Teaching and Teacher Education 60 (2016) 377–386

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Prerequisites for data-based decision making in the classroom: Research evidence and practical illustrations

Inge Hoogland [a], Kim Schildkamp [b, *], Fabienne van der Kleij [c], Maaike Heitink [d], Wilma Kippers [b], Bernard Veldkamp [d], Anne M. Dijkstra [b]

[a] University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands
[b] University of Twente, ELAN, P.O. Box 217, 7500 AE Enschede, The Netherlands
[c] Learning Sciences Institute Australia, GPO Box 2587, Brisbane, QLD 4001, Australia
[d] University of Twente, OMD, P.O. Box 217, 7500 AE Enschede, The Netherlands

HIGHLIGHTS

- Identified various prerequisites needed for the use of data in the classroom.
- School organizational characteristics, such as clear goals, are essential for the use of data.
- Focus on teacher knowledge and skills (e.g., data literacy) to increase data use.
- Professional development in the use of data is urgently needed.
- A lack of research exists with regard to the role of students in data use.

ARTICLE INFO

Article history:
Received 26 January 2016
Received in revised form
7 July 2016
Accepted 11 July 2016
Available online 25 July 2016

Keywords:
Data-based decision making
Data literacy
Leadership
Professional development
Systematic review

ABSTRACT

Data-based decision making can lead to increased student learning. The desired effects of increased student learning can only be realized if data-based decision making is implemented successfully. Therefore, a systematic literature review was conducted to identify prerequisites of such successful implementation. Furthermore, focus group meetings were conducted with experts and practitioners to verify and illustrate the findings from the review. Several prerequisites of successful data use in the classroom that are supported by a substantial evidence base were identified, including teacher collaboration around the use of data, data literacy, and leadership.

1. Introduction

Data-based decision making (DBDM) can lead to increased student achievement when data used in the DDBM process are used formatively to improve achievement in the classroom (e.g., Carlson, Borman, & Robinson, 2011; Lai, Wilson, McNaughton, & Hsiao, 2014). By formatively, we mean, for example, that assessment data can provide feedback to teachers and students for adapting their teaching and learning, based on the gaps identified by the assessment evidence (Black & Wiliam, 1998b; Sadler, 1989). As such, DDBM can be considered a subset of formative assessment, because the focus is on using data as a form of feedback to improve both teaching and learning (for a comprehensive analysis of formative assessment approaches see Van der Kleij, Vermeulen, Schildkamp, & Eggen, 2015).

DBDM can be defined as "systematically analyzing existing data sources within the school, applying outcomes of analyses to innovate teaching, curricula, and school performance, and, implementing (e.g., genuine improvement actions) and evaluating these innovations" (Schildkamp & Kuiper, 2010, p.482). There is evidence that DBDM can lead to increased student achievement (e.g., Carlson et al., 2011; Lai et al., 2014). DBDM, also described as data use, has

* Corresponding author.
E-mail addresses: inge@hoogland.it (I. Hoogland), k.schildkamp@utwente.nl (K. Schildkamp), E.fabienne.vanderkleij@acu.edu.au (F. van der Kleij), m.c.heitink@utwente.nl (M. Heitink), w.b.kippers@utwente.nl (W. Kippers), b.p.veldkamp@utwente.nl (B. Veldkamp), a.d.dijkstra@utwente.nl (A.M. Dijkstra).

http://dx.doi.org/10.1016/j.tate.2016.07.012
0742-051X/

high priority on several countries' policy and reform agendas (Levin & Datnow, 2012), for example, as a result of the No Child Left Behind Act (Mandinach & Jackson, 2012).

DBDM can take place at the school, classroom and student level. At the school level, DBDM can be used to gain insight into the coherence of the curriculum, for example. At the classroom and student level, DBDM focuses mainly on using (assessment) data formatively for adapting teaching and learning activities in order to address student needs and thereby maximize learning. Data used for DBDM are systematically collected through such means as standardized tests, formal tests, and structured classroom observations (Van der Kleij et al., 2015). This study focuses on DBDM at the classroom level.

The formative use of assessment data at the classroom level to inform decision making in order to enhance student learning and achievement consists of several steps (Earl & Katz, 2006; Mandinach & Jackson, 2012; Marsh, Pane, & Hamilton, 2006; Schildkamp, Lai, & Earl, 2013; Van der Kleij et al., 2015). These steps are: Establishing a clear purpose for the use of data with regard to improving teaching and learning; data collection; analyzing data to identify learning progress and specific student needs in relation to the goals; interpreting the data to identify possible actions to enhance student learning; taking actions to improve student learning; evaluating the results of those actions. This may result in a new cycle of data collection, and a feedback loop is created, making DBDM a cyclic and iterative process.

