Examining the theoretical positionings of data use interventions: A scoping review

Abstract

Studies of data use tend to focus on empirical work, with a corresponding lack of theorization. We conducted a scoping review drawing on hermeneutics to understand how researchers theoretically position data use interventions and how they see this positioning as contributing to improvements in student achievement. Twelve interventions were identified across 76 publications. Eight interventions did not self-identify as data use interventions. However, data use was central to their intervention, and their theoretical positionings overlapped with those that were self-identified as such. Theoretical positionings drew on assessment, content area theories, professional learning, and the theoretical underpinnings of particular research approaches. We discuss the implications of defining the field of data use.

1. Introduction

Using data to improve educational decision making and teaching has increasingly been the focus of many interventions aimed at improving student learning, with promising, albeit mixed, evidence of improvements in student learning (e.g., Carlson et al., 2011). Such interventions typically focus on supporting school practitioners (leaders and teachers) to use data to improve an aspect of schooling, which, in turn, is hypothesized to improve student learning and achievement (Lai & McNaughton, 2016). However, despite the shared focus, these interventions are grouped under different branches of knowledge, such as *data-based decision making* (Mandinach & Schildkamp, 2020) and *data-driven reform* (Carlson et al.,

2011), and are often situated between the desire to improve instructional decision making at the classroom level and increasing accountability pressures at the policy level (Hamilton et al., 2009).

Previous research has examined a range of aspects related to data use, such as teachers' capacity and beliefs for data use (Datnow & Hubbard, 2016), school leadership (Sun et al., 2016) and the prerequisites for successful implementation of data use in the classroom (Hoogland et al., 2016). However, the field of data use tends to focus more on empirical work with a corresponding lack of theorization (Prøitz et al., 2017), and is argued to lack a theory of action (Penuel & Shepard, 2016). Data use interventions, an area of study related to the wider field of data use, have similarly not been systematically studied (Schildkamp, 2019), and there are few, if any, published systematic examinations of the theoretical positionings of data use interventions.

Data use researchers have long acknowledged the need for theory-informed data use. In educational contexts, users must make sense of data using concepts, criteria, theories of action, and interpretive frames of reference before engaging in improvement work (Knapp et al., 2006). This fertile ground has attracted researchers from various disciplines (e.g., assessment and measurement, learning and cognition, organizational context and change, and power and politics) but has also resulted in separate bodies of scholarship residing in "different disciplinary homes" (Coburn & Turner, 2011, p. 227). For example, a single data use study centered on teachers' professional development in reading instruction might be framed through a teacher professional development lens, a literacy instruction lens, an organizational change lens, or even combinations of all three with varying hypothesized impacts on student learning. Furthermore, data use overlaps with related research fields, such as formative assessment, data use for research purposes, and big data (Schildkamp, 2019). Although there have been attempts to delineate the field from related concepts (Van der Kleij

et al., 2015), there are still many areas of overlap. Consequently, data use is a complex social phenomenon that is framed in different ways according to the disciplinary backgrounds of researchers. Given the multidisciplinary nature of educational research and the many contexts in which such research takes place, researchers are likely to use a variety of theoretical frames to position their work.

Much has been written about how using data will lead to improvements in teaching, with the assumption that student learning will also improve as a consequence; however, there are fewer studies that systematically examine the impact of data use interventions and/or professional learning and development and their impact on student achievement outcomes (Schildkamp, 2019). As data use interventions and the theories underpinning them are likely to be multidisciplinary, in this review, we use the broad term *data use interventions* to refer to the range of intervention studies that can be conducted in different disciplines and research fields where school practitioners analyze and use data to improve aspects of schooling and student learning. Following Schildkamp and Lai (2013), we define data as "information that is collected and organized to represent some aspects of school" (p. 10), be they qualitative or quantitative.

The many approaches to data use and the substantial number of published studies warrant a systematic exploration of the theoretical approaches used in the scholarship. This is particularly important given the cross-disciplinary nature of the data use field. This literature review addresses important gaps in the understanding of the theoretical positioning of data use interventions, focusing on data use interventions that have evaluated the impact on student learning. We aim to understand how the publication authors (intervention developers or evaluators) theoretically position the data use intervention and how they see this positioning as contributing to student learning outcomes. The research question guiding the review is "What are the theoretical positionings of data use interventions?" Our goal is

descriptive and not evaluative, in that we do not evaluate the efficacy of these theoretical positions.

We begin by explaining the concept of a "theoretical position," the challenges in understanding a theoretical position from a review of the literature, and how hermeneutics, as a theory of interpretation, can address these challenges. We then describe the methodology and findings before concluding with the implications of the findings when defining the field of data use and the methodologies that are best placed to understand the theoretical positions of data use interventions.

1.1. What is a theoretical position, and why is it important in understanding data use interventions?

"Theory" may refer to any attempt at creating concepts that allows the researcher to explore logical relationships and causal connections between conceptual abstractions (Kettley, 2012, p. 9). In educational research, "theory" typically refers to statements that describe, explain, or predict, and that help researchers select, classify, and organize ideas, processes, and concepts (Cohen et al., 2018). However, there are many kinds of educational theories (e.g., empirical, normative, and critical), and theories serve multiple purposes (Cohen et al., 2018). Consequently, what counts as theory is entangled in questions of epistemology and ontology and may inform objectivist (aiming to explain), interpretivist (aiming to understand), and emancipist approaches (aiming to improve the lives of disadvantaged groups; Rasmussen, 2017).

Theories provide a powerful means of understanding the decisions that intervention designers make and why they believe their interventions would impact student learning. In the case of data use interventions, researchers often use theory to position and describe their intervention as part of a broader "family" of like-minded studies, and to predict the impact of

their interventions on student outcomes. For example, a researcher could position their intervention within the broader "family" of formative assessment interventions, draw on formative assessment concepts to design the intervention, and interpret the effects on student learning through a formative assessment lens.

In this review, we use the term "theoretical positioning" to explore how data use researchers situate their work in the larger field of data use research. This term acknowledges the epistemological agency of researchers in purposefully selecting and using conceptual frames, interpreting and mediating research findings, and constructing knowledge, and it is sufficiently broad to cover the different ways authors in different disciplines and research fields understand and position their work theoretically.

1.2. Challenges in understanding theoretical positionings and hermeneutics as a solution

When reviewing the theoretical positioning of data use interventions, researchers can (1) interview those involved in the design and evaluation of these interventions or (2) examine publications related to the interventions. We chose the latter option and use the term "theoretical positioning" to explore how data use interventions situate their work in the larger, often cross-disciplinary field of data use research. However, this approach results in several challenges.

The context in which educational research takes place is not always explicitly acknowledged in publications (Alexander, 2020). Therefore, in reviewing multiple publications of the same intervention, researchers must rely on subtle textual cues in the publications (e.g., identifying grant numbers in acknowledgment sections), search for gray literature, or use unpublished insider knowledge to identify connections between individual publications. This approach is consistent with what Booth et al. (2016, p. 245) refer to as the

move from the critical appraisal of individual publications to a critique of the publications as a body to develop mid-range theory.

Research outlets typically require authors to position their research theoretically in the literature review section to fit the priorities of the journal, which may not be the "best fit" for the study in question. Consequently, authors may frame individual publications in ways that prohibit readers from understanding the full organizational complexity or contextual background of the intervention. Research syntheses also face a range of challenges, such as publication bias (the tendency to publish studies based on results rather than quality; Rothstein et al., 2005) and interpretive ambiguities in replication studies (Freese & Peterson, 2017). Therefore, a literature review must engage critically with the theoretical positioning of single publications to understand how they relate to a larger body of work and to explore what is not reported explicitly or is simply assumed.

To better understand the theoretical positionings of data use interventions and to address the challenges described, we turn to hermeneutics as a theory of interpretation. Hermeneutics has long grappled with the relationships between writer, text, and context. A seminal move in conceptualizing these relations is the distinction between the hermeneutic stances of *trust* and *suspicion* (Ricoeur, 1979). These stances represent different approaches to interpretation, as summarized by Felski (2011, p. 216): "a hermeneutics of trust (…) is driven by a sense of reverence and goes deeper into the text in search of revelation", while "a hermeneutics of suspicion (…) adopts an adversarial sensibility to probe for concealed, repressed, or disavowed meanings". While "trusting" interpretations are grounded in the data and seek to amplify its existing meaning, "suspicious" interpretations seek to explain more significant latent meanings. In practice, however, these two approaches are combined to make sense of the parts and the whole of a phenomenon (Willig, 2014). Roughly

corresponding to the idea of reading with and against the grain, these two stances can yield vastly different interpretations of the same body of work.

