

Data-based decision making for instructional improvement in primary education

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Abstract

Data-based decision making can help teachers improve their instruction. Research shows that instruction has a strong impact on students' learning outcomes. This study investigates whether Dutch primary school teachers use data to improve their instruction. Four aspects of instruction were distinguished: purposeful teaching, adaptive instruction, feedback and learning time. Data were collected by means of a survey ($n = 318$) and through interviews with teachers ($n = 18$). The results show that although almost all teachers use data with the intention of improving their instruction, they skip important steps in the data use process. They do not make optimal use of all available data and fail to carry out all the relevant analyses. Teachers mainly use data when their own students have disappointing learning outcomes. They are, however, less interested in using data related to the functioning of the school as a whole.

Keywords: data-based decision making; instructional improvement; school improvement

Introduction

Data-based decision making has never been more prevalent. The use of data has become a prominent feature of education policy, not only in the United States (e.g., with the No Child Left Behind Act), but also in other countries. This focus on data-based decision making comes as no surprise, since several studies have shown that effective use of data by teachers and school leaders can result in school improvement and better learning outcomes (Black, Harrison, Lee, Marshall, & Wiliam, 2004; Carlson, Borman, & Robinson, 2011; Earl & Katz, 2006; McNaughton, Lai, & Hsiao, 2012; Protheroe, 2001; Schildkamp, Lai, & Earl, 2013; Walsh, 2003; Young, 2006).

In this study, we define data-based decision making as the entire process of data use (e.g., assessment data, classroom observations, surveys) by teachers, data experts, school leaders, and school board members, which involves: collecting, analysing and interpreting data in order to study educational practices, the use of the obtained information as a basis for making decisions with regard to adapting educational practices, implementing these practices, and subsequently evaluating whether these adaptations have had the desired effect, in terms of improved learning outcomes (Coburn & Turner, 2011; Coburn, Toure, & Yamashita, 2009).

The adaptation of educational practice often involves instructional changes. Several meta-analyses (Hattie, 2009; Hattie & Timperley, 2007; Scheerens, 2007) have indicated that the teacher's instruction plays a crucial role in the students' learning process. Data can inform a teacher's instruction and can indicate where instruction needs to be improved to enhance student learning. Despite the focus on data-based decision making, there has been relatively little research into data-based decision making in relation to instructional improvement. Therefore, this study is focused on how primary school teachers use data to improve their instruction.

Research questions

The first question addressed by this study is: *What data do teachers use to adapt their instruction and how much do teachers differ in this respect?* Assessment data, for example, can provide information about the effectiveness of the teacher's instruction. When the assessment data, combined with other data available in school, are properly analysed and interpreted, they can point out possible weaknesses in the teacher's instructional behaviour, thus providing a basis for adapting certain aspects of that instructional behaviour. For example, based on the analysis the teacher can decide to spend more time on certain aspects of the curriculum, to adapt the learning goals for students, to find a more effective way of adapting instruction to differences between students, or to give students feedback on their learning outcomes and their approach. Therefore, the second question of this study is: *What role does data use by teachers play in improving their instruction?*

Theoretical framework

The students' learning process and learning progress are to a great degree determined by the quality of education provided by the teacher (Ball & Rowan, 2004; Darling-Hammond, 2010; Marzano, 2000; Rowan, Correnti, & Miller, 2002). Classroom-level factors can explain much of the difference in learning outcomes between students. By analysing instructional results in the form of students' learning outcomes (data), weak and strong aspects of the instruction can be identified and used as a basis for measures for instructional improvement (Schildkamp et al., 2013; Young, 2006).

Data use

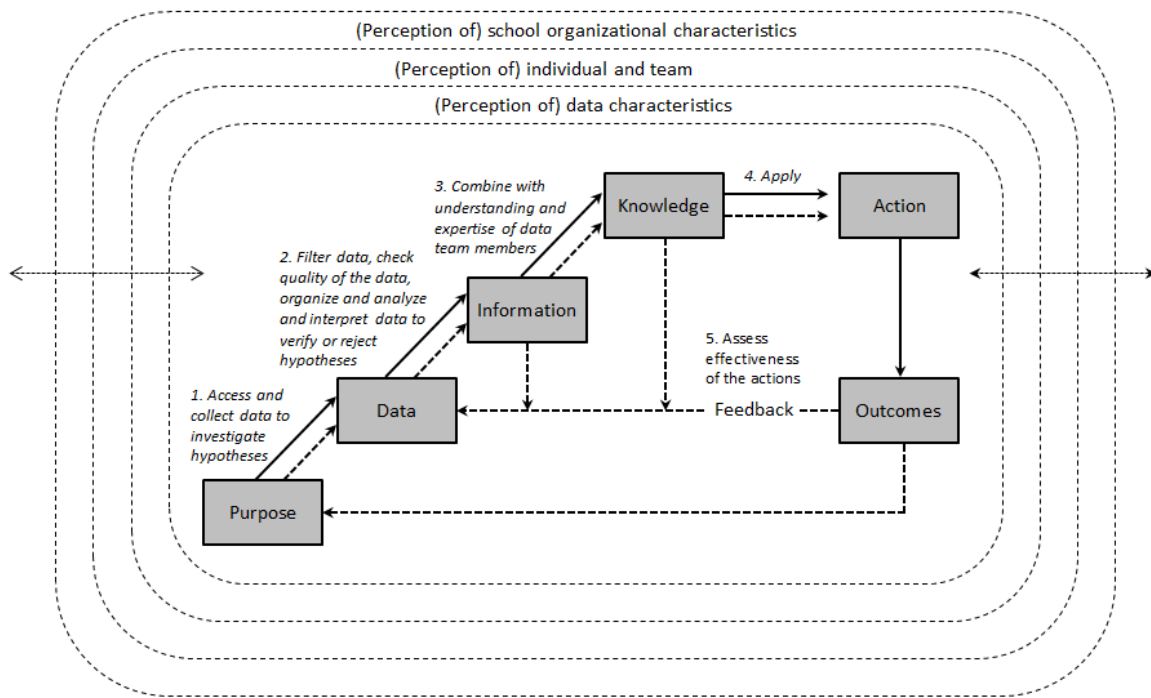
Teachers' decisions related to designing or adapting their instruction are more often based on experience and intuition than on systematically collected information (Ingram, Louis, & Schroeder, 2004). In particular, teachers use tests to take stock of the students' knowledge and skills and to monitor the students' progress, and less often to make decisions about their own instruction (Schildkamp, Karbautzki, & Vanhoof, 2013; Slavin, 2002, 2003). There is increasing evidence pointing to the fact that data use can help teachers improve their instruction. Data use can lead to school improvement and better learning outcomes (Black et al., 2004; Carlson et al., 2011; Earl & Katz, 2006; McNaughton et al., 2012; Protheroe, 2001; Schildkamp et al., 2013; Van Geel, Keuning, Visscher, & Fox, 2016; Walsh, 2003; Young, 2006).

