, 1994; Bratton, 2015; Decuypere & Landri, 2020).

3.2 User (with)

Whereas processes of implied user configuration have received substantial interest over the years, much less is known about how users *actually* interact with platforms, or how they navigate, chart, roam, deploy and *become with* data practices more broadly in real time. Whilst this argument definitely applies to digital education platforms, it equally holds true in the realm of data practices more generally, as the research field about *how* actual users effectively interact –and intersubjectively become– with interfacial features of these practices, remains quite inchoate (Decuypere & Landri, 2020; Fedorova, 2020; Hartong, 2020). In that sense, topologies of interfacing can (should) be scrutinized in close connection with *user topologies*, and more notably with dedicated attention to how they both unfold and

enfold in each other. Given the expansive size and scope of data infrastructures and given the fact that their boundaries are not easily delineated, this necessarily implies not confining the notion of 'user' to a limited scope of traditional educational actors (such as the teacher or the pupil), and how these actors are implicated in the topological becoming of the data practice itself. Rather, for an investigation of platforms to be comprehensive, analyzing user comportment equally needs to incorporate the corporate (e.g., support staff) and the technical (e.g. IT personnel) actors who equally are embedded within, and making use of the platform. Next hereto, it equally needs to incorporate other actors who make use of the platform (e.g. parents, government officials, international organizations). In other words, analyzing user topologies requires extending the analytical scope of the inquiry to include sometimes surprising or unexpected actors that are presently equally (becoming) included in the sites and temporal constellations of educational data practices (Gulson & Sellar, 2019).

When analyzing how users come into being *with* platforms, and hence when aiming to see assemblages of interfaces and users in action, several methods can be deployed. For instance, and depending on the specific study at hand, such analysis can require a straightforward ad-hoc interviewing of users, but very often requires some sort of additional, more profound engagement (see Seaver, 2017 for the full scope of this argument). As is well known, such engagement is regularly achieved by means of ethnographic methods, which can be adapted to fit the elusive and heterogeneous nature of educational data infrastructures (Alirezabeigi, Masschelein, & Decuypere, 2020). Crucially, the analytical gaze is in this respect not so much on immersion –as is customary in more traditional ethnographic studies. Conducting ethnographies *in* and *of* data practices is, in that sense, more a *defamiliarizing* than an (exclusively) *immersive* undertaking, and as such diverges from canonical ethnographic imaginaries (Roy, 2012; Seaver, 2017). Indeed, inquiring about the effects of platforms by observing how data practices unfold by and through actual user engagement, as well as the vast reach that these platforms have on users over and beyond those of traditional educational sites of the classroom, necessitates a mobile, mutating and ever-changing presence of the researcher as much as it requires care and attention for how a platform's liveness is always a momentary, fragile, and circulatory achievement that can easily break down (Alirezabeigi et al., 2020; Prince, 2017; Roy, 2012; Seaver, 2017). Analyzing the user topologies of data practices thus implies a general interest in very contingent, specific and delineated forms of education, and more particularly implies to analyze how users are *moving* in/on/around the interface, how they are *affectively touched* by these interfaces (or not); which types (e.g. complying, or precisely recalcitrant) of individual and/or collective *behavior*, *habits* and *rituals* stabilize or crystallize within the actual usage of interfacial regimes (and which not); how users seek to manage and travel around the *boundaries* imposed on them by the interface (or not); and the sorts of *times* and *spaces* that are generated in doing so (e.g. Selwyn & Pangrazio, 2018; Thompson & Sellar, 2018; van de Oudeweetering & Decuypere, 2019).

3.3 Design (behind)

Data practices should not only be investigated by scrutinizing interface and user topologies. Another distinctive methodological entry point is the *design* topology. This topology points to the myriad operations that take place when designing a data practice, and that are hence largely hidden when taking (only) interface and user topologies into account. For instance, digital education platforms are not only carefully crafted and necessitate a tremendous amount of work before the final interface is apparent to the user, they are equally in need of permanent maintenance and care (van de Oudeweetering & Decuypere, 2020). Here as well, it is important to take into account the distributed and distributing nature of data practices: inquiring about this topology (again) implies a mobile and multi-sited researcher who follows different practices of design. For instance, inquiring about the design topology of any given platform might involve following designers to edtech conferences, interviewing technical actors who do platform maintenance and/or curation in the company, teleconferencing other cooperators who are potentially working in an affiliated branch of the company in another continent, etc. In that sense, scrutinizing design topologies first and foremost entails inquiring about the relational constellations that are generated *behind* the platform's actual interface (Gulson & Sellar, 2019; van de Oudeweetering & Decuypere, 2019). It is, more particularly, a methodical attempt to question how different actors are figured together *in order for* interface and user topologies to be able to manifest and become operational (Suchman, 2012).

As with the other topologies, there is a variety of methods to disentangle the 'behind' of digital education platforms, and the precise method(s) to deploy again depends on the overall nature, purpose, and analytical focus of the inquiry. For instance, if one is interested in how processes of datafication stabilize, materialize and take shape as (often heavily aestheticized) data points, of interest become methodological tools that allow to trace and show the contextual contingencies, necessities and messiness that is implicated in the fabrication of data practices (i.e., the making of their liveness –Ratner & Ruppert, 2019). More often than not, this will imply a thoughtful combination of methods, such as internet searches, interviews, audiovisual media, etc. Such combining attests to the topological interest in the multi-sitedness of both the researcher *and* data practices themselves (Hartong, 2020; Lewis, 2020; van de Oudeweetering & Decuypere, 2019).