Within research on data use, there are examples of the field being read through the lens of a hermeneutics of suspicion. For example, Penuel and Shepard (2016) position research on data-driven decision making as lacking a theory of action, being founded on the value of treating "success on standardized achievement tests (…) as a sufficient indicator of learning and of likely success in subsequent endeavors" (p. 797), and relying "heavily on the multiple-choice and short-answer formats of state tests" (p. 798). This claim has been refuted as a misconception by other researchers arguing that data use often starts with a goal that educators want to reach and that data use researchers acknowledge the need for a balance between accountability and continuous improvement (Mandinach & Schildkamp, 2020). We interpret this critical dialogue as a symptom of existing tensions between data for improvement and accountability purposes, and as an indication of the need to review existing research on data use using both aggregative and interpretive approaches. Aggregative approaches bring similar studies together to add weight to a shared finding, while interpretive approaches, like this paper, seek to broaden our understanding of an intervention or phenomenon (Booth et al., 2016, p. 22) through the lenses of trust and suspicion.

2. Methodology

2.1. Review design and methodology

A scoping review (Arksey & O'Malley, 2005) with an interpretive hermeneutic orientation based on Ricoeur (1979) was undertaken to explore how data use interventions positioned their work theoretically. Scoping reviews are used to identify main concepts, theories, sources, and knowledge gaps in a field, and they typically answer much broader questions than systematic reviews (Tricco et al., 2018). Scoping reviews are particularly

useful in answering our research question, as identifying the theories used within a field is considered a typical task in scoping reviews, and theories are conceived of broadly under a scoping review, according to the PRISMA extension for scoping reviews (Tricco et al., 2018). Therefore, scoping reviews typically present an overview of a potentially larger and more diverse body of literature than systematic reviews and include a greater range of study designs and methodologies (Pham et al., 2014).

Because journal constraints can lead to fragmented representations of complex scholarly work, a systematic review would be more likely to miss key theoretical positions of data use interventions than a scoping review. For example, in our first reading of the data, we noticed that the theoretical positioning of an intervention investigated for nearly two decades (Learning Schools Model) was represented slightly differently over time and across journals. A scoping review allowed us to understand these key concepts and how they operate across a greater range of study designs and methodologies.

To ensure that the findings were properly contextualized and located in a theoretical position, we drew on Ricoeur's (1979) distinction between suspicion and trust as interpretive orientations. This interpretive orientation influenced how we searched for and analyzed our data sources. First, we assumed that single publications only partially represented the theoretical positioning of an intervention and searched for the full body of work published on an intervention to understand its theoretical positioning. Second, when analyzing the data, we adopted the interpretive stances of trust and suspicion, considering what was stated explicitly and what was implicit.

2.2. Selection of publications

There were three stages in the selection of publications. A visual of the three stages of publication selection is shown in Fig. 1. Review processes can be anything from highly linear

to highly iterative and emergent (Paré et al., 2016). The process of understanding how theoretical positioning occurs was highly iterative in nature in keeping with our interpretive orientation based on Ricoeur (1979). Therefore, the procedure evolved through the iterative process, and no protocol was registered in line with the PRISMA guidelines for a scoping review (Tricco et al., 2018). Instead, we provide a detailed description of the search process to ensure that the extraction and presentation of the search process and analysis are presented in a structured and transparent manner.

[Fig 1 here]

2.2.1 Stage 1: Preliminary search

Scoping reviews can include many types of evidence depending on the research question and objectives, including gray literature such as unpublished theses or dissertations (Tricco et al., 2018). Furthermore, scoping reviews may be undertaken for various purposes, such as deciding whether a topic is already covered by other reviews, the evidence is too scarce to answer the research question, or mapping emerging areas to identify which interventions have been studied (Chang, 2018). In our case, we were unable to find reviews covering our specific research questions (i.e., identifying the theoretical positionings of data use interventions that report on the link between the intervention and student achievement outcomes), and considering this in combination with the lack of theorization in the field (Prøitz et al., 2017), we deemed a systematic review inappropriate for our purpose.

The Schildkamp and Poortman (2019) publication served as a starting point for our search. The publication reviewed key data use professional development and interventions over the past few decades and identified key characteristics of these interventions. From this publication, we identified a starting list of 10 interventions represented in 12 relevant publications. We then searched the databases using the intervention names Schildkamp and Poortman mentioned. To understand the theoretical logic of how data use influences

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outcomes, we examined only data use interventions in which the authors explored the relationship between the intervention and achievement outcomes. We searched for published materials that reported on the intervention in relation to student achievement outcomes. This search resulted in the inclusion of six more publications that included an evaluation of the impact of data use interventions on student achievement.

To ensure that our coverage was exhaustive, we searched using key terms in different databases (ERIC, Web of Knowledge, JSTOR, and Elsevier and SAGE Journals). The search terms are listed in Table 1. We restricted the search to peer-reviewed publications in English focusing on journal articles, chapters, reports, and books written in English. The full texts of sources deemed of potential relevance were read, and the sources were then included or excluded based on whether the intervention reported student achievement outcomes. During this search, seven more data use interventions emerged, but only Literacy Data-Driven Decisions (Literacy 3D, L3D) had an evaluation article (n = 1) of student achievement and thus was the only one included.

[Table 1 here]

A total of 19 publications were identified through this initial database search. Publications excluded at this stage encompassed (1) empirical publications that did not contain any intervention outcomes (n = 44) (e.g., Schildkamp & Poortman, 2015) and (2) evaluation publications that contained only teacher results (n = 11) (e.g., Reeves & Chiang, 2019).

2.2.2 Stage 2: Exhaustive search

Following the initial database search, we conducted a manual search to ensure that the search was exhaustive. To ensure that all relevant data sources were identified, we searched

reference lists and footnotes in the publications identified in Stage 1. We also reviewed

websites related to each intervention (i.e., the websites of the Center for Data-Driven Reform

in Education and the Washington State Institute for Public Policy;

http://www.wsipp.wa.gov/BenefitCost/Program/363). As with Stage 1, the focus was on

published materials that reported on the intervention in relation to student achievement

outcomes in English. In total, 63 data sources were read thoroughly, of which 59 sources

were categorized as irrelevant (beyond the scope of the review), resulting in the inclusion of

four sources after this stage of the search. At this point, no new sources were identified.

We split the sources into two groups—self-identified and non-self-identified

publications—based on how the authors positioned their work. *Self-identified publications*

were interventions that self-identified as a variant of "data use", "data-based decision making

(DBDM)", or "data-driven decision making (DDDM)". *Non-self-identified publications* were

publications that were included in other reviews of data use intervention publications and in

which data use was an explicitly stated important part of the intervention, but in which the

intervention self-identified as another type of intervention. This classification was based on

our interpretive orientation (Ricoeur, 1979) by acknowledging what the intervention called

itself and how other researchers believed the intervention should be represented. This

classification rule has wide-ranging implications for how the field of data use conceptualizes

itself and for the key concept of what counts as a data use intervention, which is discussed.

By the end of Stage 2, we had identified 23 publications (7 self-identified and 16 non-

self-identified), representing 12 main interventions. Of the 23, eight were publications on one

research intervention, the Learning Schools Model. This intervention has been replicated

across multiple contexts (five countries, approximately 400 schools) and over time (15+

years), with numerous publications focusing on different evaluative aspects, such as the

evaluation of the entire intervention and the evaluation of post-intervention effects.

2.2.3 Stage 3: Supplementary resource search

Following our interpretive orientation, we did not assume that a single publication could fully expound on an intervention's theoretical positioning. Therefore, we searched for other published works on the interventions that could elucidate the theoretical positionings of the intervention, irrespective of whether those works also reported on student achievement outcomes. The inclusion criteria, purpose, and one example are presented in Table 2.

[Table 2 here]

We reviewed 53 supplementary publications in addition to the original 23. The 53 publications comprised 38 journal articles, four policy documents/reports, three book chapters, five theses, one conference paper, one research report, and one website. These supplementary publications were referred to in the original 23 sources (e.g., the journal article mentioned that details were contained in supplementary material available online), were found in the original literature search (using an intervention name search) but not previously included because they did not focus on the relationship between outcomes and the intervention (e.g., book on the intervention model), or were identified as being able to provide key information relevant to understanding the intervention (e.g., assessment policy).