In this study, our definition of 'data' is any factual material that is systematically collected and relates to the functioning of a school and its teachers and the learning outcomes of its students. It can consist of assessment data, inspection data, observations, background information on students, and so forth (Ikemoto & Marsh, 2007; Schildkamp & Kuiper, 2010). It is important to distinguish between 'data' and 'information'. Data are raw material and need to be interpreted to become useful. Data can be transformed into information by interpreting them in the context in which they were obtained (contextualising), by categorizing them or conducting a trend analysis, by performing calculations and by drawing connections and summarizing (Davenport & Prusak, 1998).

The process of data use

Data use entails the entire process of collecting, analysing and interpreting data in order to use the obtained information as a basis for decisions about adapting educational practices and subsequently evaluating whether these adaptations have had the desired effect (Coburn & Turner, 2011; Coburn et al., 2009). Data use therefore works according to an iterative cyclical research procedure in which teachers study how their teaching has led to specific learning outcomes (Marsh, 2012; Marsh, Pane, & Hamilton, 2006; Timperley, Wilson, Barrar, & Fung, 2007). Schildkamp and Poortman (2015) describe the steps taken in the data use process (see Figure 1).

Figure 1. *Data use theory of action and factors influencing data use (Schildkamp & Poortman, 2015, based on Marsh, 2012, p. 4, and based on Coburn & Turner, 2011; Lai & Schildkamp, 2013; Mandinach, Honey, Light, & Brunner., 2008; Marsh, 2012; Schildkamp & Kuiper, 2010; Schildkamp & Lai, 2013).*



The data use process as they describe it starts with a problem definition and a related *purpose*. Often the *purpose* of data use in schools is to improve learning outcomes. For example, based on assessment data a teacher has the perception that something is wrong with the students' learning outcomes. Hypotheses are formulated that explain the root cause or causes of the problem. *Data* are used to verify or reject the hypotheses. These data can provide teachers with insights into the students' learning outcomes and educational needs. At the same time, teachers can use the data to gain insight into their own educational practices.

To be able to verify or reject a hypothesis, first it is crucial to assess the validity and reliability of the collected data. The next step is the *analysis* of the data. By analysing the data, teachers can establish whether students are achieving the learning goals, whether students are making enough progress and pinpoint the possible problem areas for at-risk students. Teachers will be able to discover which students have not mastered certain aspects, and they will also be able to detect what kind of mistakes are being made by students. By analysing data, teachers can also determine how their

instruction has contributed to the students' progress, how effective their instruction was and which aspects of their instruction need more attention.

When teachers study the effects of their instruction and question their teaching, they transform data into *information*. This information may change their existing knowledge and perceptions of effective teaching, and create new knowledge and beliefs about effective teaching practices. Thus, by combining this information with the expertise and knowledge of other teachers within the school, new *knowledge* is gained.

This new knowledge can lead to *improvement measures* focused on improving instruction. Teachers can use this new knowledge to adapt their instruction in the classroom (*intervention*) and study the effects of these adaptations. For example, a teacher can conclude that he needs to use a form of direct instruction for certain aspects of the curriculum and to provide the students with more exercises. The *outcomes* of the improvement measures can be studied by collecting data again.

Viewed in this way, data provide teachers with feedback on their methods of instruction and on adaptations of their instruction (Mandinach & Jackson, 2012) and, as such, allow teachers to engage in an iterative and cyclical procedure, studying the effects of their own actions on students' results (Marsh, 2012; Marsh et al., 2006; Timperley et al., 2007) and adapting their instruction based on the outcomes. Data use is a complex and non-linear process, which is partly captured in the feedback loops displayed in Figure 1. Data use involves a number of processes, conditions, and contexts that interact in complex ways (Schildkamp, Poortman, & Ebbeler, 2014).

Instruction

For the purpose of this study, we define instruction as the goal-oriented actions of the teacher in a classroom focused on explaining a concept or a procedure, or providing students with insights that will initiate or sustain their learning process (Hattie, 2003, 2009; Hattie & Timperley, 2007; Marzano, 2000; Scheerens, 2007; Walberg, 2007). Instruction focuses on predetermined goals and results, which can be tracked by means of tests and exams (Kyriakides, Creemers, & Antoniou, 2009).

Research into instruction reveals a wide range of instructional aspects that have been found to contribute to learning outcomes (Creemers & Slegers, 2003; Scheerens, 2007). In this study, these

instructional aspects are combined into four more general aspects: purposeful teaching, adaptive instruction, feedback, and learning time. These aspects were chosen because they cover (many of) the instructional aspects addressed in reviews of the research (Creemers & Sleegers, 2003; Scheerens, 2007) and because they can be clearly linked to data use.

Purposeful teaching

Purposeful teaching can be defined as teachers' actions that are focused on student learning, which are characterized by conscious working towards clearly determined high and realistic goals. This means that teachers use test results to determine whether students have reached the goals and, if necessary, to adapt their own instruction (Young & Kim, 2010). Working with specific, challenging goals leads to better results (Locke & Latham, 2002; Smith, Locke, & Barry, 1990). Setting challenging goals results in teachers spending more time on and paying more attention to relevant activities, a higher work rate, and more energy being invested in a task (Locke & Latham, 2002). Setting goals also offers the opportunity of using data to determine which goals have and have not been reached. Teachers can use data to adapt their instructional goals (e.g., set higher goals for certain students).

