

# Understanding and Using Big Data for Educational Management

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# Chapter 12
# Understanding and Using Big Data for Educational Management


**Lars Nellemann Peter Nordestgaard and Lone Dirckinck-Holmfeld**

**Abstract** This chapter explores how elements of Big Data can be used to develop pedagogical and didactical management and to establish practices for creating shared understanding and meaning in educational organizations through constructive use of such data. The chapter builds on three sources: Heidegger's ontology of data as created and interpreted by humans; Wenger's conception of how humans participate and create meaning and identity through communities of practice; and Nonaka's idea of dialogue and openness in a free and constructive form of Ba. Based on a data report developed by the authors, the study describes a workshop for a university educational management group informed by the principles of Ba. As well as highlighting some of the challenges of using Big Data, the analysis documents how this approach can illuminate the "black box" of pedagogical management within a systematic and dialogical workshop setting. In line with the Heideggerian perspective, the data signi ed learning platform actions to be discussed, interpreted, and assigned meaning in a collaborative process with teachers and stewards of IT pedagogy. The chapter sets out guiding principles for the use of Big Data for pedagogical development and management through systematic dialogue within this boundary-crossing setup.

**Keywords** Big Data · Phenomenology · Educational management · Communities of practice · Ba

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## 12.1 Introduction

The development and use of technologies has enabled humans to shape the world in which we live. Some of those technologies have been so revolutionary as to de ne an era, as in the Bronze Age or Industrial Society. Today, we live in the Information Society, in which information flows across borders as one consequence of globalization and internationalization. Now, the fourth revolution is emerging by the increasing use of algorithms, arti cial intelligence, and large data centers that support self-driving cars and personalized search results based on individual pro ling. Although such technologies are so advanced that few of us understand how they work, we allow them to perform advanced functions such as image-based diagnosis. In this changing landscape, it seems important to reflect critically on the implications of these technologies for social relations and for our understanding of knowledge and learning. While the continuing evolution and development of technologies have potential ben- e ts for all, technologies can also fail and must therefore be employed with a critical eye.

This chapter explores how simple reports of Big Data can be used to develop educational and didactic practices, based on the master thesis *Anvendelse af data om praksis i praksis* [*Use of data about practice in practice*] (Nordestgaard & Nellemann, 2019), completed for the Danish Master Program in ICT & Learning (MIL). The thesis was inspired by the following quote from the strategy statement *Imprint on the World 2018–2020* (VIA, 2018): We must rethink administrative and educational methods, processes, roles and tasks in order to create the most meaning and value. We can do this through strategic use of data and new digital technologies (p. 12).

The project considered how VIA's pedagogical managers and leaders might respond to the task described, as managers must play a central role in ensuring that data-driven technologies properly support the desired development of practice.

## 12.2 Research Problem

The chapter investigates, how Big Data from a learning platform can be used to create knowledge and a context for critically constructive development of didactic and educational practices at a professional college. This raises a number of research questions:

What are the characteristics of Big Data in this context?
How to understand and use learning platform data for the different stakeholders involved?
How can learning platform data become meaningful within a community of practice of leaders responsible for managing and developing educational and didactic practice?

### *12 2 1 Significance of the Problem*

As system data become increasingly easy to collect, process, and present, Big Data are everywhere. In organizations of every kind, including educational settings, management decisions and development work are increasingly data-driven. In this environment, pedagogical professionals as well as learning analytics professionals and researchers from other backgrounds must contribute to the exploration and application of these new technologies, making sure to share perspectives from various practices.

## 12.3 Related Literature

A systematic search of the existing literature (Nordestgaard & Nellemann, 2019, pp. 14–19) identi ed few studies of data-driven management development of didactics and pedagogy in higher education. A number of these articles investigated how data from distance learning systems such as MOOC, flipped learning, or video-based learning (VBL) can be used to improve teaching practices. For example, Lau et al. (2018) analyzed VBL for medical students using learning analytics rather than direct feedback from the students. In another strand of the literature, academic analytics explores the more administrative use of data, including prediction of student performance and identi cation of key performance indicators (KPI). For example, Varouchas, Sicilia, and Sánchez-Alonso's (2018) qualitative study of administrators and teachers looked at KPI in administrative contexts and identi ed features of relevance for subsequent research. Finally, a third area of research explores how teachers can improve teaching practices at the level of the individual student through the use of virtual learning environments (VLE), e-learning, and general quantitative data. Limniou, Downes, and Maskell (2015) combined a web survey with VLE datasets to investigate students' views regarding technology-enhanced educational resources. Regarding the use of Big Data for developing pedagogical and didactics management and leadership, we found a few international studies related to elementary school level abroad, but there were no Danish studies. The studies in question were from Canada and England and were based on a goal-directed curriculum. For example, in a study of school leadership in parts of Canada and England, Earl and Fullan (2003) looked at the tensions that arise from the internal use of data by school management and externally in society as a whole, highlighting the data literacy required to make sense of such data. In relation to Big Data, the present approach is informed in particular by Fonseca and Marcinkowski's (2014) account of Heidegger's perspective on data and "being-in-the world" and the "being-horizon" as a framework for a critical and constructive approach to Big Data.