In sum, 76 publications were identified for the review. Twenty-three publications on data use interventions also examined the impact on student achievement, and these were the focus of this literature review. The remaining 53 expanded on their theoretical positioning and/or provided important intervention or contextual details. Twelve interventions were represented in these publications, with some interventions having multiple publications. The interventions and associated publications in which achievement outcomes are reported (main publications)

and other published work (supplementary) on the intervention are listed in Tables 3 and 4
(the findings section).

[Table 3 here]

2.3. Coding process and definition for coding

2.3.1. Coding process for theoretical positioning

Academic publication processes require authors to frame their work and support their
research questions by reviewing the extant literature at the start of a published work.
Therefore, we coded the literature reviews at the start of the published work to understand the
theoretical positioning, beginning with the main publications to identify the key theoretical
positions. Then, we examined relevant supplementary publications to fully understand the
theoretical positions per the purposes listed in Table 3. As understanding theoretical
positionings in data use interventions is a new field of study, it was unclear what bodies of
literature the different publications would draw on, how explicitly they would describe the
theories underpinning their work, and how broad or narrow the authors' conception of
"theory" would be (e.g., broad socio-cultural perspectives vs. theories specific to a content
area). Therefore, the definition of theoretical positioning was deliberately left broad at the
start of the coding process. We began by identifying the theoretical positioning of each
publication using the terminology employed by the authors, which allowed us to start in a
trusting stance before engaging critically with information that could be missing.

Step 1: Iterative process of coding

The lead author read through the literature review section for each publication and
wrote detailed notes on the literature used to frame the intervention. From these notes, an
initial set of codes was developed based on emerging themes in the data. The third author

then used the initial codes to recheck all the data sources to ensure that every publication was now coded according to the list of initial codes and to identify any additional theoretical positions. This was an iterative process of noticing and refining codes to reflect the content of the data.

Two examples of the process of moving from the detailed notes to the initial codes are provided. The first was where the code could be identified from a key word used in the publication. For example, we found that several journal articles referred to goal setting in the data use process, leading to a code called "goal setting". The third author then searched for all articles that used the words "goal(s)". The code was "Goal/s" or "SMART" (e.g., van der Scheer & Visscher, 2018, p. 308). The second was where the code was not from a single word but from the main ideas across paragraphs. For example, initial analyses showed that several publications used literature from a content area, such as mathematics, as the rationale and/or frame in their research. The third author then searched all publications that discussed literature from the content area that was the focus of the publication and coded every publication that included literature from a specific content area under the code "content area". Initially, we called this code "curriculum", but we changed the code name to better reflect the content of the emerging data, as the content of the code was more about the content area than the curriculum.

An iterative process of expanding and regrouping emerging theoretical positions was undertaken until no additional or expanding or regrouping resulted in a major change in the theoretical coding. For example, we initially had a code called "collaborative analysis of data" to capture all types of discussions in which individuals discussed data. However, in the analysis, we found that some publications referred to a specific form of collaboration (*professional learning communities*) constituting its own field of study. Therefore, we recoded all publications to identify instances in which the specific form of collaboration—

"professional learning community"—was named. We then searched all the coding originally under "collaborative analysis of data" to find any additional possible groupings or where we might be able to combine groupings and repeat this process until no further groupings or regroupings changed the explanation of the theoretical position.

We noticed that some publications mentioned a theoretical position only briefly, while others elaborated on it across several paragraphs. Treating the two forms of publications in the same way resulted in overrepresentation of the theoretical positions of the publications with brief mentions. Moreover, if the authors only briefly mentioned the theoretical position, we had little information on how the theory informed their thinking. Thus, we decided to focus on the main theories in the publication, that is, theories that were elaborated in the literature review section of the publication. One coder identified all the main theories, and this was checked with a second coder in an iterative process until all agreed on which theories were the main ones to be coded.

Step 2: Associating codes with publications and interventions

A key issue with the coding was whether to associate the codes with a particular publication or with the intervention on which the publication was reporting. This issue is best illustrated when coding the Learning Schools Model intervention. There were eight main publications in which the authors reported on the impact of the intervention on student outcomes. This represented one-third of all publications (n = 23) in this review. All Learning Schools Model publications shared a set of common theories, as outlined in Lai et al.'s (2020) book, a key supplementary source of data that described in detail the theories that underpin the intervention. However, none of the eight publications mentioned all the theories elaborated on in the book. For example, the theory of professional learning and development is a central part of the Learning Schools Model theory of intervention success described in

the book. Thus, we could code for professional learning and development eight times *even if the publication did not mention professional learning and development theory directly* because we knew the eight publications were about the Learning Schools Model and shared this theory about professional learning and development as described in the book.

This approach would result in two problems. The first is the overrepresentation of a theory in the results, where a theory is coded multiple times for the same intervention even if it was not present in a specific publication. The second relates to the stance of trust and suspicion (Ricoeur, 1979). Do we trust the individual authors' representation of the intervention in each publication, or do we trust the overall representation of the intervention as derived from across all publications on the intervention? As researchers position their work in slightly different ways when addressing different audiences, the theoretical framing of individual publications may vary across journals.

If we focused on how individual publications framed themselves, the limitation of this method of delimiting publications was that it would lead to a fragmented view of the relations between publications. If we scrutinized the larger context of the publications to locate them within their appropriate theoretical frameworks, the limitation was that we must rely on subtle textual cues in the publications (e.g., identifying grant numbers in acknowledgment sections or using unpublished insider knowledge) to identify connections between individual publications. Moreover, if we included the theoretical positionings identified only in relevant supplementary publications (in which the impact of the intervention on student achievement was not evaluated), the hypothesized link between student outcomes and these theoretical positions was less clear.

Our proposed solution to these challenges is described here. When we counted all the theoretical position codes, we counted only the ones that were in that particular publication, focusing on counting only theoretical positionings in the main publications, as those were the

ones linked to student outcomes. For example, if a particular Learning Schools Model publication did not mention a particular theory, although the book mentioned it, we did not code that theory as belonging to that publication. Moreover, we made a note associating the theory with the intervention itself, including whether there were other theoretical positions that were absent in the main publications, and we qualitatively discussed these theoretical positions in the findings section.

Using this overarching framing, we coded each main publication individually for the theoretical positions in their literature review, and we associated the code with (1) the specific publication in which it was reported and (2) the intervention. The main publications that replicated the same intervention across different contexts or reported on an aspect of the intervention (e.g., Year 1 of a project) were still coded individually because these publications often provided overlapping but also different theoretical positions, despite being the same intervention. This gave us an overall picture of how individual publications and the overall interventions theoretically positioned their work. Once all the publications were coded in this manner, we examined whether there were any differences in the coding between self-identified versus non-self-identified data use interventions to see if there were differences in theoretical positions in interventions that called themselves data use or its variant (self-identified publications) and those that did not. We also examined which theoretical positions were typically mentioned together.

We counted the number of theoretical positions in a single publication and derived a median score to identify the number of theoretical positions in a particular publication. As publications typically mentioned more than one theoretical position, the total count is higher than the number of publications. Because of the large volume of theoretical positions, in this paper, we report on the three most commonly mentioned ones. We used all relevant material (main and supplementary) to qualitatively describe the code.

2.3.2. Coding demographic information

A smaller part of the coding process was to code each publication's demographic information. The third author read all the main publications (n = 23) and generated the main codes related to describing the demographic information of each publication (e.g., intervention name and country). The aim of this coding was to provide as much contextual information as possible to understand the theoretical positioning. For example, a higher-stakes accountability culture might explain why the authors situated their work within accountability or managerial theories. The first author checked the coding and finalized any decisions on how to record the codes. An iterative process between the first and third authors ensued to determine the final demographic information to include and how to code it. Finally, all coding was reviewed by the second author. This process consisted of scrutinizing all studies reviewed and examining the codes generated to see if the overall interpretation was sound. For example, when reviewing the studies on disciplinary-specific elements such as literacy instruction and assessment, the second author critically examined codes related to ensure that they represented theoretical concepts used in these respective fields. Any disagreements were resolved by consensus between the first and second authors.

