Professional Development in the Use of Data: From Data to Knowledge in Data Teams

Kim Schildkamp, Maaike Smit & Ulf Blossing

Published online: 22 Nov 2017.

Submit your article to this journal ⬀

Article views: 164

View related articles ⬀

View Crossmark data ⬀

Routledge
Taylor & Francis Group

Check for updates

Professional Development in the Use of Data: From Data to Knowledge in Data Teams

Kim Schildkamp [a], Maaike Smit[b] and Ulf Blossing[c]

[a]Department of ELAN Teacher Development, University of Twente, Enschede, The Netherlands; [b]Datateam Partners, Hengelo, The Netherlands; [c]Department of Education and Special Education, University of Gothenburg, Göteborg, Sweden

ABSTRACT

Schools need support in the use of data. To provide this support, a data team intervention was developed. A prior study conducted in the Netherlands showed that several factors can enable or hinder the work of data teams. The current replication study focuses on the factors influencing data use in data teams and the perceived effects of the data teams' work, but looking at data teams in Sweden. The results of this qualitative study show that the data teams' work is influenced by the same factors as in the Netherlands: Data characteristics (e.g., relevance of the data), team characteristics (e.g., heterogeneity of the team), and school organizational characteristics (e.g., school leader support).

Introduction

Schools face a number of performance challenges, and are looking for strategies to improve the quality of the education they provide. Data-based decision making, or data use for short, is one of the strategies that schools can use to improve educational quality. Schildkamp and Kuiper (2010, p. 482) define data use as the process of "systematically analyzing existing data sources within the school, applying the outcomes of analyses in order to innovate teaching, curricula, and school performance, and, implementing (e.g., genuine improvement actions) and evaluating these innovations." Schools may use many different types of data in their self-improvement process, both quantitative (e.g., assessment results, surveys) and qualitative (e.g., classroom observations, interviews).

Data can be used for school development and instructional purposes. For example, with regard to school development, a school may base decisions about resource allocation, student grouping, and policy on data. Moreover, teachers may use data to adjust their instruction to the needs of their students (Coburn & Talbert, 2006; Schildkamp & Kuiper, 2010; Schildkamp, Lai, & Earl, 2013). Studies show that data use can lead to school improvement in terms of increased student achievement (Carlson, Borman, & Robinson, 2011; Lai, Wilson, McNaughton, & Hsiao, 2014; Poortman & Schildkamp, 2016; Van Geel, Keuning, Visscher, & Fox, 2016).

However, schools struggle with the use of data. School staff often lack the knowledge and skills to use data effectively, and thus need professional development in this area (Earl & Katz, 2006; Marsh, Pane, & Hamilton, 2006; Park & Datnow, 2009; Schildkamp & Poortman, 2015). To meet this need, a data team professional development intervention was designed to support schools in the use of data.

CONTACT Kim Schildkamp ✉ k.schildkamp@utwente.nl 🖳 Department of ELAN Teacher Development, University of Twente, ELAN, PO Box 217, Enschede 7500 AE, The Netherlands

Data teams consist of 4–6 teachers and 1–2 school leaders. In some countries, there is also a data expert on the team. They collaboratively learn how to use data to solve an educational problem within the school, using a systematic and cyclical approach.

The study in this article replicates earlier research conducted on the perceived effects of these data teams, and the factors influencing the use of data in data teams in the Netherlands (Schildkamp & Poortman, 2015). Replication can be defined as "the purposeful repetition of previous research to corroborate or disconfirm the previous results" (Makel & Plucker, 2014, p. 2). The educational research field has focused heavily on experimental designs, randomized controlled trials, but not on the merit of replicating research results (Makel & Plucker, 2014). Replication studies are often viewed as lacking originality, prestige, and excitementand are not seen as contributing very much to the field (Makel & Plucker, 2014). Makel and Plucker (2014) found in their study on the number of replication studies conducted in the field of educational research that only 0.13% of publications were replication studies. However, in order to develop a robust knowledge base on what works in education, and the conditions under which it works, replication studies are urgently needed (Granger & Maynard, 2015; Leithwood & Jantzi, 2000; Makel & Plucker, 2014). Therefore, we focused on replicating a study conducted in the Netherlands. The data for this study are new, collected in Sweden, but the theoretical framework, data collection instruments, and data analysis procedures are similar to the previous study (Schildkamp & Poortman, 2015).

Theoretical Framework

Data Use Theory of Action

Our data use theory of action is depicted in Figure 1. This theory of action combines several data use theories of action (e.g., Bertrand & Marsh, 2015; Coburn & Turner, 2011; Lai & Schildkamp, 2013; Mandinach, Honey, Light, & Brunner, 2008; Marsh, 2012; Schildkamp & Kuiper, 2010; Supovitz, 2010) with the data team professional development model originated by Schildkamp and Poortman (2015):

- *Purpose.* Effective data use starts with some sort of purpose. This is also the first step of the data team professional development intervention. A data team works on an educational problem it wants to solve. Next, with the aim of solving the identified problem, the team thinks about possible causes of this problem, and they formulate hypotheses. This is the second step in the data team professional development intervention.
- *Data.* A data team collects data in the first step of the data team procedure to determine the scope of the problem. Next, the team collects data in the third step of the data team professional development intervention to investigate the possible causes of the problem. These can be quantitative data as well as qualitative data.
- *Information.* The collected data must be transformed into information. In step four of the data team professional development intervention, the data team checks the quality of the collected data. Are the collected data valid and reliable? If not, the team needs to go back to step three and collect new data. If the data are of adequate quality, they need to be analyzed, in step five of the data team professional development intervention. Through this process the data are transformed into information.
- *Knowledge.* For this information to become knowledge, it must be connected with school staffs' existing understanding and expertise. This happens in step six of the data team professional development intervention. The data team draws conclusions based on the information derived from the data. Given these conclusions, the data team can decide that they need to investigate new hypotheses (step two), that they need additional data (step three), or that they should continue to the next step.
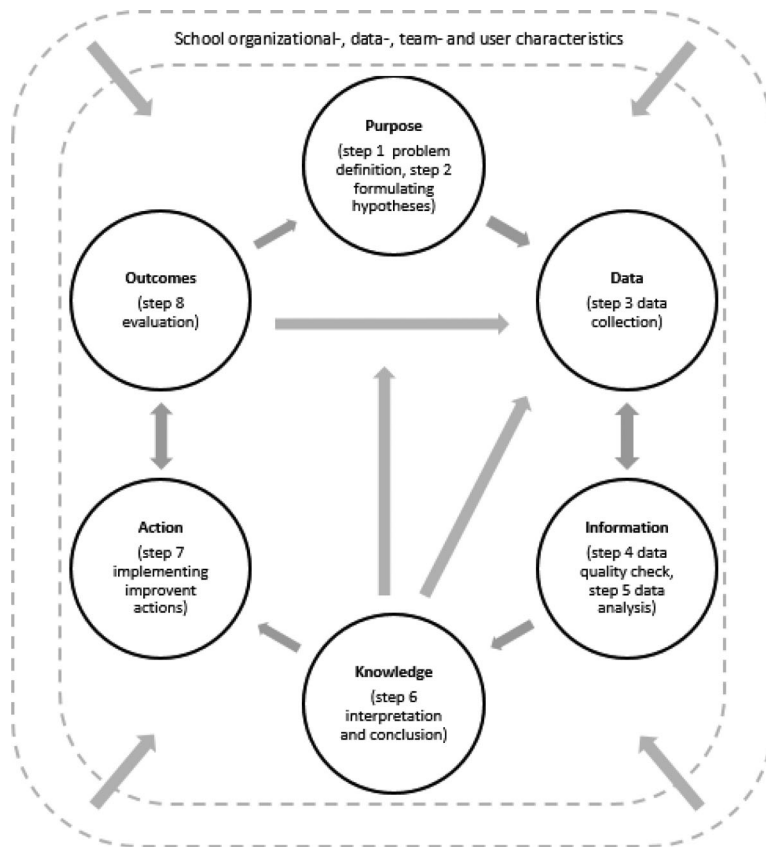
Figure 1. A data use theory of action and the data team professional development intervention.