## 12.4 Theoretical Approaches

In the present context, the primary theoretical inspirations are phenomenology (Heidegger 1884–1976), social learning theory (Wenger, 1998), and the dynamics of knowledge creation (Nonaka, Toyama, & Byosière, 2001). Despite differences of background and history, these are complementary and together provide a theoretical basis for understanding the individual, communities of practice, and the nature of knowledge sharing and creation.

### *12 4 1 Heidegger*

Heidegger's framework questions the traditional positivist ontology and epistemology that breaks the world down into measurable parts. As opposed to the Cartesian view, Heidegger holds that the world does not exist independently of us.

> We are thrown-in-the-world, and we act in the world with everything that in the present constitutes us as human beings. To understand the world, we must rst understand ourselves—our being. It is in this being that the notion that something can be made into an object is created—that is, the object cannot exist outside our being. This means that a phenomenon is understood only through one's interpretation (existential-hermeneutic) of what enables the phenomenon to appear as a phenomenon. (Pio, 2012, p. 95)

According to Heidegger's phenomenology, human beings are thrown into the world and encounter that world pre-reflexively and non-discursively, with the baggage of everyday practices that "connect us to the world in ways that are not necessarily intentional" (Pio, 2012, p. 18). Heidegger calls this "being-in-the-world" or our "being-horizon." It follows that our actions as human beings are always informed by our own experiences; in other words, our understanding conditions our actions.

#### 12.4.1.1 Ontic Understanding

At the time of *Sein und Zeit* (Heidegger, 2014), Heidegger's understanding was that everything in the world can be measured and weighed, and that today we understand everything that is as existing technically—that is, as available resources that can be combined and manipulated to solve this or that problem (Schiølin & Riis, 2013, p. 16). In his 1953 lecture entitled "The Question of Technology," Heidegger issued a warning about this optimistic view of technology, noting among other things that today, man never really meets himself again—that is, his being (Schiølin & Riis, 2013, p. 134). We have gured out the world in, with, and through technique; we think we see the truth about the world, but we forget to ask about the nature of technique. We are transforming the world itself based on our own formula for it (Schiølin & Riis, 2013, p. 133). According to Heidegger, the problem is that in

shaping the world under the conditions of technology, where everything is seen in terms of available resources, this formula can never be objective.

To counter this worldview of technological hegemony, Heidegger developed the concept of the "ontic" to refer to the factual or pure facts about the world. For example, a person may be born male or female; they may be old or young and may live in Aarhus or Copenhagen. All of these are ontic facts. In the traditional ontological understanding of the world, a hammer can be described as a piece of wood with a metal head and so appears as an object to the subject. Heidegger called this "the present-at-hand," which he said belongs to an ontic understanding (Fonseca & Marcinkowski, 2014). In this way, Heidegger transposed the traditional (positivist) ontology to the concept of the "ontic," enabling him to rede ne the concept of ontology. In Heidegger's ontological understanding, we see an object with our being horizon as linked and relational. The hammer is nothing in itself; only the encounter with man and the opportunities the hammer provides constitute an ontological step forward for man—for example, by being able to hammer. A pre-understanding always inheres in description because, as human beings, we act in the world with our being horizon. In this sense, we are created by our lives; our way of encountering the hammer with an understanding of being able to hammer is what Heidegger calls "ready-at-hand." "Ready-at-hand" is Heidegger's understanding of ontology (Fonseca & Marcinkowski, 2014), and the term "Dasein" captures the sum of the individual's interactions with the world throughout his life. In the English translation, Dasein becomes "being"—how we exist in our lives. All value and meaning appear to man through a fundamental anchoring in lived background practices (Pio, 2012, p. 24).

#### 12.4.1.2 The Man

Heidegger's concept of "Das Man" is the norm that binds us to other people. These embedded practices refer to what "we usually do," where "we" are the community and what "we do" refers to the norms that characterize the community. In relation to school practices, this means that the manager and teachers are constituted as both subject and object of a complex cultural practice called "school" (Pio, 2012, p. 32), and it is in this practice that actions (of managers and teachers) become meaningful—because they are part of a shared culture or practice and nd meaning together.

In relation to Big Data, we can use Heidegger's approach to question the positivist paradigm, which sees Big Data as more objective than qualitative data because they can be seen, measured, and documented. Following Heidegger, Big Data are signs for action that must be understood and interpreted in relation to the lived practices they belong to. As objects, however, they are "unready-to-hand" and so become "present-at-hand," questioning our lived practices in a kind of "breaking down" to reflect on action.

### *12 4 2 Wenger*

When looking at data and their use in developing pedagogical and didactic practices at VIA, we cannot expect this development to happen by itself simply because there are "data on the table." Rather, data must be used in a way that makes sense for the users. Wenger's theory of communities of practice transcends Heidegger's focus on the individual in considering how the meaningful use of data can be created, what signi cance data can have in a community of practice, and how this information can be used in practice. Wenger's theory elaborates how human beings enter into communities of a practice in which learning takes place; he characterized this as a social theory of learning (Wenger, 1998).

