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Changes in educators' data literacy during a data-based decision making intervention

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HIGHLIGHTS

- Educator's data literacy significantly improved.
- Multivariate approach enabled identification of separate pre-post covariate effects.
- Knowledge gaps based on function and education were closed.

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ABSTRACT

Data literacy is assumed to be a precondition for the effective implementation of data-based decision making in schools. This study was aimed at investigating changes in 1182 educators' data literacy with regard to student monitoring system data, during a 2-year intervention, which was assessed by using a pretest and posttest.

A multivariate multi-level IRT analysis was conducted. The multivariate approach enabled the identification of differences in initial data literacy and development, based on educators' characteristics. Findings showed significant improvements in educators' data literacy. Furthermore, the 'knowledge gap' between educators with a master's degree versus higher education was closed, just as the gap between teachers and school leaders.

1. Introduction

Although schools are increasingly expected to use data to guide their education, many educators do not feel prepared to use data to inform their practice (Earl & Fullan, 2003; Ikemoto & Marsh, 2007), struggle with the use of data (Huguet, Marsh, & Farrell, 2014), and have shown to lack testing and measurement knowledge required for effective data use (Daniel & King, 1998; Oláh, Lawrence, & Riggan, 2010; Supovitz, 2012). Relatively little attention is dedicated to the preparation of educators in the use of data during their pre-service training (Mandinach & Gummer, 2013a; Mandinach, Gummer, & Muller, 2011; Popham, 2011). Thus, in order to develop their "human capacity to use data", professional development is essential (Mandinach & Gummer, 2013b, p. 21).

In the Netherlands, a comprehensive intervention aimed at implementing data-based decision making (DBDM) was developed and implemented in 101 primary schools. Development of participants' data literacy was stimulated throughout the intervention. This study focused on investigating changes in participants' data literacy as a result of the DBDM-intervention, and at exploring differences in initial scores and the changes in scores, based on educators' characteristics.

2. Theoretical framework

First, the DBDM-intervention will be described shortly. In the sections thereafter, the conceptual framework with regard to 'data literacy for teaching' is discussed, just as the evidence on data literacy development and its effects. An operational definition, taking the context of primary education in the Netherlands into account, is developed for the purpose of this study. The section ends with an overview of the research questions and hypotheses.

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2.1. The intervention

This study was conducted within the context of a comprehensive professional development intervention: a two-year training course for entire primary school teams, aimed at developing the knowledge and skills for data-based decision making, and implementing and sustaining DBDM in the school organization. A schematic overview of DBDM is depicted in Fig. 1 (van Geel, Keuning, Visscher, & Fox, 2016). DBDM is intended to be implemented as a systematic approach. At class, school and board levels, data are supposed to be analyzed, and these analyses form the basis for setting goals, adapting instruction, adapting the curriculum, evaluating the effectiveness of programs and practices, improving policy, and reallocating time and resources as necessary (Earl & Katz, 2006; Hamilton et al., 2009; Ikemoto & Marsh, 2007; Mandinach et al., 2011). The final step is to implement and execute the chosen strategies. Furthermore, data are also supposed to be used for monitoring and evaluating the effectiveness and outcomes of the implemented actions.

As Mandinach and Gummer (2016) describe, data literacy plays an important role in all steps of the inquiry cycle. Throughout the DBDM-intervention, participants' data literacy was stimulated. By means of workshops on tests, scores, and analyses, participants learned the value of different sources of data and how to interpret these. They furthermore learned how to use the student monitoring system (SMS) and interpret SMS output. Student performance from the SMS was compared to other sources of data, such as curriculum based tests, classroom observations, and diagnostic conversations. Subsequently, participants drew conclusions for improving education and developed (instructional) plans based on their analyses. These plans were executed in practice, and evaluated by means of new data analyses. Participants were required to analyze the performance data of their own students five times during the two intervention years by following a data analysis protocol, and they received individualized feedback on the results of their analyses and the plans they developed. Trainers also devoted time during project meetings to discuss common interpretation mistakes with the entire school team. Twice per school year, schoolwide student performance analyses and evaluations of goals and plans were discussed in a team meeting.