- *Action*. The next step is the development and implementation of improvement actions (step seven of the data team professional development intervention). It is in this phase of the process that the team takes action to solve their educational problem and improve the quality of education at their school.
- *Outcomes*. The final step (step 8 of the data team professional development intervention) is evaluation. This refers to evaluation of both the process and its effect: has the goal as formulated at the start of the process been reached, did the team reach the desired outcomes? If yes, the team can begin investigating a new problem. If no, the team may need to go back to different steps of the data use process. For example, they might want to investigate new hypotheses and collect new data, or they might want to adjust their action plan. In this way, a systematic inquiry cycle is created.

The data team professional development intervention was developed with two specific goals or outcomes in mind: (1) increasing the knowledge, skills, and positive attitude of teachers with regard to (the importance of) data use, and (2) school development (e.g., division of teaching time, addressing curriculum gaps) and instructional improvement (e.g., tailoring instruction to individual students' needs, giving students feedback on their learning process), with the ultimate goal of school improvement in terms of increased student learning (Schildkamp & Poortman, 2015) or well-being. However, data use does not happen in isolation. It is influenced by several different factors.

Factors Influencing the Use of Data in Data Teams

Our literature review and previous study conducted in the Netherlands (Schildkamp & Poortman, 2015) pointed to the following *school organizational characteristics* that may influence data use (in teams). First, leadership can enable the use of data in data teams when school leaders facilitate the work of data teams, for example by providing time. Moreover, they can encourage and support team members, for example by acknowledging the importance of the team's work (Coburn & Turner, 2011; Datnow, Park, & Kennedy-Lewis, 2013; Levin & Datnow, 2012; Marsh, 2012; Park & Datnow, 2009; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015; Wayman & String-field, 2006). Second, support from and collaboration with colleagues from outside the data team is important for a team's progress. For example, a data team may come up with improvement actions that must be implemented by the entire school. It is crucial to involve colleagues in the work of data teams during an early stage (Schildkamp & Poortman, 2015). Furthermore, it is important that there is a clear vision and norms at the school with regard to data use, and that the school has clear goals that the data team can relate to in their work (Datnow et al., 2013; Earl & Katz, 2006; Levin & Dat-now, 2012; Park & Datnow, 2009; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015; Spil-lane, 2012). Finally, training and support, for example in the form of a data team coach, can support the process of data use in a data team. The data team coach can explain all the steps, model them, and re-direct the team if the team is skipping certain steps in the model or is going too fast and not really thinking about what they are doing (Mandinach & Honey, 2008; Marsh, 2012; Marsh et al., 2006; Nelson & Slavit, 2007; Schildkamp & Poortman, 2015).

Data characteristics may also influence the process of using data in a data team. First, data use in data teams is obviously not possible without data. This means that data need to be available, and that data team members should have access to the data they need for their data use process. Data avail-ability and access may be facilitated by some sort of data system (Coburn & Turner, 2011; Mandinach & Honey, 2008; Marsh et al., 2006; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015). Second, not only do these data need to be available, but the data also need to be perceived as relevant, reliable, and valid (Coburn & Turner, 2011; Mandinach & Honey, 2008; Marsh et al., 2006; Schild-kamp & Kuiper, 2010; Schildkamp & Poortman, 2015; Wayman, Jimerson, & Cho, 2012).

Finally, *team and user characteristics* may influence the use of data in data teams. First, if data team members already possess knowledge and skills with regard to collecting, analyzing, interpret-ing, and taking actions based on data (i.e., data literacy), this may speed up the process of data use in a data team. Second, a positive attitude towards data use at the start may also enable the work of data teams (Coburn & Turner, 2011; Earl & Katz, 2006; Levin & Datnow, 2012; Mandinach & Honey, 2008; Marsh, 2012; Marsh et al., 2006; Schildkamp & Kuiper, 2010; Spillane, 2012; Vanhoof, Van Petegem, & De Maeyer, 2009). Third, it is important that the team works on a shared problem (Schildkamp & Poortman, 2015). Collaboration can also strengthen the process of data use in a data team. Together, data team members need to discuss data and try to make sense of it (Coburn & Turner, 2011; Datnow et al., 2013; Marsh, 2012; Nelson & Slavit, 2007; Park & Datnow, 2009; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015). Fourth, it is important to consider the reason for participation in a data team. If teachers are obliged to participate, this may hinder the progress of a data team, because there might be too much resistance (Schildkamp & Poortman, 2015).

The aim of this study is to investigate the factors influencing the use of data in data teams, as well as the perceived effects of the data teams in a Swedish context. Therefore, the research questions are:

(1) What factors hinder and enable the work of data teams?
(2) What are the perceived effects of the data team's work in the school?
    (a) For knowledge, skills, and attitude
    (b) For data use for school development
    (c) For data use for instruction

Method

To answer our research questions, a mixed method design was used, similar to the design of the Dutch study (Schildkamp & Poortman, 2015). Several sources of qualitative data were employed (Burke Johnson & Onwuegbuzie, 2004). Triangulation is very important in a mixed methods design: if independent measures point in the same direction or at least do not contradict each other, greater confidence in the conclusion is possible (Burke Johnson & Onwuegbuzie, 2004; Miles & Huberman, 1994). Moreover, another advantage of using a mixed methods approach is complementarity. We used different measures, focus groups and individual interviews, with different respondents, to seek elaboration, enhancement, illustration, and clarification of the results (Meijer, Verloop, & Beijaard, 2002). The data obtained from different measurements provided a more comprehensive view of the effects of the data teams and the factors influencing the data teams.