Adaptive Instruction

In this study, we define adaptive instruction as the teachers' actions that are focused on purposefully adapting the instruction to the differences between students (Blok, 2004). Students differ with regard to how they learn and the pace of their learning. This highlights the importance of teachers' adaptation of their instruction to the students' different educational needs. A review by Sammons, Hillman, and Mortimore (1997) on school effectiveness shows that the students' learning outcomes particularly increase when the teacher's instruction takes into account the students' different educational needs. Vaughn and Fuchs (2003) and Haager, Klinger, and Vaughn (2007) point out that it is important for the teacher to adapt his instruction by providing additional instruction when the initial whole class instruction does not have the desired effect. This can be done, for example, by guiding the students through the exercises, repetition, one-on-one instruction, and the use of different materials (Fuchs & Fuchs, 2006). Teachers can use data to monitor their students' development and to analyse the

students' specific educational needs. Based on the interpretation of the data, they are able to adapt their instruction to better fulfil the students' needs.

Feedback

Feedback can be a powerful tool to improve learning outcomes (Hattie, 2009; Hattie & Timperley, 2007). Feedback can be defined as information about the gap between that which the students have mastered (learning outcomes) and that which the students should have mastered (objectives and standards). Feedback should lead to interventions which should be aimed at reducing this divide, and will improve learning outcomes (Hattie, 2009; Kluger & DeNisi, 1998; Locke & Latham, 2002). Information about actual student results in relation to the objective or standard is a condition for providing effective feedback. This information should challenge students to reflect or change their behaviour in order to improve learning (Shute, 2007). Teachers can use data to provide the students with feedback on their work, and to provide students with insight into their mistakes, misconceptions, strategies, and problem-solving techniques (Hattie, 2009), which they can use to improve their learning outcomes.

Learning time

Time has an important impact on students' learning outcomes (Carroll, 1963, 1989; Rosenshine & Berliner, 1978). Many studies focus on certain aspects of time, such as *allocated time* or *scheduled time*, the time the student actually spends on a task (*time spent*, *time on task*; Carroll, 1963), the time the student is actually involved with the task (*task involvement*; Harnischfeger & Wiley, 1976, or *academic engaged time*; Rosenshine & Berliner, 1978), the time the student has to wait before he gets instruction or help (*waiting time*), the time the student needs to achieve certain objectives under optimal circumstances, which sets the pace at which the curriculum is delivered (*pacing*; Posner, 1987), and the time spent on homework (Bryan, Burnstein, & Bryan, 2001; Scheerens, 2007). For this study, these various aspects are combined into the term 'learning time'. It covers the time the student needs to achieve specific objectives under optimal circumstances. An analysis and interpretation of data can inform a teacher about the aspects of the curriculum that require additional time.

The previously described aspects of ‘purposeful teaching’, ‘adaptive instruction’, ‘feedback’ and ‘learning time’ are interlinked. A teacher who teaches in a purposeful manner, will for example, also spend more time on those aspects which are relevant to the objective of a task. In the same way, a teacher who provides adaptive instruction will distribute his instructional time between his students in the best possible way. By using the available data wisely, the teacher can gain more insight into the students’ learning process and learning outcomes in order to adapt the instruction. This study starts to look inside the black box of teachers' data use (Little, 2012) by investigating how they use data to change their instruction. We aim to obtain more insight into how data-based decision making can help teachers improve their instruction.

Method

We used a mixed-method design to answer the research questions. We used a survey and interviews with primary school teachers working in different grades at Dutch primary schools. The combination of different data collection methods (surveys and interviews) allows us to triangulate the data to reinforce our findings and conclusions (Johnson & Onwuegbuzie, 2004; Miles & Huberman, 1994; Mertens, 1998).

The context of the research

The increasing attention to data-based decision making in the Netherlands is similar to the current focus on data use in the US. During the first decade of this century, societal concerns about the quality and results of education increased in the Netherlands. These concerns were amplified further by the results of international studies (Meelissen & Drent, 2008; Netten & Verhoeven, 2007; OECD, 2010) which did not match the ambitions previously formulated by the Dutch Ministry of Education (Ministerie van Onderwijs, 2011a; 2011b).

The Education Council, the advisory board of the Dutch Ministry of Education, has stated that data-based decision making within education is necessary to improve student achievement (Onderwijsraad, 2008). Comparable to the influence of the NCLB act in the US (Ravitch, 2010), more

pressure is being exerted on Dutch primary schools to adopt a more data-based approach. For example, at the policy level, the aim is that at least 90% of primary and secondary education schools in the Netherlands will use data in a systematic manner by 2018.

Dutch education is characterized by the importance it places on the school's responsibility. School boards are responsible for the quality of education in their own schools (Kuiper, Van den Akker, Letschert & Hooghoff, 2009; Scheerens, Luyten, & Ravens, 2011). Every Dutch primary school has a school leader and a data expert. Together, they usually make up the management team of the school. The school leader manages the teachers and directs daily business. A data expert is a senior teacher with coordination tasks related to investigating students' learning outcomes and guiding teachers to improve their instruction.

The Dutch Inspectorate of Education monitors the quality of Dutch schools on behalf of the government. They do this by monitoring educational outcomes, such as assessment results, but also by paying visits to the schools, observing classes and conducting interviews with teachers, school leaders and school boards. Although the school boards are responsible for the quality of the education and academic results at their schools, this does not appear to guarantee school improvement and instructional improvement.