However, scrutinizing design topologies does not need to be limited to the concrete socio-technical performances of constructing, cleaning and aestheticizing data points (and concomitant processes of data mining and automation). Analytical attention can equally be directed to the *values*, *imaginaries*, *didacticalideas*, and *learning theories* that design actors (human and non-human the like) uphold and seek to inscribe into the interface itself. Such ideas and processes are held both ex- and implicitly, but always necessarily reflect and enact some sort of assumed idea about what education should (not) be (Decuypere et al., 2021). Crucial in this respect is that the adopted methods manage one to see how practices of design encourage and inscribe technologies to create specific sorts of educational actors (e.g. specific sorts of pupils who are easier to interpret computationally), specific sorts of desired futures, and specific sorts of ideas about how an educated society can be realized

and what it should look like precisely –irrespective of whether or not these ideas are actually ending up in the eventual interface topology (Decuypere et al., 2021; Fedorova, 2020).

3.4 Ecology (beyond)

Even though data practices crystallize as practices, they are not to be conceived in an isolated manner. Instead, all data practices are always ecologically situated in a broader environment that is not exterior to the data practice itself. In the case of platforms, for instance, this implies approaching a platform not as a technical 'silo' that is operating entirely self-contained, but rather as embedded within a broader (topological *and* topographical) relational field that is co-shaping and co-forming the platform itself. It is in that sense that I propose the term ecology rather than context, for the notion of context often tends to be viewed in essentializing terms, as a thing 'out there', hanging or circling around a specific data practice (Piattoeva & Saari, 2020). Conversely, the notion *ecology* aims to stress the profound relational nature of data practices: even when sometimes crystallizing into a dedicated form or shape, digital platforms are situated within broader relational environments that are productive of the specific sorts of platform constellations that can or are allowed to emerge –as, for instance, some cases of national platform censorship forcefully show (Bratton, 2015; Hörl, 2017). However, despite their topographical embeddedness, platforms are notorious for invoking topological spaces and times, in which topographical state-borders are supplanted with topological boundaries that transcend the territorial importance of the state. Indeed, platforms operate by grace of rapid growth models, and such models regularly bypass the traditional legislative confines of nation states (e.g. Williamson, 2020). Yet, adopting a platform in one country is arguably not the same as adopting it in another, and the way in which (as well as the extent to which) such a platform becomes part and parcel of an educational data practice (or not) always comes with considerable local contingencies, specificities and particularities (cf. Hartong & Piattoeva, 2019). Similarly, each platform –however 'global' or however 'local' it is assumed to operate– has been composed within an intricate network of other actors that significantly shape the composition and eventual operationality of the platform (see Decuypere & Landri, 2020, for a very detailed example). At the same time, however, data practices are equally *generative of* specific ecologies. That is to say, platforms inevitably *add* reality to the world, instead of merely abstracting, digitizing or technicizing it: they add data points; they datafy; and they are increasingly operating as the very infrastructures on which educational practices run and operate (Hartong & Piattoeva, 2019 –equally Sellar, 2015).

Methodologically, all this implies that researchers who are investigating data practices should refrain from making sharp a priori demarcations regarding what would be part of a data practice and what not. Indeed, the ecological topology is precisely invoked here to make clear that the form of data practices is ever-changing and hard to pinpoint and/or delineate (cf. Figure 1). Platforms, for instance, almost always extend into other platforms, as one of their determining features is their capacity to stretch 'beyond' their own boundaries (Bratton, 2015). The ecological topology thus operates as a touchstone for researchers to always keep firmly in mind that the elusive nature of data practices signifies that fix-

ing, stabilizing or neatly delimiting a platform as 'that which happens on the screen' is a methodical mistake, in the sense that this seeks to fix what resists fixing, to stabilize what is in continuous movement, and to delimit something that has no clear-cut shape. In that sense, the methodical approach advocated for here asks for *compound* methods: that is, for combinatory methods that aim to show in variegated ways how these different topologies un/enfold, deform, and shape various data practices (Lury et al., 2018).

4 CONCLUSION

In this article, I aimed to outline the contours of a toolbox to research educational data practices. The Interface-Usage-Design-Ecology (IUDE) toolbox is informed by a topological methodology that allows to understand and scrutinize of data practices starting from their relational features. In that sense, the offered toolbox resists a straightforward application and should not be conceived in a prescriptive manner. Rather, it is the intention that the IUDE-toolbox functions as a *sensitizing device*; that is, as a collection of methods that allows to become attentive to the relational and topological features of data practices (Decuypere, 2019c). As such, the topological methodology allows to put the methods presented in the toolbox to work: its intention is more to enable or facilitate *that* topologies of data practices are being investigated than presenting one uniform way of doing so. In that sense, the toolbox can be adapted, modified and tweaked if-and-as-needed. In addition hereto, the article focused on the role of digital education platforms as a worked example, but the methodology and methods proposed here are intended to work for any kind of data practice (as outlined in the beginning of this paper).

In concluding, some last words about what this methodology and its associated methods show. Throughout the article, the critical position of the topological methodology has been framed in terms of the impossibility of exteriority –we cannot stand outside data practices– and an immanent form of critique –aimed at positively modifying the ecology of practices that our research is situated in (Piattoeva & Saari, 2020; Sellar, 2015). Data practices are changing educational spaces and times profoundly, and researching the topologies of data practices is an apt way to analyze and show how these practices bring particular spaces, times, norms, and values into being. That is to say, this allows the identification of what data practices *do* and, through this, to clarify and explain how some (elements of) data practices are worthy of our critiques (cf. Bratton, 2015, p. 46). Stated otherwise, the topological lens allows us to construe methods that are made specific and relevant to the elusive and heterogeneous nature of data practices, and has the capacity to introduce *answerability* into data practices as practices that are in need of scrutiny, interruption, potential modification, and, more broadly, care (Lury & Wakeford, 2012 , p. 2-3).

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