Context

This study took place in a Swedish context. The Swedish school system is public, with comprehensive and compulsory primary and secondary education for all children between the ages of 7 and 16 (Carlgren, 2015). The public schools are accountable to the municipality council and the independent schools are accountable to the company or organization board. All schools are also accountable to the State through the School Inspectorate, which checks on the quality of the school every third year, in relation to the School Law, the national curriculum and syllabuses. The pupils receive grades starting in grade 6 (age 12/13). To qualify for upper secondary school, pupils must obtain a passing grade in Swedish, English, and mathematics in grade 9 of compulsory school. Grade repetition is not possible in Sweden.

Respondents

A municipality in Sweden offered to support schools in the use of data through the data team professional development intervention. Four schools in the municipality wanted to participate. The four schools were guided through the eight steps of the data team professional development intervention by a data coach from the municipality. Each team was supported by the same coach. Each data team had their own meetings at the school site, on average once a month, with the support of the coach. The data team coach monitored the data team's process and gave just-in-time support while the team was going through the eight steps of the data team cycle. Along with these on-site meetings, the municipality organized three joint meetings at the municipality in which all data teams reflected on their work (kick-off meeting, mid-term reflection meeting, and evaluation meeting). These four data teams were followed over the course of 15 months. Four focus group interviews were conducted with members of each data team. Individual interviews were also conducted with members of each data team. Finally, the data team coach from the municipality was interviewed. An overview of all of the respondents can be found in Table 1.

Instruments

To study the factors influencing data teams, and the perceived effects, four focus group interviews were conducted with members of each of the data teams. For the focus group interviews, an interview schedule was used based on the theoretical framework. During these interviews, respondents were asked about their reason for participating in the data team, their perception of its goal and how they experienced the data team. Furthermore, they were asked to describe factors they found to enable or hinder the functioning of their data team. Finally, respondents were asked about the perceived effects of the data team. The four focus group interviews took one hour each and took place just before a joint meeting of all data teams, 15 months after their start.

Table 1. Data collection.

Data team	Type of school	(Focus group) interview	Individual interviews
School A	Lower secondary education for special needs children	2 teachers and 1 team leader	1 assistant principal 1 coach[a]
School B	Primary and lower secondary education	2 teachers	1 assistant principal 1 teacher 1 coach[a]
School C	Upper secondary education	2 teachers and 1 assistant principal	[b]
School D	Upper secondary education	1 assistant principal[c]	1 assistant principal 1 coach[a]

[a]The coach was the same person for every team.
[b]Respondents were not available for an interview at the time of the study.
[c]Two teachers were supposed to be in the focus group, but had to cancel.

Furthermore, individual interviews were conducted with data team members after the focus group meetings. Participants (see Table 1) in the focus group interviews did not participate in the individual interview. The data team coach was also interviewed. The interview questions were the same as for the focus groups.

Analyses

To study the factors influencing data teams and their effects, we first analyzed the focus group interview results. Based on the notes made during the four focus group interviews, the results were summarized for each data team and sent to the data team for member checking. All four reports were approved by the data teams. The individual interviews were audiotaped and transcribed verbatim. The results of the individual and focus group interviews were very similar, and were therefore taken together.

To analyze the focus group and individual interview data we used a coding table based on the theoretical framework and used in previous research. Codes were used with regard to possible influential factors that concerned the school organizational characteristics, data characteristics, and user and team characteristics. To this coding table, each factor's "context" was added, as during the coding process we discovered that, for example, the municipality has an important role in the school system in Sweden. Furthermore, codes with regard to perceived effects were used.

We summarized the results by team for each research question (within-case analysis—these results can be found in Tables 2–9), after which the results of all four teams were compared and contrasted (cross-case analysis). Both within-case analysis and cross-case analysis were carried out in several rounds by the three researchers. With regard to the factors influencing the data teams, a factor was only indicated as influential if respondents explicitly indicated that it had influenced their work. Furthermore, with regard to the effects of the data teams, these pertain to the perceived effects as indicated by the respondents.

Reliability and Validity

Reliability of this study was ensured by using a systematic approach for the collection of all of the data, consistent with our research questions (Riege, 2003). Furthermore, we used a protocol, describing our research questions, our data collection method and instruments, and a coding system aligned with our theoretical framework. Internal validity was ensured by analyzing the data systematically, and highlighting major patterns of similarities and differences between data teams in tables. Moreover, misinterpretation of the results was avoided by conducting a member check (Onwuegbuzie & Leech, 2007). External validity was ensured by providing data team-specific and cross-case detailed descriptions, and by describing the congruence with our theoretical framework (Poortman & Schildkamp, 2012).

Table 2. Case summaries.

	School A	School B	School C	School D
Problem	Students not qualifying for upper secondary education	Students do not feel safe at school	Student absenteeism	Low quality dialogues between mentors and students
Hypotheses	Students have language difficulties	Students feel unsafe in certain areas Presence of older students	Student absences lead to lower grades	Students do not understand the purpose of the dialogue
Data collection	Necessary data not available	Survey	Student achievement results and absence data	Survey
Conclusions	Set up new data system	Students feel unsafe in certain areas, especially when older students are present	Students with frequent absences have lower grades	Quality of dialogue already increased, perhaps by administering the survey
Measures	None taken yet	None taken yet	Early warning to students, teachers discuss absences with students	None taken

Table 3. Data characteristics influencing data use in data teams.

	School A	School B	School C	School D
Availability	Data available Sometimes issues with missing data Sometimes issues with accessing data	A lot of data available (with support from municipality), sometimes not the data needed	Data available Sometimes issues with missing data	Issues with missing data, gathered new data.
Data quality	*Not mentioned*	Problems with quality of some data	Problems with quality of some data	*Not mentioned*

Table 4. Team and user characteristics influencing data use in data teams.

	School A	School B	School C	School D
Knowledge, skills, and attitude at the start	One teacher had knowledge and skills in data analysis in Excel Negative attitude among some teachers Some misunderstandings of aim of the data team intervention	Variation in data literacy Positive attitude Pedagogical content knowledge partly available	*Not mentioned*	Lack of data literacy Good mix of teachers of various subjects Pedagogical content knowledge available
Shared problem	Shared problem, but not from the start	Shared problem	Shared problem	Shared problem
Collaboration within the team	Mix of teachers across subjects and from two schools Regular absence of particular members Several teachers left school and data team	Mix of teachers across grades	Some teachers very motivated for data team, some not Two participants left school and data team during process	Two data team members left the team, one school leader joined the team later Mix of teachers in the data team (subjects, grades) influences conversations

Results

Case Summaries

Before describing the results with regard to our research questions, we will first present a short description of each of the data teams (see also Table 2). At data team A's school, the Inspectorate was following the school because of low results. Although there was some initial resistance, the

Table 5. School organizational characteristics influencing data use in data teams.