It is common practice in Dutch primary schools to have the students take a classroom assessment after each unit. These tests show students' understanding of the content that was taught over the past few weeks. Dutch primary schools are obligated to monitor their students' progress and their assessment results by means of a standardized pupil monitoring system which shows progress in relation to national objectives over time. Almost all schools use a monitoring system (standardized pupil monitoring tests and classroom assessments) that includes standardized assessments in language/reading and mathematics twice a year. Learning progress in kindergarten is monitored through teacher observations and toddler tests. As of 2015, primary schools are legally obligated to test students in their final year of primary school by means of a final test certified by the government (Final Assessment Primary Education). In this way, schools will gain greater and greater insight into the results of the education they provide and will have an increasing amount of data at their disposal which they can use to evaluate and improve education.

Respondents and data collection

Convenience sampling was used to select the respondents to the survey. There are 6,541 primary schools in the Netherlands (as of 2014). School leaders at 410 primary schools across the Netherlands received an email informing them about the study. They were asked to inform their teachers about the study and to ask the teachers to complete the internet survey. The survey was completed by 318 teachers, working at 116 primary schools (a response rate of 28.3%). The respondents' level of teaching experience in primary education varied from zero to 41 years. On average, the respondents had been teachers for 19 years. Some teachers (35%) had management or coordination duties besides teaching (see Table 1).

Table 1. Respondents' attributes

Respondents' attributes	
<i>Grade assignment</i>	
grade 1/2 (4-6 years)	75
grade 3/4 (6-8 years)	59
grade 5/6 (8-10 years)	52
grade 7/8 (10-12 years)	75
Several grades	57
<i>Years of experience</i>	
0 – 10	92
11 – 20	89
21 – 30	60
31 – 40	73
> 40	2
Unknown	2
<i>Other roles and tasks (besides teaching)</i>	
Principal	19
Deputy principal	7
Coordination task, e.g. data expert, ICT coordinator	85

Respondents N = 318

In order to clarify the results of the survey, respondents to the survey were asked to participate in an interview. Interviews were conducted with eighteen teachers from eighteen different schools that participated in the surveys. All but one of the interviewed teachers had additional coordination or management duties besides teaching, such as being a data expert. Participation in both the survey and

interviews was voluntary. An analysis of the survey data showed that teachers who participated in the interviews mostly worked at schools that scored high on data use. Respondents often took part in the study because they were interested in the subject of the study and were involved in data use at their school. Therefore, the results of this study cannot be generalized to all schools in the Netherlands. However, the results of this study can be used for theory development with regard to the use of data for instructional improvement.

Instruments

A survey was developed based on the study of literature and existing, reliable and valid instruments (i.e., Allensworth, Correa, & Ponisciak, 2008; Geijsel, Slegers, Stoel, & Krüger, 2009; Schildkamp & Kuiper, 2010; Schildkamp & Teddlie, 2008; Vanhoof, Verhaeghe, Van Petegem, & Valcke, 2011; Wayman, Snodgrass Rangel, Jimerson, & Cho, 2010). The survey focuses on what data are available at school, how teachers use these data and how often they do so (see Table 2). The survey was administered via the internet and included 75 items, covering thirteen scales. The questions in the data-use scale focus on establishing an overview of the types of data used by teachers and the frequency with which they use them. The answer options in this scale are *never, on a yearly basis, less than once a month, once or twice a month, on a weekly or almost weekly basis, several times a week*. The items in the other scales indicate whether the teachers use the data derived from classroom assessments, pupil monitoring system tests or toddler tests to adapt aspects of their instruction (purposeful teaching, adaptive instruction, feedback and learning time). The items in these scales are presented as statements. The respondents can indicate the extent to which they agree or disagree with the statement, as measured on a four-point Likert scale (1 = *completely agree* up to 4 = *completely disagree*). Depending on the grade the respondent taught and the test used in school, the teacher was presented with a selection of specific questions; for example, teachers who did not teach kindergarten did not have to complete questions about the toddler test.

In addition to the survey, semi-structured interviews were conducted with eighteen teachers at different schools that responded to the survey. The aim of these interviews was to clarify the results of the survey, to obtain deeper analysis, and to verify our findings, in order to increase the reliability of

the conclusions, but also to obtain new information about the process of data use. The interviews provided us with deeper insight into the process of data use, how teachers make data-based decisions, and how teachers use data to improve their instruction. The interviews started with an open-ended question about the teacher's definition of data-based decision making and what role the teacher plays in data-based decision making within the school. Subsequently, the teachers were asked who within their schools are involved in analysing and discussing data, roles and responsibilities of school staff with regard to data use, teachers' purposes for data use and what influence data use has on classroom instruction. Examples of interview questions include: Can you tell something about your school's involvement in data use? What is your role as a teacher in data use? Within data use, we can distinguish collecting data, analysing data, interpreting data. Can you tell what your role is for these several aspects of data use? Are you involved in analysing data from the final assessment for primary education? Can you describe your role in this? If it became clear that teachers adapted their instruction based on data, they would be asked to provide further information on their process of decision-making. The interviews lasted for thirty to sixty minutes.

Data analysis

The first research question was analysed by means of descriptive statistics (frequencies, means and standard deviations) for the survey. The object of this study was to establish what data were used by teachers in different grades, how often and to what extent they use data to adapt their instruction. The interview data were primarily used to answer the second research question. All interviews were transcribed and the transcripts were analysed by means of a coding system which was developed based on the theoretical framework. Examples of codes are: teacher's definition of data use, analyses, influence of data use on teacher's actions. At the start of the analysis, significant fragments were selected; a code was later assigned to each of these fragments. Quotes from respondents were listed and compared in order to reveal patterns and similarities between quotes by different respondents.

Reliability and Validity

The content validity of the survey was determined by analysing whether the conceptual framework regarding data-based decision making and instructional effectiveness was sufficiently elaborated upon in the survey. In order to ascertain this, a conceptual version of the survey was submitted to a panel of four content experts. Furthermore, three experienced primary school teachers working at different schools and teaching different grades tested the survey for clarity of language and user-friendliness. Upon closer examination, it appeared that some statements were too abstract or that the differences between statements were not sufficiently clear. These statements were thereupon rephrased in an easier and more comprehensible way to make them more suitable for the target audience. The confirmatory factor analysis confirmed the structure of the scales, initially determined based on the theoretical framework. The reliability analysis shows that the reliability of the scales is adequately high (see Table 2).