3. Findings

Twelve interventions were represented in the publications, but only four of the 12 interventions self-identified as some form of data use intervention (e.g., DBDM), with the remaining interventions self-identified as another form of intervention, with data use being a significant component. A summary of the demographic information of each publication is presented in Table 4. The interventions came from three countries (the Netherlands, the

United States, and New Zealand). Most focused on primary- and secondary-aged students, with two interventions focused on preschool-aged students. The majority of the interventions concentrated on the curriculum areas of mathematics and reading. All interventions except one (case study design) used either randomized control trials or quasi-experimental methods to demonstrate intervention success. Not all interventions were able to raise achievement outcomes or replicate a previous success (n = 5). Publications were in content area–specific journals (e.g., *Reading Research Quarterly*), in which the journal explicitly focuses on a content area, and in more general or open journals that accept a range of articles (e.g., *Teaching and Teacher Education*). The process of data use to improve student learning was similar across data use studies and comprised identifying an area of student learning (or condition for learning) to improve; the collection, analysis, and interpretation of data to understand how to improve student learning or address that condition for learning; and the subsequent use of that data for decision making and instruction to improve student learning.

[Table 4 here]

The median number of theoretical positions was three. We identified the four most common theoretical positionings of data use. The first was in the *assessment literature* (n = 9 publications on 8 interventions, of which 1 intervention had two publications). The second was the positioning of data use within the *content area* literature of the intervention (n = 9 publications on 5 interventions, of which 1 intervention had 2 publications and 1 intervention had 4 publications). The third most frequently reported theoretical positioning was in *professional learning and development* (n = 7 publications on 6 interventions, of which 1 intervention had 2 publications), and the fourth (n = 6 publications on 3 interventions, of which 1 had 4 publications) discussing at length *the theoretical positioning of a particular*

research approach, such as *Response to Intervention*. In what follows, we discuss each theoretical positioning in turn, including overlaps among them.

3.1 Positioning within the assessment literature

The focus on assessments was observed in self-identified and non-self-identified publications, that is, publications that self-identified as a variant of "data use", "data-based decision making (DBDM)" or "data-driven decision making (DDDM)" (primary), and those in which the intervention itself self-identified as another type of intervention but in which data were used as a key part of the intervention (non-self-identified publications). The assessments represented several different interventions, but all were from the United States.

3.1.1   Benchmark assessments

Benchmark assessments were the most frequently mentioned theoretical position within the broader focus of the assessment literature. All publications focused on benchmark assessment focused on large-scale reform efforts involving districts (n = 4 publications from 3 interventions, of which 1 intervention had 2 publications; Carlson et al., 2011; Cordray et al., 2012; Konstantopoulos et al., 2013; Slavin et al., 2013). Cordray et al.'s (2012) distinction between benchmark assessments and formative assessments was adopted in this review. They argued that the frequency of assessment, purpose, and whether the assessment is part of the normal classroom routine are the key distinguishing features. Formative assessment is "a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning" (Council of Chief State School Officers [CCSSO], 2007, p. 2). Benchmark assessments are less frequent, and they are designed primarily to predict academic success, monitor progress, and provide information that can be used to differentiate instruction in the classroom. Thus, benchmark assessments are

administered outside normal classroom teaching (Hunt & Pellegrino, 2002). All except

Konstantopoulos et al. (2013) used the term "benchmark assessments". Konstantopoulos et

al. (2013) used the term "interim assessments", but they cited Carlson et al. (2011) and

Cordray et al. (2012) and called both interventions an "interim assessment program" (p. 482).

However, Carlson et al. (2011) and Cordray et al. (2012) called their work "benchmark

assessments".

Benchmark assessments were viewed by all publications as a way to improve student

learning by providing teachers and school leaders with information from assessments that

were aligned with high-stakes assessments. Such information would enable teachers to

understand early on whether students are on track toward improvement in their high-stakes

assessments so that instructional changes could be made (Slavin et al., 2013).

The goal was improvement in high-stakes assessments. Therefore, the professional

learning focus of these interventions was to support teachers and school leaders in

understanding and using benchmark assessments to improve instruction and evaluation and,

in turn, improve student learning.

All publications further positioned their work within state-wide accountabilities, with

two of the four (Carlson et al., 2011; Konstantopoulos et al., 2013) explicitly discussing the

impact of the No Child Left Behind (NCLB) policy on assessments. Carlson et al. (2011), for

example, argued that the NCLB policy "ushered in test-based accountability as the

predominant model of educational reform promulgated by the federal government" (p. 378).

As these four articles were focused on district-wide reform, it was unsurprising that the data

selected for use were those aligned with wider high-stakes accountability measures, and that

the goal for student learning was expressed as improved student performance on these

accountability measures.

3.1.2 Formative assessments

Two publications from two separate interventions, also from the United States, mentioned formative assessments as the predominant theoretical positioning (Heller et al., 2012; Quint et al., 2008), with Quint referencing the NCLB policy. Both publications explicitly used the term "formative assessment". The former examined three professional development models in science, with formative assessment as one of the common features, while the latter examined the Formative Assessments of Student Thinking in Reading (FAST-R) program, a program implemented in 21 schools in the Boston public school system. In short, the professional development models described by Heller were not solely focused on formative assessment, while FAST-R, as the name indicates, had formative assessment as its sole focus. Black and Wiliam's (2009, p. 11) definition of formative assessments was the one adopted in this work:

> Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.

The logic of data use in this work can be explained as follows: by using data from assessments formatively, teachers can identify the next instructional steps and adjust their instruction to improve student learning. It is important to note that for this code, we used the language that the authors used—that is, that they self-identified their work as a form of formative assessment. Although the intent of using data from assessments to improve teaching and learning is similar to that of benchmarked assessments, the latter was strongly

situated within the accountability policies of the assessment context and referred to specific tests aligned with assessments used for accountability purposes.

3.1.3 Assessments (other).

Three publications from three interventions positioned in the assessment literature could not be grouped with each other or with the other publications. Fuchs et al. (1999) focused on performance assessment as an alternative to traditional assessments for developing problem-solving skills in mathematics. According to Fuchs et al. (1999), "PAs [performance assessment] pose authentic problem-solving dilemmas and require students to develop solutions involving the application of multiple skills and strategies". Although Al Otaiba et al. (2011) and Greenwood et al. (2017) drew on the assessment literature, in both cases, the theories of assessment were positioned as part of the larger intervention in literacy (discussed in the next section).

3.2. Positioning within a content area

Nine publications (from five interventions) were positioned within the literature of a particular content area (e.g., literacy) that corresponded to the focus of the intervention (Al Otaiba et al., 2011; Connor et al., 2007; Fuchs et al., 1999; Greenwood et al., 2017; Heller et al., 2012; Jesson, McNaughton, Rosedale, et al., 2018; Lai et al., 2014; Lai et al., 2009; McNaughton et al., 2008). In these publications, the student achievement problem was positioned as a content area problem, and literature from the content area hypothesized to improve outcomes in the content area of focus was discussed extensively. For example, the intervention focusing on improving adolescent literacy drew on the literature on the increasing textual demands in specialized content areas and how basic literacy skills were a necessary but insufficient condition for future reading success. The authors then proposed a

theoretical model blending generic and subject-specific literacy enacted within a particular intervention model as a way forward to improve adolescent literacy (Lai et al., 2014).

The specific content area literature drawn on was primarily from literacy (n = 7), with most focused on reading (n = 4 publications on 2 interventions; Al Otaiba et al., 2011; Connor et al., 2007; Lai et al., 2009; McNaughton et al., 2008). The other three were in adolescent literacy involving reading across the content area and secondary school qualifications (Lai et al., 2014), literacy in preschool involving a range of preschool literacy skills, such as oral language and alphabet knowledge (Greenwood et al., 2017), and writing (Jesson, McNaughton, Rosedale, et al., 2018). The non-literacy-focused publications were in mathematics (n = 1; Fuchs et al., 1999) and science (n = 1; Heller et al., 2012).

Data use was positioned in these publications as an important component of a broader intervention, as part of a wider theoretical framework for how to improve outcomes, and as an important but not the sole contributor to changes in student learning. None of the publications claimed that data use alone could influence student learning. Rather, using data in combination with a theoretical approach in the content area was hypothesized to make a difference. To continue the example from Lai et al. (2014), the authors discussed the importance of using data to develop a context-specific instructional design as a key component of their intervention, with an entire phase of a three-phase intervention devoted to such data use. This approach was integrated with the blended model of literacy instruction, and the two were argued to be integral to improving student learning in literacy and in the attainment of secondary school qualifications.