	School A	School B	School C	School D
School leader	Practical support and presence, helps with finding time; but very active and quick, so others hold back	Gave permission to start data team	Enthusiastic, active in collecting data, but collected too much data	Should express data team importance Change of school leaders in team
Support of and collaboration with colleagues	No collaboration with colleagues	Colleagues distributed surveys and discussed the results Positive climate	Some colleagues did not collect data when asked	Supportive colleagues; no plan for spreading the experience
Vision, norms, goals for data use	*Not mentioned*	Data teams as part of teachers' work Important to spread the data team professional development intervention to other departments	Insufficient information about goal of data team before starting	Not very clear
Time to use data	Teachers indicated that they were not given extra time besides general development time Working in a data team is perceived as a lot of work, difficult to find time Assistant principal indicated that the school provided the teachers with time within their general development time	Teachers indicated that they were not given extra time besides general development time Working in a data team is perceived as a lot of work, difficult to find time Assistant principal indicated that the school provided the teachers with time both to meet with the coaches and some additional hours	Teachers indicated that they were not given extra time besides general development time Working in a data team is perceived as a lot of work, difficult to find time	Teachers indicated that they were not given extra time besides general development time Working in a data team is perceived as a lot of work, difficult to find time Assistant principal indicated that the school provided the teachers with time within their general development time

Table 6. Context characteristics influencing data use in data teams.

	School A	School B	School C	School D
Pressure and support	Pressure by Inspectorate helped to create shared goal Support from the municipality	Support from the municipality; they are good at gathering data	*Not mentioned*	Support from the municipality
Coach	Coach helped to facilitate process by asking questions, tutoring, and pausing the process when needed; lacked expertise in data analysis	Coach helped data team through the eight steps and questioning decisions; however, coach lacked data use expertise	Coach helped team to focus on each step, stick to the method	Coach had agenda for the meeting However, the coach could have steered more to enable more efficient meetings Coach absent sometimes and lacked expertise in data analysis
Collaboration with other schools	*Not mentioned*	*Not mentioned*	Because it gave the opportunity to get to know other schools in the region	*Not mentioned*

team realized after a while that too many students were not qualifying for upper secondary education. The first hypothesis they wanted to investigate was whether this was due to language difficulties. However, although they spent a lot of time on this, the team did not succeed in collecting the necessary data. As a result, the team decided to set up new procedures to improve data collection

Table 7. Effect of data teams on knowledge, skills, and attitude.

	School A	School B	School C	School D
Knowledge, skills, and attitude	Awareness of importance of data use and following each of eight steps Awareness that data use is a process that takes time More aware of availability of data Awareness that data can help determine what students need to move forward	Awareness of importance of data use and following each of eight steps Awareness around difficulties in constructing a survey Awareness of how data use can be a tool within the school to make informed decisions	Awareness of importance of data use and following each of eight steps Thinking more about reliability of data now More pedagogical skills with regard to how to motivate students	Awareness of importance of following each of eight steps Awareness that data use is a process that takes time

Table 8. Effect of data teams on data use for instruction.

	School A	School B	School C	School D
Data use for instruction	Start to use benchmark data now, when students enter the school	Data use in the classroom did not change; but instruction was also not the focus of the problem	School sends out earlier warnings to students on their absences and employs more strategies to do so Teachers tell students importance of completing grades and importance of presence	*Not mentioned*

Table 9. Effect of data teams on data use for school development.

	School A	School B	School C	School D
Data use for school development	New data collection procedures in place School leader would like to continue data team work	School management thinks more about data More knowledge of student safety based on data The result was handed over to a development group, to be continued	Discussions on improving data collection Strategies to reduce student absence	School leader would like to continue data team work, and to use already existing data

about their students when they first arrive at their school, to better determine their needs and take action to address them.

Students at data team B's school, in a survey administered by the municipality, reported not feeling safe. The team decided to develop their own survey to investigate hypotheses with regard to the causes of this problem. The data team also conducted individual interviews and group interviews with students to study possible causes. They found that students indicated that several locations (such as the toilets and football grounds) felt unsafe, and they also mentioned causes for this (e.g., the presence of older students). The data team handed over their results to the school's safety working group. This group is thinking about actions to take based on these conclusions. Furthermore, the data team started discussing with school management how to continue to use the data team professional development intervention in the school.

School C wanted to study the problem of student absenteeism. Its hypothesis was that high student absence rates led to lower grades. The data team started by building a large database. However, when they looked at this database, they discovered that there were too many data to be able to make sense of them. The team also did not trust some of the data they collected, as not all of the teachers recorded student absence consistently. The team decided to investigate the hypothesis "students who are absent between 20–30% of the time have more F grades than students with lower absence rates."

Their analysis showed that the hypothesis was correct. Based on these results, the school decided to send out warnings to pupils about their absences very early in the school year. Teachers also started using a variety of strategies to discuss absenteeism with students.

Data team D focused on the so-called "development dialogue": a conversation between mentor and student about the latter's development that takes place every term. Customer surveys from the municipality showed that around 50% of all students assessed this development dialogue as meaningless. The team came up with several possible causes, such as "students do not understand the purpose of the conversation." They designed a student survey to investigate this problem further. However, because of the low response rate of 47%, the data team considered the results to be less reliable. Around the same time, the results from the latest customer survey by the municipality were published. This survey showed that student satisfaction with the development dialogue had increased significantly over the past year. The data team wondered whether the survey and discussions about the topic had already raised awareness about the problem among teachers and students. The data team decided to wait for the results of the next survey to see whether additional action was needed.

Factors Influencing Data Teams

Several factors were found to influence the work of the data team. These factors pertain to data characteristics, user characteristics, school organizational characteristics, and context characteristics. The results by data team for each factor are summarized in Tables 3–6.

Data Characteristics

The data team coach indicated that schools have a lot of data available; however, they sometimes lack good data systems. In the focus groups, data team members from three schools also mentioned that data were available (e.g., assessment data, IQ data, attention deficit hyperactivity disorder status). However, the data teams also came across several issues with regard to data characteristics (see Table 3), pertaining to:

- Missing data (e.g., some students did not take certain assessments, did not complete surveys, records not up to date).
- Accessing data (e.g., data from students' former schools were not accessible).
- Data overload (e.g., too much data available, where to start). The respondents from school B indicated, for example: "Sometimes I think there is too much data. Lack of data is not a problem, but it is hard to get the correct data."
- Quality of some data (e.g., validity of a survey).

User and Team Characteristics

Knowledge, Skills, and Attitude at the Start. The variation in levels of data literacy within the teams was mentioned as an influential factor several times (teams A, B, and D) (see also Table 4). The contribution of a teacher with knowledge and skills to carry out data analysis in Excel was considered helpful (team A), whereas the teachers in team B who had more knowledge about data use than their colleagues in the team (because they already had some experience) observed that the process went slowly:

> The other data team members had to come to insights that we already had. I felt I always rushed things forward. Maybe I wanted to rush things forward too much.