Table 2. Scales, number of items, reliability and examples of items

Scale	Number of items	Cronbach's α	Item examples
Data use	12	0.73	How often do you use data from the pupil monitoring system?
Purposeful teaching (classroom curriculum assessments)	5	0.95	I use the calculus course tests when I set learning goals for a group of below-average students.
Purposeful teaching (pupil monitoring system)	5	0.85	I use calculus tests from the pupil monitoring system when I set learning objectives for my classes.
Purposeful teaching (toddler tests)	5	0.97	I use toddler tests while determining my pupils' progress.
Adaptive instruction (classroom curriculum assessments)	6	0.93	I use calculus course tests when adapting my instruction to the needs of my pupils.
Adaptive instruction (pupil monitoring system)	6	0.82	I use calculus tests from the pupil monitoring system when providing additional (individual or group) instruction for below-average students.
Adaptive instruction (toddler tests)	6	0.96	I use toddler tests to write a group plan for dealing with below-average and above-average students.
Feedback (classroom curriculum assessments)	5	0.92	I use calculus course tests when determining which students I will check on more often during or after finishing their task.
Feedback (pupil monitoring system)	5	0.79	I use calculus tests from the pupil monitoring system to improve my classes.

Feedback (toddler tests)	5	0.93	I use toddler tests to provide my students with feedback on the problem-solving strategies they use.
Learning time (classroom curriculum assessments)	5	0.86	I use calculus course tests when determining the pace at which I discuss the curriculum.
Learning time (pupil monitoring system)	5	0.72	I use calculus tests from the pupil monitoring system when determining the pace at which I discuss the curriculum.
Learning time (toddler tests)	5	0.88	I use the toddler tests when selecting specific skills or subjects that need to be explained further in class.

In order to check on the reliability of the analysis of the interview data, fifteen percent of the interview fragments were coded by a second researcher. The inter-rater reliability was high (Cohen's Kappa 0.91).

Results

What data teachers use

The results of both the survey and the interviews show that schools have a large amount of data available regarding the school's functioning and the students' learning. Table 3 shows that teachers claim to use these data often, particularly data from the classroom curriculum assessments, standardized assessments from the pupil monitoring system, classroom observations and background information on students (for example, the parents' level of education). Data originating from instruments for self-assessment, surveys completed by management, students and parents, seem to be used less often. Reports by the Inspectorate of Education were used by 80% of the respondents on a yearly basis or more often. Data originating from the Final Assessment for Primary Education are used by 65% of the respondents.

Differences in data use between teachers

Teachers differ in the extent to which they use data. For example, 27% of the teachers claim that they never use observation data or use it once a year at most, compared to a second group of 21% of the teachers who claim to use observation data several times a week or almost on a weekly basis (Table 3).

Table 3. *Frequency of data use by primary school teachers (N = 318)*

Data source	Never	On a yearly basis	Less than once a month	Once or twice a month	(almost) weekly	Multiple times a week
	%	%	%	%	%	%
Observations	5	22	35	17	12	9
Classroom curriculum assessments	12	2	8	35	37	7
Pupil monitoring system	3	17	38	22	15	5
Final Assessment Primary Education	35	53	8	3	1	0
Inspection report	20	62	17	1	0	0
Quality card Inspectorate of Education	33	35	22	8	2	0
Background information on students	8	35	20	15	12	10
Self-assessment data	61	28	7	2	2	0
Teacher surveys	22	54	21	3	0	0
Management surveys	50	39	10	1	0	0
Student surveys	24	52	20	4	0	0
Parent surveys	21	67	11	1	0	0

Data from the Final Assessment for Primary Education are used by 65% of the teachers at least once a year, whereas 35% of the teachers never use these data. When it comes to the students' background information, 8% of the teachers claim never to use these data, 35% claim to use these data on a yearly basis and 57% claim to use these data more often than once a year.

Table 4 displays the results for the first five types of data use, according to the grades/age groups taught by teachers. Table 4 shows that teachers of specific age groups differ from each other in the extent to which they use data. For example, the percentage of teachers claiming to use observation either never or once a year at most is at 19% for the grade 1 and 2 (ages 4-6) teachers, 27% for the grade 3 and 4 (ages 6-8) or 5 and 6 (ages 8-10) teachers, and 32% for the grade 7 and 8 (ages 10-12) teachers. This indicates that observation results are more commonly used as a source of data by teachers who teach younger children.