To understand the concept of community of practice, it is helpful to consider its two component terms: *practice* and *community*. Regarding practice, Wenger writes:

> The concept of practice connotes doing, but not just doing in and of itself. It is doing in a historical and social context that gives structure and meaning to what we do. In this sense, practice is always social practice. Such a concept of practice includes both the explicit and the tacit. (Wenger, 1998, p. 47)

Wenger de nes communities as"A way of talking about the social con gurations in which our enterprises are de ned as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5).

Wenger is not preoccupied with our being-in-the-world as individuals in the same way as Heidegger; perhaps for that reason, Wenger characterizes insight as "the forgotten familiarity"—in other words, it has always been there but only becomes apparent when it comes before us. Our most useful insights emerge from seeing the obvious in our practice.

In its most basic form, Wenger's theory of social learning comprises four components; in addition to practice and community, the theory encompasses *meaning* and *identity*. For Wenger (1998), meaning is the sum of the lived life and the surrounding context, such that "negotiated meaning is at once both historical and dynamic, contextual and unique" (p. 54). And identity is "a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities" (p. 5).

### *12 4 3 Nonaka*

Both Heidegger and Wenger hold that the actions of people in everyday life are to a greater or lesser extent pre-reflective and non-discursive. Nonaka's theory of tacit and explicit knowledge posits that knowledge sharing and knowledge creation depends on nding words and concepts to capture unexplained data as information. According to Nonaka, knowledge is anchored in the beliefs and commitment of its holder and is created by information as a flow of messages (Nonaka et al., 2001, p. 492). Nonaka et al. (2001) view the dynamics of knowledge as a consequence

of our social interactions and therefore also of the social context: "Knowledge is context-speci c and relational. It depends on the situation. Knowledge is dynamic, for it is dynamically created in social interactions between individuals both within and across organizations" (p. 493).

Highlighting the challenge that knowledge is not always known, Nonaka et al. (2001) distinguishe between two types of knowledge: tacit and explicit. Existing in various visible and concrete forms such as documents and procedures, explicit knowledge is accessible to everyone. In contrast, tacit knowledge is embedded in the individual's commitment to a speci c context and in personal skills that may be dif cult to disseminate to others: "Tacit knowledge … is highly personal and hard to formalize" (p. 494).

#### 12.4.3.1 The SECI Model and Ba

In Nonaka's (2007) SECI model (Socialization, Externalization, Combination, Internalization), knowledge is transformed through four kinds of sharing and creation.

1. *From tacit knowledge to tacit knowledge*—for example, socializing or training a social worker. This approach does not support knowledge sharing in larger organizations.
2. *From explicit knowledge to explicit knowledge*—for example, assembling knowledge in a report. In this case, knowledge is reproduced, but no new knowledge is created.
3. *From tacit knowledge to explicit knowledge*—translating tacit knowledge into explicit knowledge that others can use.
4. *From explicit knowledge to tacit knowledge*—internalizing explicit knowledge as practice.

In this spiral process, knowledge is created at each pass. Tacit knowledge is made explicit and disseminated before again becoming tacit knowledge. The starting point is individual knowledge, which is disseminated to a group and then becomes tacit organizational knowledge. In converting tacit to explicit knowledge, the primary task is to move the holder of that knowledge into a "space" that allows it to be opened. Nonaka uses the term "Ba" to characterize that space, which may be physical, virtual, or mental. According to Nonaka and Konno (1998), "To participate in a Ba means to get involved and transcend one's own limited perspective or boundary" (p. 41). In Ba, one must understand oneself as part of a larger entity, escaping the limitations of existing understanding in order to act: "self-transcendence is fundamental to sharing individual tacit knowledge" (Nonaka & Konno, 1998, p. 42).

## 12.5 Data and Big Data

Having discussed the different forms of knowledge and their requisite conditions, we turn now to a deeper discussion of data, and especially of Big Data, as the basis for a critical discussion of the theoretical inspirations outlined above. According to Heidegger, Wenger and Nonaka, the relation between data, information, and knowledge is relational and is anchored in the holder's beliefs and commitments (Nonaka et al., 2001, p. 492). As the smallest building block of information and knowledge, data are attached to the values and attitudes of the holder. In contrast, the positivist account views data as abstract. For present purposes, we understand data as structured information that can be processed by a computer; in a learning platform, for example, the actions of users are recorded as "data tracks"—a collection of data that can be counted and measured and that behave in a uniform and structured way (Data, 2019). As these data are quantitative abstractions, isolated from the holder's original beliefs and values, we must respect quantitative criteria when analyzing and using data by establishing a material whose sub-elements can be counted and which can be processed, precisely quantitatively, by various kinds of calculations, typically of a statistical nature (Justesen & Mik-Meyer, 2010, p. 16).