2.2. The data literacy concept

There is wide-spread agreement about the importance and relevance of educators being knowledgeable about testing, assessment and data, and being able to use data correctly. Mandinach and Gummer (2013b) noticed that the terms 'data literacy' and 'assessment literacy' are often used interchangeably. People often seem to think of only assessment data, when talking about data in general. However, data use does not only concern assessment results, but should involve a wide range of data (Mandinach & Gummer, 2013b).

Assessment literacy is often defined in a statistical or technical manner. In their evaluation of the effects of an instructional module to enhance school personnel's assessment literacy, Zwick et al. (2008) defined it as "understanding of the psychometric and statistical principles, needed for the correct interpretation of standardized test scores" (p.15). Interpreting test scores is a vital component of assessment literacy (Sklar & Zwick, 2009), but Popham (2011) took a broader perspective, which includes the understanding of assessment concepts and procedures that influence educational decisions. This is also reflected in the description used by Koh (2011), in which the emphasis lies more on teachers being competent at developing and using assessment and scoring rubrics, and to master evaluative skills to judge student performance.

The concept of data literacy takes a broader perspective, and comprises an array of knowledge and skills that are assumed to be important for the effective use of data in education. For example, Mandinach, Honey and Light (2006) stated that educators need to be able to transform raw data into actionable knowledge, and therefore that skills such as collecting and organizing data, analyzing and summarizing data, and synthesizing and prioritizing data are required. Mandinach (2012) expanded on this description of data literacy by considering the knowledge and skills required for the interpretation and use of data, and referred to this as 'pedagogical data literacy'. This definition includes the transformation of numbers, statistics and analysis outcomes into instructional strategies that meet the students' needs. Earl and Fullan (2003) stressed that the "process of human interpretation and creating meaning has to happen to change data into information and ultimately into workable knowledge" (p.389).

Although there is no consensus among experts, the majority of participants at a convening of experts organized by Mandinach and Gummer (2013b) regarded assessment literacy as a component of data literacy. The common conflation of data literacy and assessment literacy, and the lack of a common, operational definition led to the development of a conceptual framework on data literacy for teaching by Gummer and Mandinach (2015). They argued that data literacy is closely intertwined with other broad domains of teaching, such as disciplinary knowledge, pedagogical content knowledge, and understanding about student development. In their conceptual framework, the domain of data use for teaching is unpacked and presented as parts of the different steps in the inquiry cycle (Gummer & Mandinach, 2015; Mandinach & Gummer, 2016). At each step in this cycle, from identifying problems to using data, transforming data into information, transforming information into decisions and evaluating outcomes, teachers require specific knowledge and skills to make sense of the data they are using. This knowledge and skills together form the domain of data

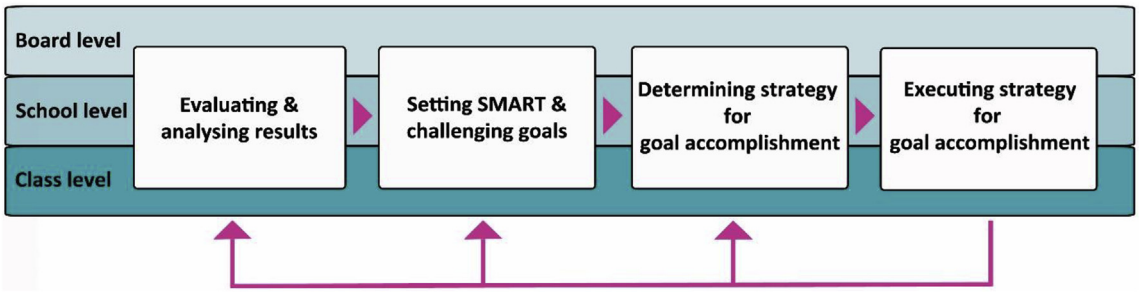

Fig. 1. Schematic overview of DBDM.