The focus on content area knowledge is all from the non-self-identified publications and was mentioned by five interventions (Learning Schools Model, ISI, Literacy 3D, PA, and Teaching Cases & Looking at Student Work). Thus, interventions that self-identified as other than data use or its variant foregrounded the content area literature to position their

interventions or hypothesize the impact on student learning. By contrast, interventions that

self-identified as data use did not draw on content area literature, although all self-identified

interventions focused on improving learning in a particular content area or areas (e.g.,

mathematics), with the exception of the Poortman and Schildkamp (2016) article, which also

included non-content area foci (e.g., improving student retention). For example, an

intervention located itself in goal setting, feedback, and professional learning and

development literature (to name some key theories), although the focus was on improving

mathematics achievement (van Geel et al., 2016).

3.3. Positioning within the *professional learning and development* literature

Interventions that drew on the professional learning and development literature argued

that improvements in student learning would occur only if the interventions augmented their

other theoretical positions (e.g., goal setting and content area theories) with the literature on

what is known to be effective features of professional learning and development (e.g., amount

of time spent on professional learning; Greenwood et al., 2017; Heller et al., 2012; Keuning

et al., 2019; Poortman & Schildkamp, 2016; van Geel et al., 2016). The professional learning

and development theories were the focus of seven publications on six interventions, of which

one intervention had two publications. The publications included self- and non-self-identified

interventions, meaning that interventions that self-identified as data use and those that did not

draw on the professional learning and development literature.

Almost all publications drew on the professional learning and development literature

to design and implement their intervention (n = 6 publications on 5 interventions, of which 1

intervention had 2 publications), with one (Quint et al., 2008) positioning itself within the

professional learning and development literature without theorizing or further discussing

primarily (this could be because it was a report that focused more on outcomes, while the

others were journal articles.) Publication authors designed their interventions based in part (or in full) on the features of professional learning and development known to influence teaching and learning and discussed how their intervention design reflected the stated effective characteristics of the professional learning and development literature known to influence teaching and/or learning. To illustrate, Poortman and Schildkamp (2016) reported on a professional development program to support teachers' use of data. In Section 2.1 ("Professional development"), they discussed effective professional learning and development characteristics that would support teachers' and school leaders' use of data (e.g., professional learning and development occurring in teams) and then described how their *data use intervention* (the term they use in the paper) takes place in teams.

It is important to point out that all publications analyzed involved some form of professional learning and development, in that practitioners (e.g., teachers or administrators) were trained to analyze and use data through the intervention, albeit with different emphases and intensities of training. However, only seven discussed the literature related to professional learning and development in more detail in the literature review. This could imply at least two things. First, authors who did not mention professional learning and development in their theoretical positions did not believe that professional learning and development was an important reason for their intervention success. Second, they might have chosen to foreground other theories as more relevant, given their publication focus (e.g., if writing for a literacy journal, authors may have chosen to foreground literacy-related theories).

3.4. Positioning within a research approach

Only the non-self-identified publications (n = 6 publications on 3 interventions, of which 1 had 4 publications) theorized that a research approach was an important factor

leading to intervention success. A research approach here is distinct from a specific intervention in that it is an umbrella approach under which multiple different interventions can be designed and implemented. There were two such research approaches mentioned: Response to Intervention (n = 2 publications on 2 interventions; Al Otaiba et al., 2011; Greenwood et al., 2017) and design-based research with a design-based approach as the alternate wording (mentioned by four but not all of the Learning Schools Model intervention publications (Jesson et al., 2015; Jesson, McNaughton, Rosedale, et al., 2018; Jesson, McNaughton, Wilson, et al., 2018; Lai et al., 2014).

In both research approaches, the use of data is an important part of the approach. There are different Response to Intervention models. Multitiered Response to Intervention models (mentioned in this review) focus on reading and involve three tiers. The first tier is effective initial reading instruction (Tier 1), and if students do not respond to Tier 1, then Tiers 2 and 3 are provided, each tier of which involves more frequent and intensive support for and assessment of the child (Al Otaiba et al., 2011). According to Al Otaiba et al. (2011, p. 537), although the number of tiers (and length of time students spend in tiers) varies across models, "the underlying theory is that students who struggle with reading require more time in explicit and systematic instruction in their assessed areas of weakness". In Tier 1 of the model, there is an emphasis on effective reading instruction grounded in reading research and on using assessment data to determine student needs and differentiate instruction (Al Otaiba et al., 2011).

Similarly, there are elements in design-based research that require the use of data to modify practices. Components of design-based research are situated in real educational contexts, focusing on the design and testing of a significant intervention, using mixed methods, involving multiple iterations and collaborative partnership between researchers and practitioners, and impacting practice (Anderson & Shattuck, 2012). The components of

mixed methods, multiple iterations, and design and testing have a strong data component, in which data are used in collaboration with partners to design and test the intervention. However, as evidenced by their descriptions, each research approach views using data as part of a larger process involving other key elements hypothesized to lead to better outcomes for teachers and students.

There was an overlap between the content area and the theoretical positions of the research approach. All publications that mentioned a research approach in their theoretical framing also had a strong content area focus; that is, they all had a theory about a specific aspect of literacy hypothesized to improve outcomes. With Response to Intervention, the focus on a content area is embedded in the model. In the design-based research approaches, this was not evident in the components of design-based research itself but was a focus of the specific interventions.

4. Discussion and conclusion

In this paper, we examined the theoretical positioning of data use interventions aimed at improving student achievement. Delineating what counted as a data use intervention required an interpretive stance that enabled us to report how publication authors positioned their intervention and how other researchers positioned them. Researchers did not always self-identify their intervention as a data use intervention, although they drew heavily on using data use within the intervention, while other researchers positioned their intervention as part of the wider group of data use intervention studies. The theoretical positionings underpinning the use of data could be broadly grouped into the literature on assessment, content area theories, and professional learning and development, and multiple theoretical positions were integrated and used in combination to describe the intervention and hypothesize and evaluate

their impact on student learning. Thus, data use is less a field in need of theorizing (Prøitz et al., 2017) than a field where there is a proliferation of different theoretical combinations from different disciplines combined in various ways based on what appears to be the intervention designers' position and the journal focus. We discuss the commonalities across theoretical positionings before discussing two main implications: the first theoretical (how the field of data use should be defined) and the second methodological (how best to identify theoretical positionings of publications from literature reviews).

4.1 Commonalities in theoretical positionings

The data use process to improve student learning is similar across data use studies and typically comprises identifying an area of student learning or condition for student learning (e.g., retention) to improve, followed by the collection, analysis, and interpretation of data to understand how to improve student learning and the subsequent use of that data for decision making and instruction to improve student learning. The main theoretical positionings represented differences in what the authors chose to foreground in the data use process as key to improving student learning. For example, foregrounding the assessment literature focuses on the data sources and how to use them as the key mechanisms to improve student learning, while foregrounding content area theories places greater emphasis on the content area knowledge required to improve instruction over the assessment process in improving student learning. One of the four main theoretical positionings focused on the content area literature, while the rest focused more on the processes of data use (assessment) or processes that support data use by teachers in that if data are used according to these processes, improvements would occur (theoretical positionings in the professional learning and development literature and as part of research approaches).

These findings raise an important question around the theorizing of the data use process in data use interventions. Are all aspects of the data use process (and their associated theoretical positionings) of equal importance when the goal is to improve student learning? The way the theoretical positionings are presented in publications suggests that authors foreground some aspects of the data use process and may thus believe some aspects of the process to be more central. However, we also need to view the foregrounding of theories with some suspicion (Ricoeur, 1979), as authors position their work for specific journals, and the foregrounding of theories could simply be a position for a particular journal. Thus, further avenues for further research present themselves. While the focus of this paper was on understanding theoretical positionings from publications, future research could extend this work by interviewing the intervention designers to understand what theoretical positions they view to be central and how and why they position their work in the way that they do across different publications. Research into the aspects of data use theorized to be central to improving student learning, and the relationship between these theories and student learning could also be further explored more systematically, for example, through meta-analyses.