However, quantitative data cannot capture a mood or a feeling, the intensity of a class debate, an idea arising during a coffee break or a telephone conversation. These are qualitative data, referring to phenomena that cannot be measured or counted (Data, 2019). Instead, they must be processed with due regard to the context in which they originate, using qualitative methods. According to Justesen and Mik-Meyer (2010), qualitative studies use methods that are well-suited to describe phenomena in their context and, on this basis, provide an interpretation that provides an increased understanding of the phenomenon (p. 17).

### *12 5 1 Big Data*

When discussing Big Data, it is important to distinguish between quantitative and qualitative data, and to ensure that data-driven approaches do not unreflectively prioritize quantitative data. Although there is no clear de nition of the term, Big Data can be said to refer in general to "enormous amounts of unstructured data produced by high-performance applications falling into a wide and heterogeneous family of application scenarios" (Fonseca & Marcinkowski, 2014, p. 130).

According to Fonseca & Marcinkowski (2014), Big Data can be understood in terms of three characteristics (the three Vs):

- volume (the amount of data);
- variety (whether the data are structured or unstructured and the mix of different data types (text, video, audio, etc.); and
- velocity (the direction and dynamics of data collected from many sources—sensors, questionnaires, data tracks, social media, etc.).

It follows that the term *Big Data* relates not only to the amount of data collected but to the potential for data processing. According to Fonseca and Marcinkowski (2014), "Big Data is less about data that is big than it is about a capacity to search, aggregate and cross-reference large data sets" (p. 130). On that basis, VIA learning platform data might be characterized as Big Data. However, although these data meet the criteria of volume (20,000 users) and variety of data tracks ( les, links, images, surveys, learning paths, videos etc.), Big Data also requires the capacity to deal with data velocity. As VIA lacks the capacity, resources, and competences to search, aggregate, cross-reference, and analyze all of the data from the learning platform and other systems, we con ned our attention to a single element: the large *volume* of data from the Itslearning platform, based on patterns identi ed by simple tools—in this case, tables in the Power BI program.

For clarity, we adopt Greller and Drachsler's (2012) distinction between *data clients* (who read and analyze data) and *data subjects* (who produce and deliver data). In the Itslearning platform, data are created when an action is performed (as represented by clicks). These data tracks are aggregated into tables that can be accessed from a data warehouse. From a critical perspective, these data track settings are designed by a programmer or data designer, whose choices have a signi cant impact on what the data subject can create. Data clients who use the learning platform are likely to have no influence or insight regarding the design of the algorithms for data collection; while there may be good and justi able reasons for the particular method of collection, these decisions are likely to be hidden or at least remain invisible to the data client. For example, data clients must consider whether the collected data are reliable and/or valid. Reliability depends on collecting the data in a way that can in principle be repeated over and over again; this is a quantitative criterion. In contrast, the issue of validity relates to whether the data are relevant to the phenomenon in question, which is typically a qualitative matter (Justesen & Mik-Meyer, 2010; Klausen, 2018). In the case of Big Data, validity is typically judged by the data clients without the involvement of data subjects or the use of methods to situate the data in their actual practice and actions.

From Heidegger's ontic perspective, quantitative data are seen as concrete traces within a positivist worldview. Conversely, qualitative data belong to Heidegger's ontological understanding of our being-in-the-world. Regarding the phenomenological de nition of data, it is important to emphasize that the issues of who de nes the criteria for Big Data and how methods and procedures are implemented should be of immediate concern to the pedagogical and didactical community, as these determine the criteria for valid action, and ultimately for what the organization values as knowledge.

## 12.6 Research Design

In pursuing a deeper understanding of the *volume* element of Big Data, the original project (Nordestgaard & Nellemann, 2019) combined phenomenological and pragmatic approaches to illuminate users' understandings of Big Data and data-driven pedagogical management. Based on the principles of Ba, we conducted workshops with two groups of stakeholders: the manager and leaders of pedagogy and didactics from VIA (the case organization), and stewards of IT pedagogy from different university colleges in Denmark. To gain an insight into user's meaning making, we primarily used the Future Workshops method (Jungk & Müllert, 1984). Additionally, the workshop with VIA leaders and managers was supported by a data report developed by the authors (Nordestgaard & Nellemann, 2019), based on data from the Itslearning platform. As a component of all VIA programs, this platform has more than 20,000 users. The following account refers primarily to the workshop with VIA managers and leaders, focusing on how they received the data report. Before turning to an analysis of the workshop, we will outline the design of the data report.

### *12 6 1 The Road to Data*

The design of the data report was subject to certain constraints from the outset. To comply with the ethical guidelines for Danish institutions, the use of data could not relate directly to individual employees or students of VIA. As the data report was designed by MIL students as IT professionals at VIA without consulting teachers or students, they acted as data subjects and chose which data to use.

The Itslearning platform affords access to data at various levels. Teachers and students can access data related to activities in the "rooms" where teachers and students meet. Typically, these data show whether students have opened documents or submitted assignments and record logins. Special user rights (which teachers and students do not have) allow access to "Advanced Reporting," which displays such data as logins over time, number of elements in rooms by type of element, and user statistics. Other special administrator privileges allow access to the provider's data warehouse, which is a collection of data linked to the customer—in this case, VIA. Data analytics enable users to create relationships between tables and to specify the graphical presentation. To retrieve data from the warehouse, we used Microsoft's Power BI Desktop platform, which employs the O-data protocol standard, with a user interface similar to a heavily inflated version of Excel or Access.