Table 4

Frequency of data use by primary school teachers by student age

Scale	Respondents	Student ages	Never		On a yearly basis		Less than once a month		Once or twice a month		(Almost) weekly		Multiple times a week		
			N	%	n	%	n	%	n	%	n	%	n	%	n
Data from observations	TCHR 1/2	4-6	75	2.7	2	16	12	30.7	23	21.3	16	17.3	13	12	9
	TCHR 3/4	6-8	59	8.5	5	18.6	11	39	23	5.1	3	15.2	9	13.6	8
	TCHR 5/6	8-10	52	9.6	5	17.3	9	38.5	20	21.2	11	3.8	2	9.6	5
	TCHR 7/8	10-12	75	5.3	4	26.7	20	28	21	22.7	17	10.7	8	6.6	5
	TCHR various grades		57	1.8	1	31.6	18	42.1	24	10.5	6	10.5	6	3.5	2
TCHR 1 - 8	4-12	318	5	16	22	69	35	112	17	53	12	39	9	29	
Data from classroom curriculum assessments	TCHR 1/2	4-6	75	46.7	35	5.3	4	18.7	14	17.3	13	10.7	8	1.3	1
	TCHR 3/4	6-8	59	1.7	1	0	0	5.1	3	44.1	26	39	23	10.2	6
	TCHR 5/6	8-10	52	10	0	0	0	1.9	1	25	13	59.6	31	13.5	7
	TCHR 7/8	10-12	75	0	0	2.7	2	5.3	4	46.7	35	38.7	29	6.7	5
	TCHR various grades		57	1.8	1	1.8	1	7	4	45.6	26	42.1	24	1.8	1
TCHR 1 - 8	4-12	318	12	37	2	6	8	26	35	112	36	116	7	21	
Data from pupil monitoring system	TCHR 1/2	4-6	75	8	6	32	24	37.3	28	12	9	6.7	5	4	3
	TCHR 3/4	6-8	59	1.7	1	8.5	5	50.8	30	23.7	14	11.9	7	3.4	2
	TCHR 5/6	8-10	52	1.9	1	11.5	6	34.6	18	23.1	12	23.1	12	5.8	3
	TCHR 7/8	10-12	75	0	0	16	12	36	27	26.7	20	14.7	11	6.6	5
	TCHR various grades		57	0	0	14	8	35.1	20	29.8	17	17.6	10	3.5	2
TCHR 1 - 8	4-12	318	3	8	17	54	38	121	22	71	15	49	5	15	
Data from Final Assessment Primary Education	TCHR 1/2	4-6	75	53.4	40	45.3	34	1.3	1	0	0	0	0	0	0
	TCHR 3/4	6-8	59	40.7	24	52.5	31	5.1	3	1.7	1	0	0	0	0
	TCHR 5/6	8-10	52	46.2	24	42.3	22	7.7	4	3.8	2	0	0	0	0
	TCHR 7/8	10-12	75	14.7	11	60	45	17.3	13	5.3	4	2.7	2	0	0
	TCHR various grades		57	22.8	13	64.8	37	8.8	5	1.8	1	1.8	1	0	0
TCHR 1 - 8	4-12	318	35	111	53	168	8	27	3	9	1	3	0	0	
Data from inspection report	TCHR 1/2	4-6	75	22.7	17	65.3	49	12	9	0	0	0	0	0	0
	TCHR 3/4	6-8	59	25.4	15	62.7	37	10.2	6	1.7	1	0	0	0	0
	TCHR 5/6	8-10	52	28.8	15	55.8	29	13.5	7	0	0	1.9	1	0	0
	TCHR 7/8	10-12	75	16	12	60	45	24	18	0	0	0	0	0	0
	TCHR various grades		57	10.5	6	63.2	36	22.8	13	3.5	2	0	0	0	0
TCHR 1 - 8	4-12	318	20	64	62	197	17	53	1	3	0	1	0	0	

From grade 3 onwards, teachers are required to administer *assessments* on a regular basis. It is therefore not surprising that our study shows that these data are frequently used. The majority (93%)

of the teachers of grades 3 and 4 (ages 6-8) claim to use these data once or multiple times a month. This level of data use was seen for 98% of teachers of grades 5 and 6 (ages 8-10) and for 92% of teachers of grades 7 and 8 (ages 10-12).

Standardized assessment data from the pupil monitoring system are less frequently used by teachers of grades 1 and 2 (ages 4-6) than by teachers of other grades; for example, 23% of the teachers of grades 1 and 2 (ages 4-6) claim to use data from the pupil monitoring system at least once a month, while the same level of data use is seen for 39% of the teachers of grades 3 and 4 (ages 6-8), 52% of the teachers in grades 5 and 6 (ages 8-10), and 48% of the teachers of grades 7 and 8 (ages 10-12).

The teachers of different age groups also differ from each other in the extent to which they use the data from the *Final Assessment for Primary Education*. For example, 85% of the teachers of grades 7 and 8 (ages 10-12) claim to use the data from the final test at least once a year, whereas the percentage of the teachers working in the lower grades claiming to use these data is considerably lower (54% for grades 5 and 6/ages 8-10, 59% for grades 3 and 4/ages 6-8, 47% for grades 1 and 2/ages 4-6). Interviews show that these data are often analysed and discussed by teacher of grade 8 (the final grade in Dutch primary schools), the data expert and the school leader, but that these data play a less important role for teachers of other grades. Or in the words of one of the teachers that were interviewed: *“The teachers of the senior year students pay more attention to the final test than the teachers of the lower grades. But mind you, the data are not discussed extensively. When the Inspectorate of Education considers you to be performing well, the general attitude is to leave well enough alone.”*

When it comes to the *report by the Inspectorate of Education*, 20% of the teachers claim never to read this report. However, 24% of the teachers of grades 7 and 8 (ages 10-12) claim to use these data several times a year. The teachers of the lower grades do so considerably less often. Only 12% of the teachers of grades 1 and 2 (ages 4-6) and grades 3 and 4 (ages 6-8) claim to use inspection data several times a year.

What role does data use by teachers play in improving instruction?

Respondents claim to use data, primarily from classroom curriculum assessments, standardized assessments from the pupil monitoring system, and toddler tests, to adapt their instruction in the areas of purposeful teaching, adaptive instruction, feedback and learning time. The results show that teachers use data for adaptive instruction ($m = 1.87$, $sd = 0.41$) and purposeful teaching ($m = 1.90$, $sd = 0.40$) and slightly less for scheduling learning time ($m = 2.30$, $sd = 0.40$) or providing feedback ($m = 2.16$, $sd = 0.40$) (where a lower mean score indicates greater use of data for this purpose) (Table 5).

Table 5. *Influence of data use on aspects of instruction*

Scale	Items	N	Mean*	SD
Purposeful teaching	15	153	1.90	0.399
Classroom curriculum assessments	5	250	1.78	0.599
Pupil monitoring system	5	262	1.79	0.454
Toddler tests	5	170	2.10	0.787
Adaptive instruction	18	149	1.87	0.408
Classroom curriculum assessments	6	246	1.72	0.580
Pupil monitoring system	6	260	1.76	0.428
Toddler tests	6	166	2.05	0.770
Feedback	15	147	2.16	0.395
Classroom curriculum assessments	5	242	1.86	0.564
Pupil monitoring system	5	257	2.17	0.441
Toddler tests	5	164	2.39	0.706
Learning time	15	147	2.30	0.395
Classroom curriculum assessments	5	245	2.02	0.565
Pupil monitoring system	5	259	2.37	0.440
Toddler tests	5	164	2.49	0.657

* 1 = completely agree; 2 = agree; 3 = disagree; 4 = completely disagree

Although the survey results indicate that teachers use data to improve instruction, the interview results show that depth of use is rather superficial. Teachers often do not have a clear *purpose* for using data. Moreover, they do not use a range of different *data* sources, but focus on assessment results. Teachers' analysis of the available data is also often superficial. For example, although teachers look at which students perform below average, and which students show unsatisfactory progress compared to earlier tests, teachers often fail to conduct a category analysis in order to identify the parts of the curriculum for which the students' progress is not satisfactory. As a result, data use does not lead to in-depth and new *knowledge* upon which to base *actions* to improve student learning.