It is not the intention of this paper to analyze the combination of theoretical positionings of a particular intervention; rather, to look for commonalties across interventions. However, on average, there were three theoretical positionings mentioned per intervention, and there were patterns as some theoretical positions were commonly mentioned together. For example, our findings showed that those who theoretically positioned their interventions within a research approach also did so within a content area. A more systematic analysis of the combinations of theoretical positionings of an intervention would increase our understanding of not just what theoretical positions are mentioned but, for example, why these particular combinations were selected and how they are integrated to explain the impact on student learning.

4.2 Defining the field of data use

The challenges with selecting and then categorizing interventions as data use interventions raise several issues around how the field is defined. In the literature, the use of data to improve educational practice is framed variously as an issue of high-stakes accountability or as part of teacher inquiry (Lai & McNaughton, 2016). Some have distinguished data use from fields such as formative assessment or action research (e.g., Van der Kleij et al., 2015). This could explain why data use scholarship is perceived as residing in "different disciplinary homes" (Coburn & Turner, 2011, p. 227). Whether data use is a discipline, a field, or perhaps an interdisciplinary domain is a complex question, in part because data use is an important component of many fields. The latter is illustrated in our study in how data use is an important component of research approaches aimed at improving student learning, which are integral to but not seen as the sole reason for how the intervention improves student learning.

There are several positions that could be taken regarding the field of data use. The first position is to view it as a separate field of study from other related fields (e.g., formative assessment) and tighten the definition of data use. Viewing data use as a distinct field with clearer boundaries of research provides the field with legitimacy and allows a body of research to grow within it. This idea echoes broader international discussions about the relation between educational research and practice and whether education should be considered a "field", a "discipline", or a "profession". Such debates typically emphasize issues of institutional autonomy, epistemological rigor, and the existence of professional associations (see e.g., Furlong, 2013; Wyse, 2020). In the case of data use, there are considerable high-quality research outputs and associations such as the American Educational Research Association (AERA), the Special Interest Group on Data-Driven Decision Making

in Education, and the International Congress for School Effectiveness and Improvement (ICSEI) Data Use Network. This suggests that data use is a distinct field. If data use is viewed as a distinct field, then authors should emphasize its existence when positioning their research so that its boundaries are defined less by the requirements of research outlets and more by the unifying theoretical concepts that the field offers.

However, the problem with stricter adherence to data use as a separate field would mean excluding publications in which data use is not the singular focus of an intervention. Strict adherence also does not take into account how a large number of intervention designers actually position their work. Yet, it would be remiss to exclude these publications from the field of data use as this review suggests that data use within a wider theoretical framework can lead to improved achievement outcomes and that large numbers of intervention designers self-identify as both outsiders and drawing from the field of data use.

In addition, there are many commonalities between researchers who identify as working within DBDM and those who merely acknowledge that data use is important. These commonalities include having similar theoretical positionings as identified in this literature review or similar approaches to data use processes (Lai & McNaughton, 2016).

This brings us to a possible second position: explicitly acknowledging data use as an interdisciplinary field with fuzzy boundaries. The arguments for taking this approach come not only from the findings of this review but also from the nature of data analysis. Increasingly, researchers have argued that teachers need a combination of content area or disciplinary knowledge, pedagogical content knowledge, and knowledge of the student to use data effectively (Mandinach & Gummer, 2016). For example, to improve literacy instruction, teachers likely need access to data about student achievement, as well as examples of alternative teaching strategies, an understanding of students' motivation for learning, and other factors. In other words, effective data use requires practitioners to combine knowledge

from various fields when using data, at least regarding how data are used in interventions to improve student learning.

However, if research on data use has unclear boundaries, individual studies may lean in different directions, depending on the focus of a study or the preferences of individual researchers. Journals too often reside in "different disciplinary homes" (Coburn & Turner, 2011, p. 227), spanning from subject-specific journals (e.g., literacy or mathematics) to organizational research. On the one hand, this may lead to a multiplicity of theoretical positionings, which may in turn hinder attempts to develop more robust theory in the field. On the other hand, this may also contribute to a virtuous and dynamic cycle of theory building in the field, one that is not too attached to the theoretical apparatus of one specific field or adheres too strictly to a unified set of concepts.

Regardless of which position (separate field vs. interdisciplinary) is adopted, defining the field of data use will also require including the policy context in which such publications are located. There is an argument that publications on data use or its variants (e.g., DBDM) are strongly influenced by its strong accountability context, particularly the NCLB policy (Datnow & Hubbard, 2015). However, the relationship between policy and theoretical positioning is neither simple nor linear even within a single country. Our findings suggest that large-scale and district-focused publications in the United States have elements of a strong accountability approach. However, not all publications with an assessment focus from the United States have this accountability focus, with others positioning themselves within formative assessment and other less accountability-focused theoretical frames. Therefore, although broader educational policies shape how data are perceived and used, academics are agentic in responding to or resisting these policies in their research foci.

4.3 Methodological issues of identifying theoretical positions from literature reviews

The second methodological implication stems from the first challenge. Our first challenge in this paper was to define what counts as a data use intervention. Based on the literature we reviewed, it was difficult to draw the line between what is considered data use interventions and what is not. If we include one data use intervention with formative assessment as its core theoretical positioning, do we then have to include all similar formative assessment interventions? In our work, we used the hermeneutics stance of trust or suspicion (Ricoeur, 1979) to navigate the two positions of (1) excluding all interventions that do not call themselves data use or its variant even when data are self-identified as a critical component of the intervention and (2) including every intervention that has data as a critical component (which, as the formative assessment example suggests, would mean a large and far too loose grouping for inclusion). We did so by explicitly acknowledging the authors' position, the pragmatic choices researchers must make when submitting to a journal, and how researchers' work will be perceived by others (as belonging to the field of data use).

For example, our starting article on data use interventions included a formative assessment publication. Therefore, only that study and other formative studies that were directly referenced by data use intervention studies in their literature review as per our search processes were subsequently included. The logic for this decision is explained. If we included all formative assessment studies, even those that were not used by data use intervention authors to position their work, we would potentially be including studies that were not considered to be part of data use studies by the intervention designers. However, excluding formative assessment studies that other data use interventions have used to position their work would mean ignoring how data use intervention authors position their work.

Our findings further highlight the difficulties of gaining a full understanding of a theoretical position through the analysis of a single publication on an intervention. This could

be due to a variety of factors: various aspects of an intervention being described across multiple publications, changes over time in thinking by intervention developers, and differing foci and reporting requirements for different publications. These factors make it difficult to determine whether an aspect or theoretical position was not reported or absent in the authors' thinking. In fact, we found more supporting publications than main ones, suggesting that a full description of the theoretical positionings of an intervention was typically not contained in the publication aimed at demonstrating the impact of the intervention on student learning. This also means that the "silences" in the description of the process or theory in a journal article may not reflect a silence in understanding, but rather a practical consideration of what to include given journal requirements.

We suggest that methodologies for research synthesis should consider that authors foreground and background certain aspects of their theoretical positionings based on journal requirements and audiences. This practice may lead to self-selection bias in that authors who position their interventions in a particular theoretical frame seek out journals with similar frames. In this way, data use could be shaped by the requirements of research outlets as much as by the authors' views of the theoretical framing of data use. Future reviews of data use research should consider how an interpretive paradigm such as the one used here can provide insight into the formation and development of research fields, and how the opportunities and constraints of academic publishing shape disciplinary boundaries and interdisciplinary connections in subtle or unexpected ways. A hermeneutics of suspicion can enhance attention to the explicit and implicit positionings of single publications as part of a body of work and within a domain of research. Furthermore, we suggest that research syntheses combine aggregating strategies (e.g., systematic reviews) with contextualizing approaches (e.g., conceptual reviews or meta-ethnography) to ensure that the data use phenomenon is understood through multiple lenses. Ultimately, these strategies can contribute to a better

understanding of the epistemological issues in the field, whether they be tensions between policy issues and classroom practice, differences in research perspectives across contexts, or designing interventions aimed at improving student learning and achievement.

4.4. Limitations

A potential limitation is that we considered only theoretical positionings in the literature review section of the publication. Theoretical positionings are found in both the literature review and the discussion section of a publication, with the latter being a useful source of information on authors' reflections on theoretical positionings. However, for the purposes of this paper, we wanted to concentrate on their theoretical framing of their intervention rather than their *reflections* on their theoretical positionings. Future studies could focus on examining and comparing and contrasting both the theoretical positionings and author reflections to provide an understanding of how authors frame and then reflect on and critique their own work.