In the individual interview, the assistant principal from school D mentioned that several teachers lacked the competence to work in this more scientific manner. The data team coach was also surprised about the (low) level of data use skills in the teams:

> The people in schools are not used to thinking and to speaking in this way about their problems, challenges, etc. They are not used to thinking scientifically and to using data. Most have a degree from higher education, so I am also a bit astonished about this. We have a long way to go.

At school A, it also became clear from the individual interview with the assistant principal that not all teachers were enthusiastic about using data, especially at the beginning, but the teachers also admitted that they did not understand the purpose of the data team at the start.

Pedagogical content knowledge was mentioned as an important factor by two of the teams (teams B and D). Respondents from team B described, for example, how they were missing the content knowledge that teachers of grades 1–3 would have had when they wanted to interview children from these age groups.

Shared Problem. All of the teams (A, B, C, and D) mentioned that having a shared problem positively influenced the functioning of their data team. The problems were selected because they were "interesting to everyone" (team C), because of the complexity of the problem (team B), and because municipal surveys clearly pointed the data team towards a problem (team B and D). For two of the teams (A and C), the outside world also played a role: respondents from team A reported that pressure by the Inspectorate was an enabling factor for data team success because it made everyone understand and focus on the same problem. For team C, a shared problem was also their school's low status in the region. As one respondent phrased it:

> We would like to improve our status. We thought this project could be a good way to reach out to other schools and say: "this is not such a bad school." Also, this could help us to be even better.

Collaboration within the Team. Several teams (teams A, B, and D) mentioned aspects of team collaboration as factors influencing the functioning of their data team. Three of the teams mentioned the mix of teachers in the team as difficult for their collaboration. The mix of teachers from various grades and subjects made planning meetings difficult in some cases (teams A and C). On the other hand, the mix in backgrounds was considered positive. Having good social networks is important for data teams, and participation in a data team seemed to strengthen the social networks at some schools. Team D, for example, mentioned that the variety in backgrounds encouraged good discussions on collecting and analyzing data. In team A, the fact that there were teachers from two schools experiencing the same problem was considered positive. The data team coach commented on this mix of backgrounds:

> All data teams were teams of people who did not usually work together. So they took a school perspective rather than a class or group perspective. That made it that they understood that there were different perspectives on the problem, and that they all had different knowledge.

School Organizational Characteristics

School Leadership. All data teams had a school leader in the team (the assistant principal)—see also Table 5. The change of school leaders in team D was mentioned as a hindering factor. Some of the school leaders took a more leading role than others; the school leader at schools A and C was especially active. Several of the respondents valued the active involvement of the school leaders as helpful for the data team. However, there can also be a downside. A teacher from school A stated, for example, that some team members held back because the school leader was so active. He reflected:

> Because she talks so much, sometimes people cannot say what they think. They are still thinking about things, and she is already saying things.

Respondents listed a few other characteristics of effective leadership in relation to the data team:

- Provide information on data team process and goal (team C).
- Support with the practical organization of the data team (e.g., planning) (team A).
- Facilitate the data team's work by helping them to find time (team A).

Vision for Data Use. The focus group respondents from school B talked about the importance of using data, and the data team professional development intervention as a way to involve teachers in the use of data. The assistant principals of schools B and D both indicated that they wanted to continue with the work of the data teams. The assistant principal of school B stated that she wanted to spread the data team professional development intervention to other departments. The respondents from team B indicated that working in data teams should be included permanently in teachers' schedules.

Time to Use Data. A divergence in perceptions exists regarding time to use data. Several teachers mentioned the lack of time as a hindering factor. Interestingly, the assistant principals from schools A, B, and D stated that the teachers had time for it, as work on school development is incorporated in the overall service as a teacher. Teachers perceived this differently; for them, the data team work came on top of all other tasks. This raises the question of whether teachers and school leaders explicitly discuss what is expected of teachers in terms of school development tasks.

Context Characteristics

Pressure and Support. Three of the schools discussed how pressure and support from the municipality influenced the data team functioning (schools A, B, and D), but this support was not mentioned by the respondents from school C, although all schools belonged to the same municipality (see also Table 6). Respondents from school B explicitly mentioned the abundance of data in their municipality as an enabling factor. This support was also mentioned as an enabling factor by the respondents from schools A and D, who mentioned that collaboration with the municipality enabled their work. Furthermore, the data provided by the municipality also determined the focus of three of the data teams. At school A, it was the school Inspectorate who influenced the problem the data team wanted to focus on. Respondents from school A mentioned that pressure exerted by the Inspectorate as a result of low student achievement results had been facilitative for the data team's work because it gave all team members the same goal.

Coach. Respondents from schools A and C considered the outside coach as an enabling factor for their data teams. The coach was perceived as an objective outsider. A respondent from school A noted:

> When he was there, we did much more than without him. He helped us stick with the method: "No, do not go there yet" "and" An enabling factor is to have a coach from the outside. To have a different perspective. An outside coach also helps because of the status: someone is coming from the outside.

Respondents from schools A, B, and D had mixed experiences with the outside coach. Teachers from school B and the assistant principals from schools C and D would have liked a coach who had more expertise in data use in addition to general coaching skills. The assistant principal from school D would have liked more steering from the coach, to guide the process and to coach the data team members:

> He was very focused, but also rather waited for us to figure things out on our own, which is frustrating, but I can understand why; this is probably more efficient in the long run. I expected him to lead the process a little bit more.

Collaboration with Other Schools. The focus group respondents from team C indicated that collaboration with other schools (and the municipality) also enabled their work. The municipality organized meetings where all four data teams got together, shared their work, and reflected on their work. For school C, one of the reasons to participate was to get to know other schools in the region.

Effects of Data Teams

Knowledge, Skills, and Attitude

In the focus group interviews, respondents did state that their knowledge and skills with regard to data use (see Table 7) increased as a result of participating in a data team. However, this did not pertain to knowledge and skills with regard to how to analyze data, but had more to do with an increased awareness, such as:

- Awareness of the need to use data to make informed decisions (teams A, B, and C). A teacher from school A explained: "Personally, I like the data team structure. You waste a lot of time just talking about problems without going forward, or you go forward too fast, which we would have done without data teams."
- Awareness of the importance of following each of eight steps in data use, rather than rushing to implement measures (all teams). A respondent from team B noted: "You have to really follow each step; do every step well or you will ruin the process, the other steps as well." Similarly, a teacher from team A said: "The process is very good. I tended to jump ahead, but our team leader stopped us. Our pupils need structure, but we need structure, too."

Data Use for Instruction

Only team C reported using data for instruction at the classroom level. At school C, students now receive earlier warnings about their absences. A teacher from school C reported that, in addition to these school-wide warnings, he also talked more with his students about absenteeism:

> I am now telling my students more that they have to participate in all the classes to be a craftsman in their career. I tell them about their absence and why it is important to be present. I use the conclusions from our research in my conversations with pupils.

However, the question remains of whether these measures were really based on data or still based on the team's hunches. Instead of investigating further why students were absent, and what role teachers played in this absence, the data team immediately took action to try to prevent absenteeism. It is unclear whether their measures actually targeted the root causes of their problem.