The interview results show that, in line with the survey results, the actions that teachers take mostly concern the use of data for adaptive instruction. Moreover, data are only used when a student or a group of students show(s) unsatisfactory progress, when the final test yields disappointing results, or when the assessment by the Inspectorate of Education specifies that the school needs to improve its students' results. Examples of data use for adaptive instruction mentioned by teachers include:

- adapting instruction to the differences between students: for example, writing a plan for a group in order to deal better with the differences between students. One teacher stated, for example: *“Sometimes we make a plan for improving instruction for an individual student, but usually data use leads to changing the group plan.”*
- measures implemented in order to take into account the at-risk students: for example, intensive reading instruction for poor readers. In the words of one teacher: *“When I discover that students have learning problems, then I will adjust my instruction in the next lessons. I will help these students in a small group.”*
- paying more attention to those parts of the curriculum the students have yet not mastered. One teacher stated: *“The results for our reading lessons were not good. We have changed the curriculum and now we pay more attention to reading.”*

However, although these are examples of using data to adapt instruction to the needs of the students, the level of adaptation shown in these examples seems superficial. For example, sometimes teachers change their plans for group instruction, but it is not clear how teachers adjust their instructional activities in the classroom, or if they actually implemented their plan. Moreover, teachers indicated that they helped students with learning problems in small groups. But the participants in the interviews could not explain what exactly the help in small groups involved. Was it just a form of repeated instruction (reteaching) or did the teacher actually adjust the instruction to the learning needs and learning strategies of the individual students? Since most of the teachers did not, for example, conduct category analysis on the data to establish what areas students struggle with, it is likely that the small group instruction just consisted of re-teaching. Moreover, some of the interviewed teachers stated that data use particularly enhanced their awareness of their own instruction, instead of leading to actual

changes in their instruction. As one teacher stated: *“I cannot say whether it directly affects my instruction. As a teacher, you do become more aware of things going wrong. I do value that, but I cannot say whether it directly leads to improved instruction.”*

The interview results further show that teachers particularly use data on an individual and general basis. Teachers do not collectively discuss and analyse data. A data expert stated in this regard: *“We do not discuss the results often, not often enough by far. When teachers have questions, they come to me on their own initiative. Just this week, a teacher asked me ‘my entire class failed, could we have a look?’*. And someone else stated: *“To me, this really is a key point which we should place on the agenda. I think it is important to discuss it within the context of the school as a whole. It should be a standard item on the agenda.”* Moreover, measures for improvement are also often taken without conferring with other colleagues, and as stated above, based on a superficial analysis of the data. Therefore, it is not very likely that the use of data will lead to the desired *outcome* of increased student achievement.

Conclusions

What data do teachers use and to which extent do teachers differ from each other in this respect?

Our findings indicate that Dutch primary schools have a broad range of data available for learning about the functioning of the school and about students’ learning. Almost all teachers claim to use data with the intention of improving education. Teachers primarily use data related to the students in their own classroom. While doing so, they particularly use data from classroom assessments (88%), the pupil monitoring system (97%) and classroom observations (95%). Data that are further away from the daily practice of teachers (e.g., self- assessments and management surveys), but are more closely related to the functioning of the school as a whole, are used less frequently by teachers.

Teachers differ from one another in the extent to which they use similar types of data. For example, 38% of the respondents claim to use observation data at least once a month, whereas 27% claim never to use these data or to use them only once a year. These differences in data use are partly

related to the grade to which the teacher is assigned or the other duties and responsibilities the teacher has within the school.

What role does data use by teachers play in improving their instruction?

Teachers are aware of the importance of using data and almost all teachers (96%) claim they use data to improve their instruction. The survey results indicate, for example, that teachers use data to adapt their instruction to the needs of the students (adaptive instruction). However, although the survey results indicate that teachers make use of data, the interview results indicate that there seem to be several challenges with the use of data for instructional improvement:

- The interview results show that data use does not always seem to start with a clear and measurable purpose, or the use of data is only narrowly focused on underachieving students.
- Both the survey and interview results indicate that most teachers do not make use of a variety of data sources. The survey, for example, shows that teachers only use data which are directly related to their daily practice regarding the students in their own grade.
- The interview results show that teachers sometimes refrain from conducting relevant analyses. For example, some teachers fail to conduct a category analysis, but this type of analysis can pinpoint the possible problem areas for at-risk students. A category analysis provides valuable information regarding the topics that need more attention and more measures for improvement. Without these types of analyses it is difficult to adapt instruction to the needs of the students.
- Teachers indicated in the interviews that data use sometimes leads to more awareness, but not necessarily to concrete actions. Moreover, teachers were not always able to provide concrete examples of instructional changes in the classroom informed by the use of data. Teachers seem to mostly use data when their students show unsatisfactory progress.

Examples that teachers mentioned of instructional improvement concerned adapting their instruction to the needs of the students in their lesson planning, through small group instruction and re-teaching.

Data use by teachers in this study was rather superficial and most times did not lead to instructional improvement. The data only had an effect at the level of awareness.

Discussion

Major findings and comparison to previous research

Although many Dutch primary schools are increasingly making use of data (Inspectie van het onderwijs, 2010) and teachers claim to use data to improve education, the results of this study show that there is much to gain in certain important aspects of the data use cycle. Although schools have a lot of data available and teachers claim to be aware of the importance of data use and consider themselves to use data to a great extent, the results of this study show that using data for instructional improvement is not an easy task and that it can go awry during various steps in the data use process.