A second limitation is related to the challenges of the particular review methodology used in this paper, a challenge that is part of the broader discussion around differences in methodological approaches for literature reviews and their implications for processes and findings. This was a scoping review with an interpretive orientation aimed at understanding the theoretical positionings of intervention studies that report on the impact on achievement outcomes. As we argued in our introduction section, an interpretive approach using the lenses of trust and suspicion is the best approach for our particular purposes given the lack of theorization in the field, and issues with how theoretical positionings are expressed over time and across different journals. As such, understanding theoretical positionings requires interpretive sensitivities characteristic of qualitative analysis, and not the aggregative logic

characteristic of systematic reviews. However, interpretative approaches to literature reviews can be seen as lacking measures of replicability. In the context of review methodology, this corresponds to the differences between aggregative and interpretive approaches (Booth et al., 2016, p. 22), where aggregative approaches adopt a different view and way of addressing replicability.

It is not our place to resolve the methodological challenges inherent in different approaches, and each approach has strengths and weaknesses. Our position is that both kinds of reviews (interpretive and aggregative) are complementary and important, particularly given the nature of the data use field, where there is a need to capture both aggregated empirical results and the nuances of theoretical positionings. Future syntheses in the field of data use should therefore seek ways to combine the iterative and inductive logic of interpretive approaches with the more linear and deductive logic of aggregative methods and compare and contrast between them.

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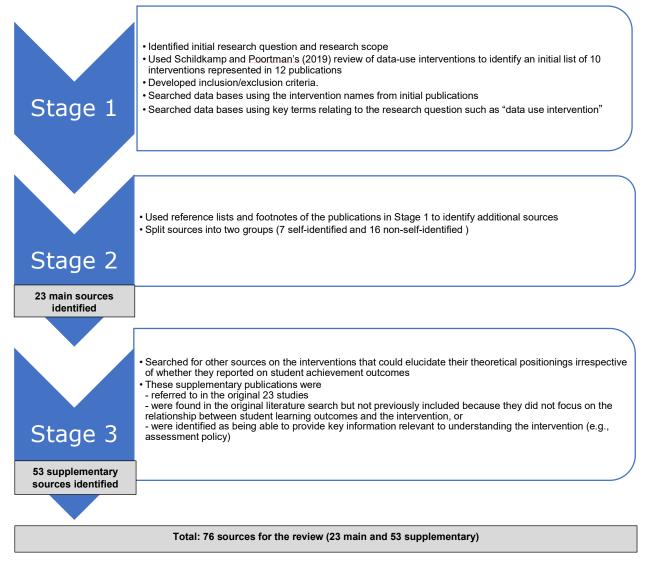No conflict of interest is reported as part of this study.

Figure 1

Stage 1
- Identified initial research question and research scope
- Used Schildkamp and Poortman's (2019) review of data-use interventions to identify an initial list of 10 interventions represented in 12 publications
- Developed inclusion/exclusion criteria.
- Searched data bases using the intervention names from initial publications
- Searched data bases using key terms relating to the research question such as "data use intervention"

Stage 2
- Used reference lists and footnotes of the publications in Stage 1 to identify additional sources
- Split sources into two groups (7 self-identified and 16 non-self-identified)

23 main sources identified

Stage 3
- Searched for other sources on the interventions that could elucidate their theoretical positionings irrespective of whether they reported on student achievement outcomes
- These supplementary publications were
  - referred to in the original 23 studies
  - were found in the original literature search but not previously included because they did not focus on the relationship between student learning outcomes and the intervention, or
  - were identified as being able to provide key information relevant to understanding the intervention (e.g., assessment policy)

53 supplementary sources identified

Total: 76 sources for the review (23 main and 53 supplementary)

Fig. 1. Literature search stages.

Tables

Table 1

Key terms

Key terms	Relevant search
Data use intervention	Data use reform, data use professional development, data use professional learning, data use professional learning and development
DDDM intervention	DDDM reform, DDDM professional development, DDDM professional learning, DDDM professional learning and development
Data-driven intervention	Data-driven reform, data-driven professional development, data-driven professional learning, data-driven professional learning and development
Data-based intervention	Data-based reform, data-based professional development, data-based professional learning, data-based professional learning and development
Data-informed intervention	Data-informed reform, data-informed professional development, data-informed professional learning, data-informed professional learning and development

Table 2

Supplementary publications inclusion criteria and purpose.

Inclusion criteria	Purpose	Example
Supplementary publications were included if:		
• the intervention described in the main publication was subsequently published as a book (or similar) that provided an expanded and/or cohesive account of the intervention over time	To better understand the intervention's theoretical positioning To triangulate theoretical positions across publications of the same intervention (this could reveal contradictions or expansions in theoretical positioning over time and across publications on the same intervention)	The 2020 book on the Learning Schools Model, provided the first cohesive account of the intervention over time. There were no obvious contradictions between the theoretical positions in the book and in individual publications. However, there were differences in emphases across publications, changes in language over time, and additional theoretical positionings that were discussed in a publication but not discussed in detail in the book.
• the main publication referred to a different source for details or had published the details in another publication, such as a report	To fully understand the theoretical positioning, as it was not fully described in the main publication	Connor et al. (2007) contained four relevant hyperlinks to article tools, supplementary materials, related content, and references cited in the article. These were read to understand the theoretical positioning and the intervention outlined in the 2007 article.

• key information relevant to understanding the intervention and its context (e.g., assessment, policy) were not elaborated in the publication but could be found in other publications	To understand aspects of the intervention or context that were relevant to understanding the theoretical positioning but were not described fully in the publication	To understand the theoretical positioning of benchmark assessments in the U.S. context, and how that related to state-wide accountability outcome measures, we read publications on the state-wide accountability processes and testing. We also read (if available) any published material on the benchmark assessments.

Table 3

Interventions by the number of main and supplementary publications

Interventions (self-identified publications: self-identified as data use interventions)	Number of main publications reporting impact on achievement	Number of supplementary publications
Data Team	1	11
Center for Data-driven Reform in Education (CDDRE)	2	2
Data-based Decision Making (DBDM)	2	5
FOCUS project for DBDM intervention	2	3
Total	7	21
Interventions (non-self-identified publications: Identified by others as data use interventions of which data use is a significant component)	Number of main publications reporting impact on achievement	Number of supplementary publications
Learning Schools Model	8	8
Individualizing Student Instruction (ISI) and Individualized Student Instruction for Kindergarten (ISIK)	2	11
Classroom-based performance assessment (PA)–driven instruction	1	0

Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) program	1	5
Indiana Diagnostic Assessment Tools Intervention	1	5
Formative Assessments of Student Thinking in Reading (FAST-R)	1	2
Teaching Cases & Looking at Student Work	1	0
Literacy 3D	1	1
Total	16	32

Table 4

Publication demographics

	Publication name	Intervention name	Improved achievement outcomes	Methodology	Country	No. of schools	Type of school	Content area focus
1.1 [1]	Poortman, C. L., & Schildkamp, K. (2016). Solving student achievement problems with a data use intervention for teachers. *Teaching and Teacher Education*, *60*, 425–433. https://doi.org/10.1016/j.tate.2016.06.010	Data Team	Yes[2]	Case study	Netherlands	9	Secondary	Variety of foci
1.2	Carlson, D., Borman, G. D., & Robinson, M. (2011). A multistate district-level cluster randomized trial of the impact of data-driven reform on reading and mathematics achievement. *Educational Evaluation and Policy Analysis*, *33*(3), 378–398. https://doi.org/10.3102/0162373711412765	Center for Data-Driven Reform in Education (CDDRE)	Yes	Randomized control trials	United States	500+	Primary and Secondary	Mathematics and reading
1.3	Slavin, R. E., Cheung, A., Holmes, G., Madden, N. A., & Chamberlain, A. (2013). Effects of a data-driven district reform model on state assessment outcomes. *American Educational Research Journal*, *50*(2), 371–396. https://doi.org/10.3102/0002831212466909	Center for Data-Driven Reform in Education (CDDRE)	No	Randomized control trials	United States	622	Primary and Secondary	Mathematics and reading
1.4	Keuning, T., van Geel, M., Visscher, A., & Fox, J. (2019). Assessing and validating effects of a data-based decision-making intervention on student growth for mathematics and spelling. *Journal of Educational Measurement*, *56*(4), 757–792. https://doi.org/10.1111/jedm.12236	Data-based Decision Making (DBDM)	Yes	Quasi-experimental	Netherlands	39	Primary	Mathematics and spelling