Data Use for School Development

The focus group respondents mentioned several school-level effects related to data use (see Tables 8 and 9). These included:

- (Plans for) improving data collection (schools A and C). At school A there are new procedures in place for data collection: when the school gets new students, data from their old schools are now systematically collected in order to better attend to their needs in future. Data team members from school C began to discuss with the school how to improve data collection about student absences.
- More awareness of student safety, and a school development team is creating a plan to increase safety based on the data team's results (school B).
- Strategies to reduce student absenteeism (school C). Students now receive earlier warnings about their absences and teachers employ more strategies to address this issue.

Conclusion and Discussion

Factors Influencing Data Teams

The purpose of this study was to replicate an earlier study (Schildkamp & Poortman, 2015) into the factors influencing the use of data in data teams and the perceived effects of data teams. This study confirms the importance of several factors that need to be taken into account when supporting the use of data in schools. The same factors seem to influence the work of data teams in both the Netherlands and Sweden.

Similar to the results of the Dutch study (Schildkamp & Poortman, 2015), several *data characteristics* were found to influence the functioning of data teams. Each characteristic can become either an enabler or a barrier (see Figure 2). For example, the availability of good quality data can enable the work of a data team. In this study, this was specifically provided by the municipality, which made sure that schools had access to a lot of high quality data. A lack of good quality data can hinder the work of data teams. Furthermore, the data must be relevant. If too many data are collected (as happened in teams B and C), then data team members are "drowning in data" and experience data overload.

Several *user and team characteristics* can also act as either an enabler for or barrier to data teams' work, according to the data team members (see Figure 3). The data characteristics found to be important in this study are almost exactly the same as in the Dutch study (ibid), again confirming the importance of these factors. As also found in the Dutch study, the team's work is enabled if some data team members already possess some knowledge and skills with regard to how to use data (i.e., data literacy), have pedagogical content knowledge, and have a positive attitude. Using data is not
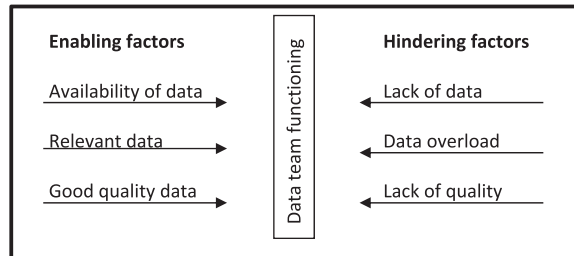

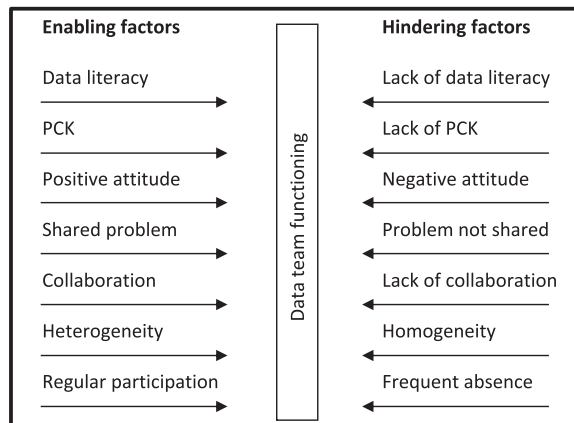**Figure 2.** Enabling and hindering data characteristics for data teams.

Figure 3. Enabling and hindering user and team characteristics for data teams.

just about using data, but is about data as a source of information to blend with existing pedagogical content knowledge.

Furthermore, it helps if members of a team work on a shared problem and have shared goals, and when team members participate and collaborate in meetings. Having good social networks is important for the progress of data teams, but participating in a data team can also help strengthen these social networks. A lack of or absence of these same factors can hinder the work of a data team.

However, similar to the results of the Dutch study, the results with regard to the backgrounds of teachers in a team are again mixed. On the one hand, having teachers with different backgrounds in the team (e.g., various subjects and grades) appears to be helpful because these teachers have different types of knowledge it can use. On the other hand, it also seemed to hinder the progress of the team at times, because teachers sometimes did not understand each other. Moreover, the different backgrounds of the members sometimes seemed to hinder the learning pace for some of the team members, especially those more experienced, who had to wait for others to arrive at the insights they already possessed.

Moreover, again similar to the Dutch study (Schildkamp & Poortman, 2015), it was found that school *organizational characteristics* can both enable and hinder the work of data teams (see Figure 4). First, this pertains to factors inside the school organization. The school leader can enable the work of data teams by providing members with time, by encouraging and motivating team members, by making the goal and importance of the data team clear, and by distributing leadership tasks. School leaders who do not behave in this way may hinder the work of a data team. For example, the school leader at school A did not distribute leadership tasks; rather, she was so enthusiastic that she did all the work herself. This was counterproductive, as teachers started to hold back, realizing that she would do everything and make all the decisions. A clear vision of how the data team fits into the daily lives of school staff is also important.

Finally, the results show that context characteristics influence the work of data teams (see Figure 5). These results are slightly different from the Dutch results. In Sweden, the municipality supported the data teams. The municipality made sure that data were available (see also Figure 1), which influenced the problems the teams decided to focus on. Moreover, the municipality supported all four teams in this study by providing them with a data coach and by organizing reflection activities on three occasions. In the Netherlands, municipalities do not provide this support to schools. In both the Netherlands and Sweden, the data team coach facilitated the process and facilitated the data analysis and data use. However, as the results indicated, sometimes it was difficult to find a balance between too much or too little coaching. Some respondents indicated that they would have liked to receive more steering, and also more support in the data analysis.
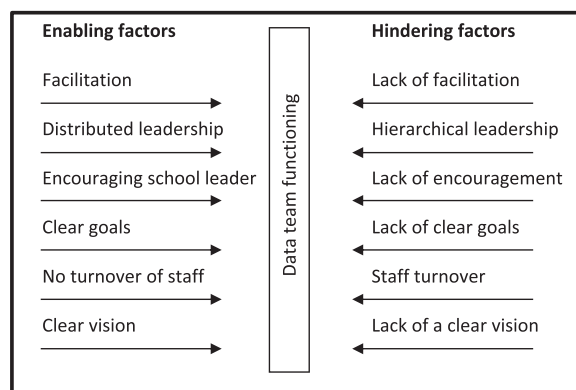

Enabling factors		Hindering factors
Facilitation		Lack of facilitation
Distributed leadership		Hierarchical leadership
Encouraging school leader	Data team functioning	Lack of encouragement
Clear goals		Lack of clear goals
No turnover of staff		Staff turnover
Clear vision		Lack of a clear vision

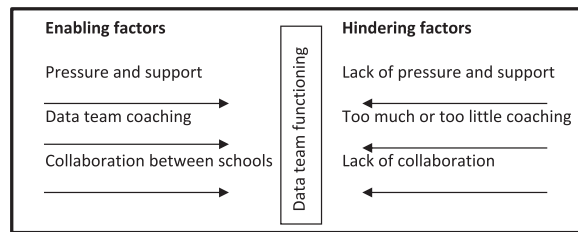**Figure 4.** Enabling and hindering school organizational characteristics for data teams.