However, the research shows that teachers struggle with the use of data at the classroom level (Schildkamp & Kuiper, 2010; Schildkamp & Teddlie, 2008). There are several factors that can enable or hinder the successful use of data by teachers (i.e., where data are used formatively to improve teaching and learning). However, no comprehensive systematic reviews for DBDM at the classroom level have been published to date. More knowledge is needed on the prerequisites for DBDM in order to support teachers in using data to enhance learning.

Therefore, this study synthesizes the scientific research evidence to generate a better understanding of the prerequisites necessary for implementing DBDM in the classroom. The study presented in this paper is part of a large-scale review study into the prerequisites for implementing formative assessment in the classroom (Schildkamp et al., 2014). For the purpose of this paper we only selected and analyzed the DBDM studies.

Four categories of factors that can influence the use of data at the classroom level are often distinguished: prerequisites with regard to (1) assessment tools and processes, (2) the teacher, (3) the students, and (4) the context of the school (e.g., Mandinach & Jackson, 2012; Schildkamp & Kuiper, 2010). Moreover, to contribute to decreasing the research-practice gap, we also conducted focus group meetings to cross-reference and illustrate the findings in relation to the experiences of local practitioners and experts. This paper focuses on the following research question: *Which prerequisites regarding (1) assessment instruments and processes, (2) the teacher, (3) the student and (4) the context are important for the successful implementation of data-based decision making in the classroom?*

2. Method

For this study, we aggregated evidence from multiple studies on the implementation of DBDM (Gough, Oliver, & Thomas, 2012), and verified and illustrated the results of the review using focus group results. The initial literature search was conducted in March 2014. The terms 'formative assessment' and 'DBDM' are often used interchangeably (Van der Kleij et al., 2015). Therefore, this literature review initially focused more broadly on studies of formative assessment in the classroom. Next, we selected studies specific to DBDM. After analyzing the preliminary results from the literature review, findings were presented to several focus groups in June 2014 (primary education teachers (PE1), secondary education teachers (SE1) and experts (EXP)). These qualitative data were gathered to verify the results in a local (Dutch) context and to help translate the results into practice. Based on consultation with two experts in the field of DBDM, an additional literature search was conducted in July 2014. Finally, in September 2014 two more focus group meetings were organized with teachers from primary and secondary education (PE2 and SE2, respectively), based on updated findings that included the full set of publications selected for the review.

2.1. Literature review

This review used a stepwise process for conducting a systematic review in the social sciences (Petticrew & Roberts, 2006). This process encompassed: (1) formulating the research question, (2) defining the search terms, (3) choosing literature databases, (4) conducting the literature search, (5) formulating inclusion criteria, (6) selecting literature, using the inclusion criteria, (7) data extraction, (8) aggregation and synthesis of the evidence.

We consulted a library professional to guide our literature search. For each relevant publication, we used a data extraction form to collect the information needed to answer the research question. We also checked the scientific quality of each publication to ensure that only studies that met the quality requirements were selected (Gough et al., 2012; Petticrew & Roberts, 2006).

2.1.1. Literature search and selection

Five electronic databases were used for the literature search: ERIC, PsycInfo, Scopus, Web of Science, and PiCarta. The searches were restricted to the field of social sciences, and limited to publications in English after 1998, after the popularity of formative assessment increased as a result of the influential Black and Wiliam studies (1998a,b). The search process started with the search terms 'formative assessment', 'data-based decision making' and related terms, as found in a thesaurus and advised by experts (e.g. 'classroom assessment' and 'data-driven decision making'). A broad search strategy was used to retrieve a range of possible relevant publications, using OR instead of AND in our search strings. Because feedback is a crucial part of formative assessment (Sadler, 1989), 'feedback' and related terms were added to the search (using AND). In addition, because this review focused on the classroom level, 'classroom' and related terms were added to the search terms (using AND).

Screening of the abstracts led to the realization that several known DBDM publications had not been retrieved in our searches. International experts on DBDM pointed out that this was probably due to the use of the term 'feedback' in the search process. Even though feedback is an essential element in formative assessment in general, as well as in DBDM, the term feedback is not commonly used in DBDM publications. The experts pointed us to publications that we missed, and an additional search was conducted in June 2014, focusing specifically on DBDM, without the term 'feedback' in the search string.

To select relevant studies for the literature review (Petticrew & Roberts, 2006), and to avoid reviewer bias (Slavin, 1995), four inclusion criteria were defined: (1) the study must be published in a scientific journal article or be a doctoral dissertation, to ensure quality through rigorous peer review processes; (2) the study must report empirical research and not, for example, a theoretical synthesis or literature review; (3) the research must have taken place in primary and/or secondary or vocational education; and (4) the