#### 12.6.1.1 The Data Warehouse

To ensure thorough identi cation of valid and credible data, we began by visiting <https://developer.itslearning.com/Data_Warehouse_API.html> where the Data Warehouse solution was described by the vendor. As part of our investigation, we wanted to compare identical processes at the different educational sites room by room, as it seemed interesting to look at how each addressed the same curriculum and learning objectives in terms of resource use and activities on the learning platform.

The database includes a table called "Course," which shows all the "rooms" ("Rum" in Danish) in VIA's platform. As shown in Fig. 12.1, "course" contains the following data of relevance to our project.

1. CourseID is a unique key used to accurately identify a space.
2. CourseTitle is the title of the space assigned by VIA.
3. CourseCode refers to the space provided by VIA student administration.
4. CourseOrganizationID is the unique key associated with a VIA entity (such as an educational program), linking a space to an organizational unit.

Based on this information, we can establish a relationship with the organization summary table, allowing us to lter the view by organizational unit as shown in Fig. 12.2.

| CourseId | CourseTitle | CourseCode | CourseStatus | CreatedOn | DeletedOn | ExternalCourseId | CourseOrganizationId |
|---|---|---|---|---|---|---|---|
| 6118 | [redacted] | [redacted] | Active | 01-11-2018 00:00:00 | 31-12-9999 00:00:00 | aktivitet_62349_course | 2747 |
| 6865 | [redacted] | [redacted] | Active | 23-11-2018 00:00:00 | 31-12-9999 00:00:00 | aktivitet_64939_course | 232 |
| 7089 | [redacted] | [redacted] | Active | 03-12-2018 00:00:00 | 31-12-9999 00:00:00 | aktivitet_65184_course | 200 |
| 7223 | [redacted] | [redacted] | Active | 11-12-2018 00:00:00 | 31-12-9999 00:00:00 | aktivitet_65267_course | 2721 |

**Fig. 12.1** Course

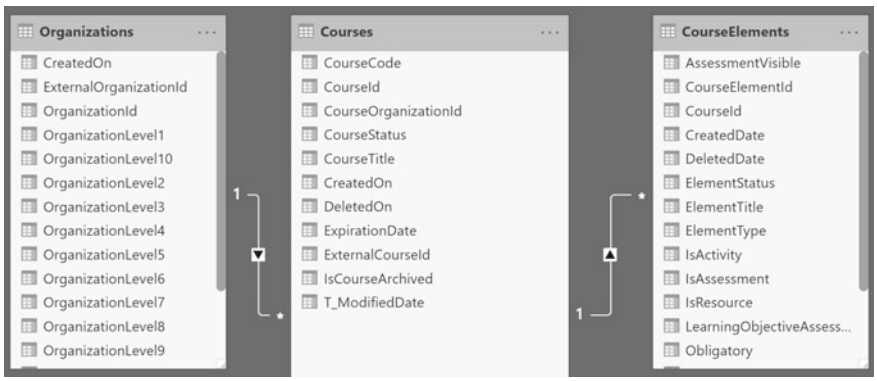


**Fig. 12.2** Organizational unit

| CourseCode | Assignment tool | File | Folder | Link | ResourcePowerPoint | ResourceWord | Task | Test tool | Total |
|---|---|---|---|---|---|---|---|---|---|
| [redacted] | 1 | 150 | 13 | 12 | | 1 | 5 | 1 | 183 |
| [redacted] | 2 | 131 | 19 | 1 | | 3 | 2 | | 158 |
| [redacted] | 1 | 95 | 11 | 7 | 1 | | 1 | | 116 |
| [redacted] | 4 | 27 | 4 | 12 | | | 2 | | 49 |
| **Total** | **8** | **403** | **47** | **32** | **1** | **4** | **10** | **1** | **506** |

**Fig. 12.3** Course elements

In the same way, we can establish a relation to the table "CourseElements." With lters on organizational units corresponding to places of supply and number of items by type, we derived the table shown in Fig. 12.3.

To ensure that the data were valid, we then manually entered the four compartments and counted the elements in the compartment from which we had extracted data to ensure the consistency of the two inventories. As the results were the same, we could assume that the data were valid for this design and measured what we aimed to measure.

#### 12.6.1.2 Advanced Reporting

It was hoped to develop a novel graphical presentation of the data, but we realized this was a signi cant undertaking, which would overstretch our time-use as MIL students used on the intervention. Instead, we looked at the options in Advanced Reporting; the user interface itself was easier to work with, as the supplier's "out-of-the-box" design means that one can simply choose the relevant organizational units and spaces. However, on repeating our data warehouse exercise to nd identical courses at the different educational sites, it quickly became apparent that something was wrong. Although we marked four educational sites, only three were returned. On closer examination, it turned out that Advanced Reporting sorts by CourseTitle, which meant that two different rooms with the same title were added together as one space despite being located at different educational sites, and two compartments were shown as one. For that reason, we decided to make a report that only sorted by educational site and not at more detailed levels such as rooms, as we could not be sure that these data were valid. We also chose only to look at elements in rooms, as we could test the validity and reliability of the data by manually counting the rooms.

