



Data literacy: What do educators learn and struggle with during a data use intervention?



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ABSTRACT

Data literacy is a prerequisite for making data-based decisions. This paper focuses on the extent to which educators develop components of data literacy during a 1-year data use intervention, as well as what they learn and struggle with concerning these data literacy components. In the data use intervention, teams of teachers, school leaders and a data expert use data to solve an educational problem at their school. We employed a mixed-methods approach, combining data from a pre- and post-test data literacy test ($N = 27$), interviews ($N = 12$), evaluations of meetings ($N = 33$), and logbooks. Findings show that educators' data literacy increased significantly. Participants and the data coach indicated that educators had learned, for example, to analyze data with Excel, and to refute misconceptions. Still, there is room for further improvement. For example, educators struggled with formulating a data use purpose that is plausible, sufficiently concrete and measurable.

1. Introduction

Every day educators make educational decisions, for example, about the instructional guidance they provide to their students. Educators often use only intuition and experience to make decisions, which can lead to making incorrect decisions, such as adjusting their instructional practice to the wrong group of students. If educators can make high quality, data-based decisions, that will improve the quality of education and learning in the classroom (Ingram, Louis, & Schroeder, 2004; Schildkamp & Lai, 2013).

One way to promote making informed decisions is by implementing data-based decision making (DBDM). In this research, DBDM is defined as making educational decisions, based on a broad range of possible types of data (Ikemoto and Marsh, 2007; Schildkamp & Lai, 2013). By data, we mean 'information that is systematically collected and organized to represent some aspect of schooling' (Schildkamp & Lai, 2013, p. 10). Examples of data that can be used are test results and structured classroom observations (Ikemoto & Marsh, 2007; Schildkamp & Poortman, 2015). DBDM can help educators to use data in a formative way, by identifying students' learning strengths and weaknesses, and, based on that, taking instructional action that is in line with what students need (Hoogland et al., 2016; Van der Kleij, Vermeulen, Schildkamp, & Eggen, 2015). For example, a decision educators may make based on data is to differentiate in the use of curricular materials by providing different materials to specific subgroups of students (Farrell & Marsh, 2016). DBDM can enhance student achievement,

because it can bridge the gap between students' current learning and students' desired learning outcomes (Lai, Wilson, McNaughton, & Hsiao, 2014; Van Geel, Keuning, Visscher, & Fox, 2016). However, educators need to have the ability to use data to make decisions.

Educators' ability to implement DBDM is referred to as 'data literacy', which we define as educators' ability to set a purpose, collect, analyze, and interpret data, and take instructional action (Hamilton et al., 2009; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a, 2016b; Van Geel et al., 2016). In the research, there is not as yet a consensus on precisely what knowledge underlies this broad and complex concept. For example, content knowledge can be essential for analyzing and interpreting data, and pedagogical content knowledge can be important for determining appropriate instructional actions in the classroom (Mandinach & Gummer, 2016a, 2016b; Van Geel, Keuning, Visscher, & Fox, 2017).

Little attention is devoted to data literacy in teacher training colleges (Bocala & Boudett, 2015; Mandinach, Friedman, & Gummer, 2015), and in-service educators' data literacy could also be improved (Schildkamp, Karbautzki, & Vanhoof, 2014). For instance, they struggle with interpreting data, and with taking instructional steps accordingly (Datnow & Hubbard, 2015; Kippers, Wolterinck, Schildkamp, Poortman, & Visscher, submitted; Marsh, 2012). Several DBDM interventions have been implemented to help educators develop data literacy, such as the Data Wise Project (Bocala & Boudett, 2015) and the Center for Data-Driven Reform in Education intervention (Carlson, Borman, & Robinson, 2011). The findings in terms of effects of data use

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interventions are, however, mixed (Marsh, 2012).

Moreover, research on the development of data literacy is scarce. Assessment literacy (i.e., the ability to use assessment data only) has often been studied instead of the broader data literacy concept (i.e. the ability to use different types of data) (Mandinach & Gummer, 2016a; Van Geel et al., 2017). The field has mainly focused on stating that data literacy is a key prerequisite for DBDM, has defined the data literacy concept, and has identified educators’ current abilities regarding data use (Hamilton et al., 2009; Kerr, Marsh, Ikemoto, Dariley, & Barney, 2006; Mandinach & Gummer, 2016a; Means, Chen, DeBarger, & Padilla, 2011).

In this study, we aimed to obtain more detailed insight into the extent to which educators develop several *data literacy components* during a data use intervention, by studying their ability to set a purpose, collect, analyze, and interpret data, and take instructional action. In this data use intervention, teams of teachers, school leaders and a data expert learned in 11–13 meetings and 1–2 workshops about data use, by trying to solve an educational problem at their secondary school with support from an external data coach. This study provides an overview of which data literacy components educators develop, or not, and what educators learn and struggle with concerning a number of data literacy components.