1.5	van der Scheer, E. A., & Visscher, A. J. (2018). Effects of a data-based decision-making intervention for teachers on students' mathematical achievement. *Journal of Teacher Education*, *69*(3), 307–320. https://doi.org/10.1177/0022487117704170	Data-based Decision Making (DBDM)	No	Randomized control trials	Netherlands	48	Primary	Mathematics
1.6	van Geel, M., Keuning, T., Visscher, A. J., & Fox, J.-P. (2016). Assessing the effects of a school-wide data-based decision-making intervention on student achievement growth in primary schools. *American Educational Research Journal*, *53*(2), 360–394. https://doi.org/10.3102/0002831216637346	Focus project for Data-based Decision Making (DBDM)	Yes	Quasi-experimental	Netherlands	53	Primary	Mathematics
1.7	Staman, L. L., Timmermans, A. A., & Visscher, A. A. (2017). Effects of a data-based decision making intervention on student achievement. *Studies in Educational Evaluation*, *55*, 58–67.	Focus project for Data-based Decision Making (DBDM)	No	Quasi-experimental	Netherlands	84	Preschool to Primary	Mathematics
2.1	Lai, M. K., McNaughton, S., Timperley, H., & Hsiao, S. (2009). Sustaining continued acceleration in reading comprehension achievement following an intervention. *Educational Assessment, Evaluation and Accountability*, *21*(1), 81–100. https://doi.org/10.1007/s11092-009-9071-5	Learning Schools Model	Yes	N/A	New Zealand	7	Secondary	Reading
2.2	Lai, M. K., McNaughton, S., Amituanai-Toloa, M., Turner, R., & Hsiao, S. (2009). Sustained acceleration of achievement in reading comprehension: The New Zealand experience. *Reading Research Quarterly*, *44*(1), 30–56. https://doi.org/10.1598/RRQ.41.1.2	Learning Schools Model	Yes	Quasi-experimental	New Zealand	7	Primary and Secondary	Reading
2.3	McNaughton, S., Lai, M. K., & Hsiao, S. (2012). Testing the effectiveness of an intervention model based on data use: A replication series across clusters of schools. *School Effectiveness*	Learning Schools Model	Yes	Quasi-experimental	New Zealand	41	Secondary	Reading

	and School Improvement, *23*(2), 203–228. https://doi.org/10.1080/09243453.2011.652126							
2.4	Lai, M. K., Wilson, A., McNaughton, S., & Hsiao, S. (2014). Improving Achievement in Secondary Schools: Impact of a Literacy Project on Reading Comprehension and Secondary School Qualifications. *Reading Research Quarterly*, *49*(3), 305–334. https://doi.org/10.1002/rrq.73	Learning Schools Model	Yes	Quasi-experimental	New Zealand	7	Secondary	Reading
2.5	Jesson, R., McNaughton, S., Wilson, A., Zhu, T., & Cockle, V. (2018). Improving achievement using digital pedagogy: impact of a research practice partnership in New Zealand. *Journal of Research on Technology in Education*, *50*(3), 183–199. https://doi.org/10.1080/15391523.2018.1436012	Learning Schools Model	Yes	Quasi-experimental	New Zealand	9	Primary and Secondary	Writing, Reading, and Mathematics
2.6	Jesson, R., McNaughton, S., Rosedale, N., Zhu, T., & Cockle, V. (2018). A mixed-methods study to identify effective practices in the teaching of writing in a digital learning environment in low income schools. *Computers & Education*, *119*, 14–30. https://doi.org/10.1016/j.compedu.2017.12.005	Learning Schools Model	Yes	Quasi-experimental	New Zealand	7	Secondary	Writing
2.7	McNaughton, S., Lai, M. K., Amituanai-Toloa, M., & Farry, S. (2008). Enhanced teaching and learning of comprehension in Years 5–8: Otara Schools. *Teaching & Learning Research Initiative*, 121.	Learning Schools Model	Yes	Quasi-experimental	New Zealand	7	Secondary	Reading
2.8	Jesson, R., McNaughton, S., & Wilson, A. (2015). Raising literacy levels using digital learning: A design-based approach in New Zealand. *The Curriculum Journal*, *26*(2), 198–223. https://doi.org/10.1080/09585176.2015.1045535	Learning Schools Model	Yes	Design-based research	New Zealand	6	Secondary	Reading and writing

2.9	Al Otaiba, S., Connor, C. M., Folsom, J. S., Greulich, L., Meadows, J., & Li, Z. (2011). Assessment data–informed guidance to individualize kindergarten reading instruction: Findings from a cluster-randomized control field trial. *The Elementary School Journal*, *111*(4), 535–560. https://doi.org/10.1086/659031	Individualizing Student Instruction for Kindergarten (ISI-K)	Yes	Randomized control trials	United States	14	Preschool	Reading
2.10	Connor, C. M., Morrison, F. J., Fishman, B. J., Schatschneider, C., & Underwood, P. (2007). The early years: Algorithm-guided individualized reading instruction. *Science*, *315*(5811), 464–465. https://doi.org/10.1126/science.1134513	Individualizing Student Instruction (ISI)	Yes	Randomized control trials	United States	10	Primary	Reading
2.11	Fuchs, L. S., Fuchs, D., Karns, K., Hamlett, C. L., & Katzaroff, M. (1999). Mathematics performance assessment in the classroom: Effects on teacher planning and student problem solving. *American Educational Research Journal*, *36*(3), 609–646.	Classroom-based Performance assessment (PA)–driven Instruction	Yes	Randomized control trials	United States	4	Primary	Mathematics
2.12	Cordray, D., Pion, G., Brandt, C., Molefe, A., & Toby, M. (2012). *The impact of the Measures of Academic Progress (MAP) program on student reading achievement*. U.S. Department of Education.	Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) program	No	Randomized control trials	United States	32	Primary	Reading
2.13	Konstantopoulos, S., Miller, S. R., & van der Ploeg, A. (2013). The impact of Indiana's system of interim assessments on mathematics and reading achievement. *Educational Evaluation*	Indiana Diagnostic Assessment Tools Intervention (Indiana)	Yes	Randomized control trials	United States	59	Primary and Secondary	Mathematics and reading

	and Policy Analysis, *35*(4), 481–499. https://doi.org/10.3102/0162373713498930							
2.14	Quint, J. C., Sepanik, S., & Smith, J. K. (2008). Using student data to improve teaching and learning: Findings from an evaluation of the Formative Assessments of Students Thinking in Reading (FAST-R) Program in Boston elementary schools. MDRC.	Formative Assessments of Student Thinking in Reading (FAST-R)	No	Quasi-experimental	United States	57	Primary	Reading
2.15	Heller, J. I., Daehler, K. R., Wong, N., Shinohara, M., & Miratrix, L. W. (2012). Differential effects of three professional development models on teacher knowledge and student achievement in elementary science. *Journal of Research in Science Teaching*, *49*(3), 333–362. https://doi.org/10.1002/tea.21004	Teaching Cases & Looking at Student Work	Yes	Randomized control trials	United States	39 school districts (No. of schools not provided)	Primary	Science content
2.16	Greenwood, C. R., Abbott, M., Beecher, C., Atwater, J., & Petersen, S. (2017). Development, validation, and evaluation of Literacy 3D: A package supporting Tier 1 preschool literacy instruction implementation and intervention. *Topics in Early Childhood Special Education*, *37*(1), 29–41. https://doi.org/10.1177/0271121416652103	Literacy 3D	Yes	Randomized control trials	United States	18	Preschool	Child literacy

Note.

[1] 1 = self-identified publications, 2 = non-self-identified publications. 1.1, 1.2 etc. stands for the first publication, the second publication etc. in self-identified publications. 2.1, 2.2, etc. stands for the first publication, the second publication etc. in non-self-identified publications.

[2] "Yes" means that the publication reported that the intervention improved achievement, including publications that had mixed success, e.g., improvement

in one focus area but not another; "no" means that the publication reported that the intervention did not improve student achievement.