### *12 6 2 Workshop with Pedagogical Leaders*

To explore the detail of pedagogical managers' data practices, we invited the ve leaders of the VIA educational programs to attend a workshop, representing four sites and four teacher training programs (the same programs but at different locations). The workshop was informed by Nonaka's SECI model and ideas for Ba creation, as

well as by Wenger's ideas on communities of practice. The basic ontology for the workshop was the pre-understanding that we (as MIL students) shared the pedagogical leaders' interest in exploring Big Data in relation to their practice. The workshop was envisaged as a "free space," in which pedagogical leaders could briefly escape their strategic obligations. In terms of the SECI model, we expected the workshop to move from tacit to explicit knowledge and back from explicit to tacit based on the new data-sets, which would be important for the participants.

The workshop was divided into two equal phases to meet two objectives. In the critique and vision phase of the Future Workshop, the objective was to capture the participants' reflections and perspectives on the role of data in educational and didactic practice and the possibilities of Big Data in practice. In the second phase, we wanted to investigate how reflection on actual data from practice would trigger the managers' ability to see the limitations as well as potentials of Big Data for developing their own educational and didactic practice, and to address any points raised about applying the report in practice.

#### 12.6.2.1 Presenting the Data Report

Presentation of the data report was incremental. We began by displaying data from one educational site and then from another. Each was simply represented, introducing participants to the data that formed the basis of the overall report and developing an understanding of the data used and how they were generated for this purpose. Figure 12.4 shows the view of an educational site. We also explained how we ensured that data were reliable and valid (as described in "The road to data").

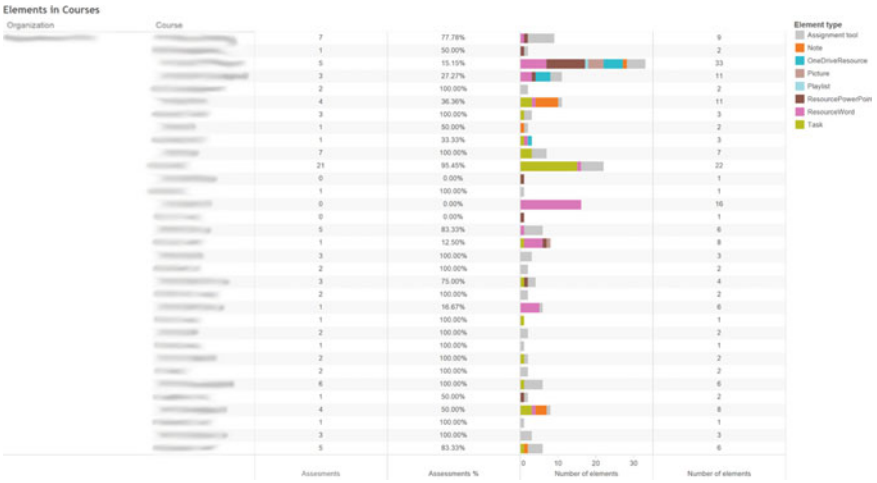


**Fig. 12.4** Educational site and course elements

Each row in Fig. 12.4 represents a course and its elements as created by the associated teacher(s) on the team.

Next, we presented two "dashboards" that included all of the educational sites offering the same training. Dashboards are harder to understand and decode, but they provide a composite view of the individual educational sites in the context of all sites. The rst dashboard shows all elements including links and les. In the second dashboard, we removed data on the links and les because these two accounted for over 90% of items; removing links and les made the use of other elements much clearer. The difference between the two views is illustrated by Figs. 12.5 and 12.6, which are sections of the same graph on the dashboard. Figure 12.5 shows that there are over 16,000 les and links at the tender sites; the 350 other types of element are barely visible.

The last page of the report was a compilation of the educational sites, showing the elements used by teachers per year (Fig. 12.7). The difference between the number of items per unit owes mainly to the differences in size of the educational sites.