Figure 5. Enabling and hindering context characteristics for data teams.

In both the Netherlands and Sweden it was also found that the Inspectorate can enable or hinder the work of a data team. Respondents from team A reported that pressure by the Inspectorate was an enabling factor for data team success, because it made everyone acknowledge that they had an urgent problem that they needed to solve. However, too much or too little pressure from organizations such as the Inspectorate can be counterproductive.

The results of this replication study show that most of these factors enabling or hindering a data team seem to work in the same manner in different contexts. This study confirms again how data use is intertwined with characteristics of the data, individuals and the team, and with organizational capacity, structure, and functioning. All of these components are interdependent, and how data-based decision making takes shape within different contexts depends on many interrelated structures. The results of this study provide an indication that many of the issues found here may also be found in other countries, such as the USA (e.g., Mandinach et al., 2008; Marsh, 2012), the Netherlands (Schildkamp & Poortman, 2015), England, Poland, Lithuania, and Germany (e.g., Schildkamp, Karbautzki, & Vanhoof, 2014). It is now time to take this knowledge base one step further. We have confirmed the importance of all of these single variables; now it is time to investigate how these variables influence each other, and how we can leverage these different variables to support schools in the use of data.

The results of this study also show that context can influence all the factors mentioned above. In Sweden, for example, much more attention is being paid to the social domain of education in educational policy, whereas the focus in the Netherlands has always been more on the cognitive domain. This influences the types of problem data teams choose to focus on. Furthermore, the municipality enabled the work of the Swedish teams by providing them with a coach, and by facilitating between-school collaboration at meetings for the four data teams. The latter is also crucial, because the municipality in a sense facilitated another type of professional learning community, consisting of members of different schools. Hargreaves (2010) argues that these types of network are fundamental to achieving effective school improvement.

Perceived Effects of the Data Teams

Participation in a data team led to some effects on knowledge, but mostly at the level of awareness. Data team participants became more aware of the importance of using data to make informed decisions, and the importance of going through all the steps of the data team professional development intervention instead of skipping steps and rushing through the process. In team C, teachers talked about using data to prevent student absenteeism. Students in this school received early warnings about their absences from class, and their absence was addressed by their teachers to a greater extent.

However, the question here is whether these measures will lead to the desired effects, as the data team did not investigate further why students skipped classes. Moreover, they did not investigate what role they themselves played in these absences. As noted by Timperley, Kaser, and Halbert (2014), when starting with a process of school improvement, teachers and school leaders often

have deep-seated beliefs about the role of the "others" (in this study, the students). However, after investigating these initial types of hypotheses, it is important to focus on these two questions: "How do *we* contribute to the problem?" and "How can *we* solve the problem?" A shift is needed from what others should do (e.g., "You should come to school") to what can we do (e.g., "Why are you not coming to school, and how can we change that?").

In the other three teams, the focus group results show that (1) the team members were planning to use data in the classroom in the future and (2) a heightened awareness of the importance of using data to address student needs existed. In the Netherlands, the same effects were found after the first year, but effects at both teacher and student learning levels were also found after two years or more (Poortman & Schildkamp, 2016).

Limitations

This study has some limitations. This is a small-scale study, and the results are based on self-perceptions. We focused on the factors hindering or enabling the work of the data teams that were experienced as such by the data team members. Data team members may have forgotten to mention some factors, and they might not have been aware of some of the factors. However, it was not the aim of the study to identify causal relations between the work of the data team and influential factors. It was our aim to gain more in-depth insights into possible enablers and hinderers of the work of data teams as perceived by data team members. The results give indications of important enablers and barriers to take into account. Furthermore, we focused on the perceived effects, which might be an over- or under-estimation of the effects found. However, because we used respondent triangulation and asked for the views of the teachers, assistant principals and coach from the municipality, we do think that the awareness effects that we found represent the reality. Since the implementation of changes can take up to five years (Desimone, 2002), it will be interesting to monitor the results of these data teams further.

Practical Implications and Further Research

Although we know from previous research how important the provision of time is for any data use intervention (e.g., Datnow et al., 2013; Marsh, 2012; Schildkamp & Poortman, 2015), it is interesting to note that provision of time is perceived differently by teachers and school leaders. Teachers indicated that they were not given time, whereas assistant principals indicated that they were given time. Therefore, before a data team start its work, it is crucial that school leaders and teachers discuss these kinds of issue.

Moreover, especially in the first year, it is important for the data coach to steer the process and support the team in its data collection and analysis. As stated by Lachat and Smith (2005), the coach needs to have both a coaching role (e.g., steer the process, promote reflection) and an expert role (e.g., support and model data analysis, explain the eight steps). In the second year, the coach can slowly reduce this more active role in order to stimulate independence and sustainability. However, more research is needed into the role of the data coach; for example, how much support do coaches need to provide, which roles are crucial for the progress of a team, and how can coaches stimulate reflection and deep thinking in a data team to support the learning of its members?

Another question that needs to be answered regards the most effective composition of a data team. How much heterogeneity is optimal, and when do the differences become too large and waste too much time? Differences between team members can be stimulating if the team has discussions that lead to cognitive conflicts; that is, differences in opinion, premises, and ideas, for example with regard to which actions to take based on particular data. These kinds of conflict, if addressed properly in a team, can stimulate learning (Achinstein, 2002; Butler & Schnellert, 2012; Katz, Earl, & Ben Jaafar, 2009). However, if the differences in a team are too great, another type of conflict might arise, which is counterproductive: affective conflicts, which pertain to personal differences,

rivalry, and opposing personalities (Butler & Schnellert, 2012). An important element of the coach's role is steering the team away from affective conflicts and addressing cognitive conflicts, as was also found by Bolhuis, Schildkamp, and Voogt (in press).

Finally, the results of this study show that data use does not happen in isolation, but is influenced by factors inside and outside the school. This study shows that factors external to the school also shape data use in schools. Policy support, in this study from the municipality, can enable the use of data. Some pressure from policy, in this study from the school Inspectorate, can also be beneficial. The question that arises here is how much support is enough and what type of support is needed? A balance needs to be found between pressure and support, so that schools want to show others how they are doing (e.g., the municipality, the Inspectorate, parents) and want to use data for improving the quality of teaching and learning.

Disclosure Statement

ORCID

Kim Schildkamp 🆔 http://orcid.org/0000-0001-6154-6857

References

Achinstein, B. (2002). Conflict amid community: The micro-politics of teacher collaboration. *Teachers College Record*, *104*, 421–455.

Bertrand, M., & Marsh, J. A. (2015). Teachers' sensemaking of data and implications for equity. *American Educational Research Journal*, *52*(3), 423–462.