First of all, we see that improving the progress of the weaker student is often the *purpose*, but far less attention is paid to adapting instruction based upon the information from data and to the needs of average or above-average students. This study seems to confirm that Dutch primary schools focus more on weaker students than on students who excel, as the PISA research (CITO, 2012, p. 85) has shown: “*Dutch schools show better results at the bottom of the ability-scale than at the top.*” Not all teachers are aware that data use can also be useful when the students' results are above a certain standardised norm (set by either the Inspectorate of Education or a national test development agency). Moreover, the purpose is not always described in the form of clear and measurable goals. However, having clear and measurable goals is crucial for performance improvement. It can make people focus their activities on achieving those goals (Locke & Latham, 2002; Morisano & Locke, 2013).

Secondly, a lot of *data* that could provide insight into instruction, such as observations, are not used or hardly ever used by some teachers. This is also the case for data that are somewhat farther away from their daily practices and their own students, for example, data from the test in the final grade in primary schools. Teachers primarily use data that are directly related to their own students and that are closely related to their daily practices. In the survey, teachers indicated that they make the greatest use of test results. However, by focusing on only test data, valuable data that are crucial for

improving student learning and achievement are ignored. Test data can inform teachers about how students are performing, but these data do not provide sufficient information for teachers to know what instructional practices to change to improve student achievement. To be able to improve instructional practices in the classroom, different types of data sources are needed; not just test data, but also, for example, classroom observations (*how* students are learning) (Ikemoto & Marsh, 2007; Lai & Schildkamp, 2013).

Thirdly, the *analyses* teachers conduct are often limited, and they are therefore only a limited source of new *information*. Visscher and Ehren (2011) have already pointed out that although schools have implemented a pupil monitoring system, they not always conduct category analyses and neither do they always map out their students' progress, even though these analyses could provide them with a wealth of information.

Fourthly, the data use process sometimes seems to stop at the information or knowledge phase. Data are collected, are analysed and turned into information, and sometimes new knowledge is even created. But this does not necessarily result in instructional improvement, although it does lead to greater awareness regarding the teacher's own instruction. Some teachers mentioned examples of instructional changes. These improvements concerned adapting their instruction to the students' needs in their lesson planning, through small group instruction and re-teaching. However, re-teaching a topic does not change the way the instruction is delivered. The teacher uses the same instructional strategy in the same group, or in a smaller group. This does not constitute a significant change in instructional practice (e.g., see also Nelson, Slavit, & Deuel, 2014; Supovitz, 2012).

Finally, research has shown that teachers' collaboration in using data is essential for improving the quality of education (Coburn & Turner, 2011; Schildkamp & Kuiper, 2010; Wayman et al., 2010). This study shows that data use in schools is often done on an individual basis. There are few 'data discussions' within schools, and teachers primarily decide on how to improve their instruction on an individual basis.

This study clearly shows that things can go awry during the different steps of the data use process and therefore it remains to be seen whether teachers do gain new knowledge and whether the *actions for improvement*, such as revisiting certain aspects of the curriculum, are indeed instructional

improvements that will lead to better learning outcomes. It is doubtful whether the purpose of data-based decision making (improving learning outcomes) will be achieved.

Limitations

There are some limitations to this study. This was not a random sample and the results are limited to the perceptions of the teachers. For example, a high score on 'feedback' does not mean that a teacher provides a lot of feedback, but that he perceives that he frequently uses data for his feedback to students. Teachers often took part in the study because they were interested in the subject and because they had a formal involvement or role in using data in their school. However, because these are the responses of the teachers who show an above-average interest in data use, they offer us, together with the interview data, a particularly rich overview of the ways in which primary school teachers use data to improve their instruction.

Implications for practice and future research studies

The question remains whether teachers are sufficiently equipped to analyse data, whether they are aware of the types of analyses they can carry out and what they can learn from different types of analyses (trend analyses, category analyses, benchmarking), whether they are able to compare and contrast the results of different analyses (triangulation), and more generally whether they are sufficiently equipped to use data in a structured way. Moreover, it is not just a question of whether or not the teachers have the expertise to analyse data, but also whether they are able to take a close look at their own educational practices, whether they are able to conduct meetings and plan measures for improvement based on data (Ledoux, Blok, & Boogaard, 2009; Schildkamp & Visscher, 2009; Van Petegem & Vanhoof, 2004). Data-based decision making and data use is not just a question of measuring and analysing. Black and Wiliam (1998) refer in this context to profound changes in the way in which teachers view their own role and considerable changes in their daily practices in the classroom.

As this study and other studies (e.g., Wayman, Jimerson, & Cho, 2012) have shown, the availability of data does not ensure the use of data in terms of actually taking actions to improve

instructional practices. Hindering factors with regard to the use of data include a lack of collaboration, a negative attitude towards data use (Jimerson, 2014), and a lack of data literacy (e.g., knowledge and skills) with regard to data use (Mandinach & Gummer, 2013; Marsh, 2012; Schildkamp & Kuiper, 2010; Schildkamp & Poortman, 2015). There is a need for professional development interventions on the use of data (Marsh & Farrell, 2015), and studies into the effects of these interventions (Marsh, 2012; Marsh & Farrell, 2015).

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Abstract

Data-based decision making for instructional improvement in primary education

Data-based decision making can help teachers to improve their instruction. Research shows that instruction has a strong influence on the learning outcomes of students. This study investigates whether Dutch primary school teachers use data to improve their instruction. This article distinguishes four aspects of instruction: purposeful teaching, adaptive instruction, feedback and effective learning time. Data has been collected with a survey (n = 318) and through interviews with eighteen teachers. The results show that almost all teachers use data with the intention to improve their instruction, but teachers skip important steps of the data use process. Teachers mainly use data when results of their own students are disappointing. They are less interested in data related to the functioning of the school as a whole.