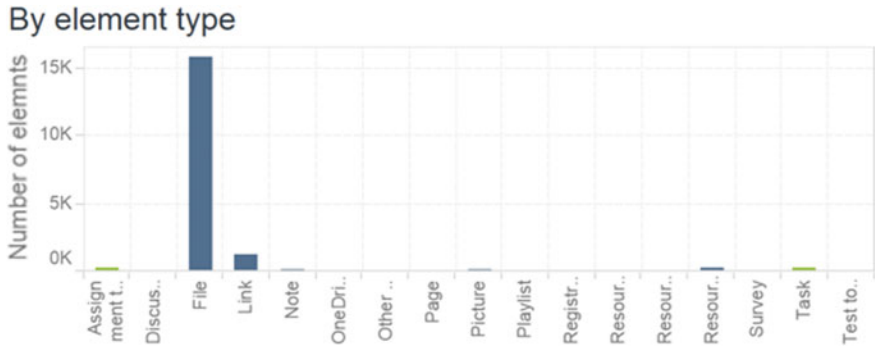


**Fig. 12.5** All elements in the dashboard

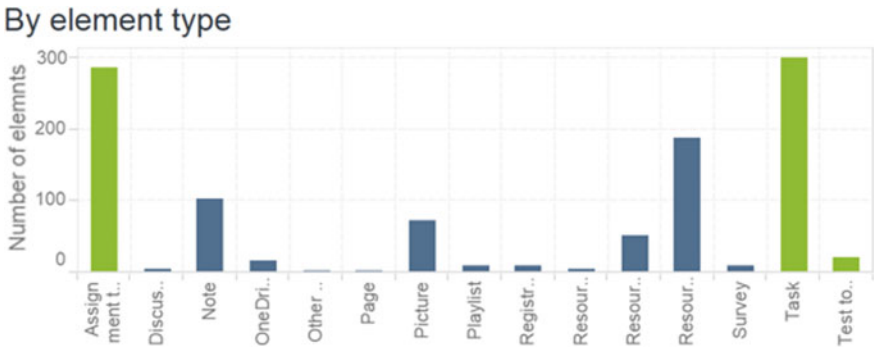


**Fig. 12.6** Other elements in the dashboard. Links and les have been removed

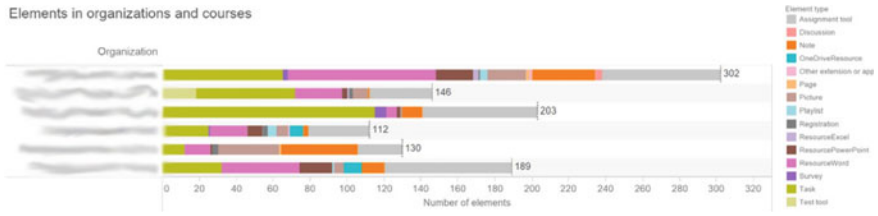


**Fig. 12.7** Compilation of the educational sites. Elements used by teachers per year

## 12.7 Analysis of Data-Driven Educational and Didactic Practice

This section addresses opportunities for development as discussed by leaders after viewing the data report. (For a full analysis, please see Nordestgaard & Nellemann, 2019). Overall, the managers received the data report with great curiosity and quickly identi ed some patterns, as in the following examples.

D3 There is a greater variation as soon as there is online education.
D2 It is also our intention that there should be that [diversity application].
D3 But it is also interesting that this is where a fairly strong development project has been running (Nordestgaard & Nellemann, 2019, p. 100).

The participants could see that the desired development effort had actually succeeded, at least in terms of educators' goal of making the learning platform's capabilities more diverse. The data report made some things clearer and helped to shift understandings of the learning platform's potential uses.

> I think it was really fun—to see it there. … When you get this [data report] on the table, you see everything that it can deliver, [beyond] what we talked about so much in the rst half—all these tools and pictures and all that Itslearning really can do—so there's something there. This makes it clear that we still have a substantial task ahead of us in relation to competence development and the use of Itslearning, although in fact we think we have got off to a good start. (Nordestgaard & Nellemann, 2019, p. 101)

Based on the data report's picture of the application and what the learning platform can do in relation to various educational and didactic functions, the manager can see what tasks remain to be addressed. Some managers noted that the data report could be used for continuous follow-up—for example, in relation to strategic development projects. As such the data report presentation con rms a direction and a goal and prompts reflection on new possibilities for skills development.

By seeing that some sites had outstanding experiences with speci c elements of the learning platform, the leaders formulated the perspective, that teachers at these sites could act as mentors or dialogue partners for other educational sites. For example, the data report might reveal that a particular element was used extensively in one site and not so much in another. This knowledge could then be used to internally work on didactical design and meaning-making across sites when using the learning

platform in their professional work. In this way, knowledge from the data report would enable managers to engage more fully in a quali ed dialogue with teachers regarding competence development. One of the managers described this as follows.

> It was the various coordinators who identi ed what this team really needed to specify in relation to the modules. So this was articulated and they were quite quick in reporting back. They chose some things that they would like to get better at (….) but it may well be that next time we need some kind of workshop where we could look at this [data report] and then say 'maybe this is where we should focus a little more.' To take the dialogue with the coordinators and say that we have selected four things to talk to them about. What do you think we should aim for? Should we bet on all four or just two, or what? So it could well be used in this way going forward. (Nordestgaard & Nellemann, 2019, p. 105)

In this reflection, we see a signi cant shift in approach to competence development planning. In the rst phase of the future workshop, the participants talked about competence development as a kind of a black box. However, with the knowledge from the data report, they began to discuss a strategic direction for competence development, in a collaboration between management and coordinators/educators. They also found it interesting that the data came from the learning platform, which is the didactic tool that is closest to practice—and it is something the educators would be interested in, it can contribute to a didactic and educational development dialogue. And that is what they [the teachers] are there for (Nordestgaard & Nellemann, 2019, p. 102).