2. Theoretical framework

Several data literacy components can be distinguished: set a purpose, collect data, analyze data, interpret data, and take instructional action (Hamilton et al., 2009; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a, 2016b; Van Geel et al., 2016). Educators use these five data literacy components to implement DBDM. The data use intervention is developed by the University of Twente to support educators with implementing DBDM and consists of eight steps: 1. Problem definition, 2. Formulating hypotheses or questions, 3. Data collection, 4. Data quality check, 5. Data analysis, 6. Interpretation and conclusion, 7. Implementing improvement measures, and 8. Evaluation (Schildkamp & Ehren, 2013). Educators use the five data literacy components several times when following the eight steps of the data use intervention. For example, the ability to collect data is applied by educators in the problem definition (step 1 of the data use intervention), data collection (step 3 of the data use intervention), and evaluation (step 8 of the data

use intervention).

Fig. 1 presents our theory of action. It is a framework linking the components of data literacy (shown in bold text) with the data use intervention (shown in italic text). It is based on studies about data literacy and DBDM (Bocala & Boudett, 2015; Coburn & Turner, 2011; Earl & Katz, 2006; Hamilton et al., 2009; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a; 2016b Marsh, 2012; Means et al., 2011; Van Geel et al., 2016). In the following section, we describe more precisely how the data use intervention and the concept of data literacy relate to each other.

2.1. Set a purpose

The ability to set a purpose for using data is a key component within the concept of data literacy (Hamilton et al., 2009; Earl & Katz, 2006; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a, 2016b; Means et al., 2011; Van Geel et al., 2016). Educators make use of this ability in the first and second step of the data use intervention. In the first step of the data use intervention, educators learn to set a clear purpose for using data, by thinking about the reason for using data, such as gaining insight into the retention rates in the 3rd year of secondary education or the final examination results. In teams of 4–6 teachers, 1–2 school leaders and a data expert from the same school, educators collaboratively formulate a concrete and measurable *problem definition*, and include the shared goals they want to achieve. These goals are always focused on their own school context, and the team is supported by the coach. For example, ‘We are dissatisfied with the% of students failing mathematics in grade 9, because we have been coping with an average percentage of 20% failing students for the past three years. We would like to achieve no more than 15% of students failing mathematics next year and fever than 10% within two years.’ Next, in the second step of the data use intervention, educators will *formulate hypotheses* (quantitative research) or *questions* (qualitative research) regarding the underlying causes of the problem, to capture the purpose for using data more specifically. For example, related to the problem definition stated above, ‘At least 30% more students from elementary schools A, D and F fail in mathematics in the first year of upper secondary school than students from the other elementary schools.’

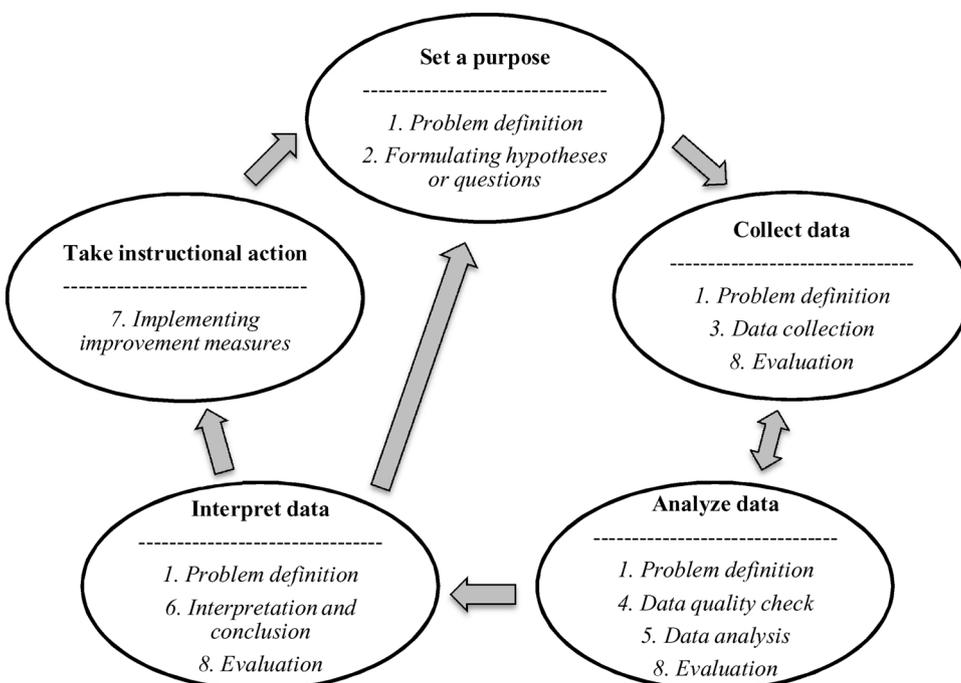


Fig. 1. Links between the concept of data literacy (bold) and the data use intervention (italics).

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