Bolhuis, E., Schildkamp, K., & Voogt, J. (in press). Improving teacher education in the Netherlands: Datateam as learning team? *European Journal of Teacher Education*.

Burke Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14–26.

Butler, D. L., & Schnellert, L. (2012). Collaborative inquiry in teacher professional development. *Teaching and Teacher Education*, *28*(8), 1206–1220.

Carlgren, I. (2015). *Kunskapskulturer och undervisningspraktiker [Knowledge cultures and teaching practices]*. Gothenburg: Daidalos.

Carlson, D., Borman, G., & 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.

Coburn, C. E., & Talbert, J. E. (2006). Conceptions of evidence use in school districts: Mapping the terrain. *American Journal of Education*, *112*, 469–495.

Coburn, C. E., & Turner, E. O. (2011). Research on data use: A framework and analysis. *Measurement: Interdisciplinary Research and Perspectives*, *9*(4), 173–206.

Datnow, A., Park, V., & Kennedy-Lewis, B. (2013). Affordances and constraints in the context of teacher collaboration for the purpose of data use. *Journal of Educational Administration*, *51*(3), 341–362.

Desimone, L. M. (2002). How can comprehensive school reform models be successfully implemented? *Review of Educational Research*, *72*(3), 433–479.

Earl, L. M., & Katz, S. (2006). *Leading schools in a data-rich world. Harnessing data for school improvement*. Thousand Oaks, CA: Corwin Press.

Granger, R. C., & Maynard, R. (2015). Unlocking the potential of the "what works" approach to policymaking and practice improving impact evaluations. *American Journal of Evaluation*, *36*, 558–569. 1098214015594420.

Hargreaves, D. (2010). *Creating a self-improving school system*. Retrieved October 28, 2016, from http://dera.ioe.ac.uk/2093/1/download₃FID3D1336722₆FILENAME3Dcreating-a-self-improving-school-system.pdf

Katz, S., Earl, L., Ben Jaafar, S. (2009). *Building and connecting learning communities: The power of networks for school improvement*. Thousand Oaks, CA: Corwin Press.

Lachat, M. A., & Smith, S. (2005). Practices that support data use in urban high schools. *Journal of Education for Students Placed at Risk (JESPAR)*, *10*(3), 333–349.

Lai, M. K., & Schildkamp, K. (2013). Data-based decision making: An overview. In K. Schildkamp, M. K. Lai, & L. Earl (Eds.), *Data-based decision making in education: Challenges and opportunities* (pp. 9–21). Dordrecht: Springer.

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.

Leithwood, K., & Jantzi, D. (2000). Principal and teacher leadership effects: A replication. *School Leadership & Management*, *20*(4), 415–434.

Levin, J. A., & Datnow, A. (2012). The principal role in data-driven decision making: Using case-study data to develop multi-mediator models of educational reform. *School Effectiveness and School Improvement*, *23*(2), 179–201.

Makel, M. C., & Plucker, J. A. (2014). Facts are more important than novelty replication in the education sciences. *Educational Researcher*, *43*, 304–316. 0013189X14545513.

Mandinach, E. B., & Honey, M. (2008). *Data-driven school improvement: Linking data and learning*. New York, NY: Teachers College Press.

Mandinach, E., Honey, M., Light, D., & Brunner, C. (2008). A conceptual framework for data-driven decision-making. In E. Mandinach & M. Honey (Eds.), *Data-driven school improvement: Linking data and learning* (pp. 13–31). New York, NY: Teachers College Press.

Marsh, J. A. (2012). Interventions promoting educators' use of data: Research insights and gaps. *Teachers College Record*, *114*(11), 1–48.

Marsh, J. A., Pane, J. F., & Hamilton, L. S. (2006). *Making sense of data-driven decision making in education: Evidence from recent RAND research* (OP-170). Santa Monica, CA: RAND Corporation.

Meijer, P. C., Verloop, N., & Beijaard, D. (2002). Multi-method triangulation in a qualitative study on teachers' practical knowledge: An attempt to increase internal validity. *Quality and Quantity*, *36*(2), 145–167.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage Publications.

Nelson, T. H., & Slavit, D. (2007). Collaborative inquiry among science and mathematics teachers in the USA: Professional learning experiences through cross-grade, cross-discipline dialogue. *Journal of In-Service Education*, *33*(1), 23–39.

Onwuegbuzie, A. J., & Leech, N. L. (2007). Validity and qualitative research: An oxymoron? *Quality and Quantity*, *41* (2), 233–249.

Park, V., & Datnow, A. (2009). Co-constructing distributed leadership: District and school connections in data-driven decision-making. *School Leadership and Management*, *29*(5), 477–494.

Poortman, C. L., & Schildkamp, K. (2012). Alternative quality standards in qualitative research? *Quality and Quantity*, *46*, 1727–1751.

Poortman, C. L., & Schildkamp, K. (2016). School improvement effects of a data use intervention for teachers. *Teaching and Teacher Education*, *24*, 377–386.

Riege, A. M. (2003). Validity and reliability tests in case study research: A literature review with "hands-on" applications for each research phase. *Qualitative Market Research: An International Journal*, *6*(2), 75–86.

Schildkamp, K., Karbautzki, L., & Vanhoof, J. (2014). Exploring data use practices around Europe: Identifying enablers and barriers. *Studies in Educational Evaluation*, *42*, 15–24.

Schildkamp, K., & Kuiper, W. (2010). Data-informed curriculum reform: Which data, what purposes, and promoting and hindering factors. *Teaching and Teacher Education*, *26*, 482–496.

Schildkamp, K., Lai, M. K., & Earl, L. (Eds.). (2013). *Data-based decision making in education: Challenges and opportunities*. Dordrecht: Springer.

Schildkamp, K., & Poortman, C. L. (2015). Factors influencing the functioning of data teams. *Teachers College Record*, *117*(5), 1–42.

Spillane, J. P. (2012). Data in practice: Conceptualizing the data-based decision-making phenomena. *American Journal of Education*, *118*(2), 113–141.

Supovitz, J. (2010). How principals and peers influence teaching and learning. *Educational Administration Quarterly*, *46*(1), 31–56.

Timperley, H., Kaser, L., & Halbert, J. (2014). *A framework for transforming learning in schools: Innovation and the spiral of inquiry: Seminar series 234*. Melbourne, Victoria: Centre for Strategic Education.

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*, 360–394.

Vanhoof, J., Van Petegem, P., & De Maeyer, S. (2009). Attitudes towards school self-evaluation. *Studies in Educational Evaluation*, *35*(1), 21–28.

Wayman, J. C., Jimerson, J. B., & Cho, V. (2012). Organizational considerations in establishing the data-informed district. *School Effectiveness and School Improvement*, *23*(2), 159–178.

Wayman, J. C., & Stringfield, S. (2006). Data use for school improvement: School practices and research perspectives. *American Journal of Education*, *112*(4), 463–468.