It seems that the data report can strengthen leaders' peripheral participation in the teachers' community of practice, bringing them even closer to the core task of pedagogical management. At the same time, they realized that a manager must be aware of multiple issues before using the data report for development purposes with teachers. To ensure that the data report does not increase teachers' work pressures, a balance must be struck between management's expectations and demands and the teachers' day-to-day work. Some participants also saw that the composition of the data report might prompt resistance among the teachers if they were being compared to colleagues at other school sites, even if individuals could not be identi ed. As in the future workshop with IT staff, understanding manager's data may also devalue other arguments: (…) if data become something to hit each other in the head with … then other types of argument may lose their value (Nordestgaard & Nellemann, 2019, p. 102).

### *12 7 1 Room for Interpretation*

In the course of discussion, the leaders highlighted the need for an interpretation room: (…) we miss having an interpretation room; if something is a management room, where is our interpretation room? (Nordestgaard & Nellemann, 2019, p. 102). We understand this to refer to a space where managers can interpret both Big Data and all of the other available data—for example, from narratives told by teachers. It seems clear that the interpretation room can form part of the leaders' community

of practice, where they develop a comprehensive understanding of the teachers' community of practice.

> For me, if we are to use data more systematically in our management work, it is incredibly important that we can fully discuss the available opportunities and what we want, and then be critical and sort all that to somehow reach agreement. (Nordestgaard & Nellemann, 2019, p. 102)

One manager described their previous experience of using data in the context of educational practice as follows.

> [It] demanded a different and systematic dialogue with teachers regarding content and didactics … [it's important] not to make it too tight a management tool that just speci es exactly what we want. It requires a very systematic approach to dialogue, which must also be on a completely different basis. But I think this different and systematic dialogue … is really important when you have [qualitative and quantitative] data sets of different kinds. (Nordestgaard & Nellemann, 2019, p. 103)

Given space for interpretation within their community of practice, leaders will be better able to reinforce each other's participation in their teachers' community of practice. This is especially true where interpretation occurs at the boundary between teachers and leaders, where both communities are striving to make sense of educational and didactic practices as highlighted above. In this way, teachers can have a voice in the interpretation room, so becoming part of the interpretive space and the facilitating dialogue between teachers and leaders.

One leader referred to the potential of data-based dialogue for a deeper conversation with the teachers. It was also noted that a prerequisite for using data is a discussion with you (IT pedagogical professionals) that can deliver data we consider to be of interest based on a two-way dialogue. What are the possibilities, and what can we imagine? (Nordestgaard & Nellemann, 2019, p. 103). Clearly, the leaders recognize the need for dialogue with "those who can pull data" at the boundary crossing between our two communities of practice as IT pedagogical staff and leaders. This presupposes that IT pedagogical staff have developed critical competences in relation to the creation, presentation, analysis, and use of data, and that they are capable of establishing systematic dialogue with managers to advance mutual understanding of their respective practices.

## *12 7 2 Summing Up*

We have seen how managers understanding of data shifted during the workshop, with a corresponding shift in how they understood their role as educational leaders. As Heidegger put it in his lecture on the challenge of technology, (…) we understand what it means to be technicians in our relationship with the world and what opportunities it offers (Schiølin & Riis, 2013, p. 11). Our account of the data report highlights the many challenges in constructing and using data for management purposes, as

well as the multiple possibilities of interpretation. For managers, this means understanding the need to make fuller use of data to illuminate educational practices—in Nonaka's words, to make the "tacit toolbox" more explicit. However, one prerequisite is that both data subjects (in this case IT pedagogical staff) and data clients (leaders and managers) must be critically aware and professionally trained to understand the opportunities and pitfalls. As a nal illustration, one manager noted the need for ongoing development of data use: "This is the conversation we are having now—about having an understanding of the available numbers, which I could never have gained alone" (Nordestgaard & Nellemann, 2019, p. 104).

## 12.8 Conclusion

To conclude the theoretical discussion of knowledge and data, we return with a critical eye to Fonseca and Marcinkowski's (2014) view that Big Data in itself tells us nothing.

> Big Data is made, in effect, by our relationship to it and is not anything ontological by itself. It comes into being through analysis. The task, therefore, is to look at Big Data as a tool we use—and as nothing else. (pp. 130–131)

We challenge the position that Big Data in itself has no ontological status; on the contrary, we consider it important to state that Big Data as a tool is grounded in a positivist paradigm. As such, it may contribute to our institutions by introducing new kinds of data. However, it is equally important to note that these data are understood as quantitative and abstract. Our position has two consequences. First, the quality of Big Data (as valid data) can be improved by looking more closely at the practices of data clients (managers, teachers, and learners). Secondly, from a critical phenomenological position, Big Data may provide valuable new insights into an organization, but these data are abstractions rather than the actions themselves, and the value of such data should not be overestimated. The present ndings con rm that data are seen to strengthen the argument—but this strength is grounded in our understanding of the data rather than in the data themselves. In short, the crucial issue is our understanding of the data and the accompanying dialogue. Through dialogue between systematically collected quantitative and qualitative data as well as narratives from pedagogical practices, the interpretation room can provide new insights into the black box of professional pedagogical and didactic practice.

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