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Teachers' high-stakes decision making. How teaching approaches affect rational and intuitive data collection.

Introduction

Teacher judgement has a significant impact on pupils' educational trajectories, especially transition decisions that sort pupils in educational tracks. Understanding how teachers judge the competencies of pupils, and why they judge them the way they do, is therefore of crucial importance. Human judgement is believed to be based on rational as well as intuitive processes (Harteis, Koch, & Morgenthaler, 2008; Kahneman & Frederick, 2005). For many years in the education field, so-called informed intuition was accepted as the primary basis of teacher judgement (Creighton, 2007). According to theories on intuitive expertise, experienced teachers are able to recognise the most important data without needing to search for it (Harteis et al., 2008; Klein, 2008). This intuitive type of data collection is considered to be an important aspect of expertise and a valuable basis of teacher judgement (Harteis et al., 2008; Klein, 2008).

However, the disadvantage of intuitive data collection is that it can lead to confirmation bias when teachers focus their attention on what they expect to see and consequently they may miss important data that questions their assumptions.

In the past, numerous studies of teacher judgement have emphasised the lack of reliability when the outcome of teacher judgment was compared with the results of objective measures such as standardized test (Bennett, Gottesman, Rock, & Cerullo, 1993; Harlen & Deakin, 2002). More recently, Kaiser, Retelsdorf, Südkamp, and Möller (2013) came to similar conclusions as they found teacher judgment of students' achievement level and progress to be far from reliable. The low accuracy of teacher judgement was mostly explained by the conclusion that teacher judgement included many non-achievement factors collected spontaneously during practice (e.g. motivation, interest) (Allal, 2013; Bennett et al., 1993). These findings have led to an increased expectation that teachers will collect data rationally to enhance their quality of judgement (Carlson, Borman, & Robinson, 2011; Earl & Louis, 2013; Schildkamp & Lai, 2012; Wohlstetter, Datnow, & Park, 2008).

Many studies have therefore investigated factors that might promote or hinder data collection within schools, such as school context and data characteristics (see e.g. Coburn & Turner, 2011; Ikemoto & Marsh, 2007; Levin & Datnow, 2012; Mandinach, Honey, & Light, 2006; Schildkamp, Poortman, Luyten, & Ebbeler, 2017; authors, 2016).

On the individual level, scholars initially focused on technical factors relating to teachers' data literacy - the ability to transform information into actionable instructional knowledge and practices by collecting, analysing, and interpreting all types of data (Mandinach & Gummer, 2013). To a lesser extent, psychological or motivational factors were also considered, for example teachers' attitude with regard to data use, teachers' confidence in their ability to use data or the quality of teachers' motivation to use data (see e.g. Pajares, 2003; Rubie-Davies, 2010; Tschannen-Moran & Hoy, 2001; authors, 2014; Woolfolk & Hoy, 1990). In their

review study with regard to teacher beliefs about data-driven decision making, Datnow and Hubbard (2016) concluded that teacher belief systems are frequently underexposed in data use research as well as educational reforms. Nevertheless, examining teachers' beliefs would provide a better understanding of their capacity and willingness to use data to inform their judgement (Coburn & Turner, 2012). While rational models of data use are supported by researchers and policy-makers, these new approaches to teaching may not coincide with how teachers believe good teaching and judgement should be exercised (Thomas & Beauchamp, 2011). When it comes to data use, teachers do not adopt new expectations as passive executors, instead they actively use their conceptions of good teaching to interpret, evaluate and adapt new approaches to the practice of teaching (Buchanan, 2015; Drake, Spillane, & Hufferd-Ackles, 2001). Teachers' approaches to teaching influence their teaching and assessment practices (Postareff & Lindblom-Ylänne, 2008).

How teachers approach the practice of teaching and why they believe in the approach they adopt has been the focus of many studies in recent years (e.g. Calderhead, 1996; Postareff & Lindblom-Ylänne, 2008; Trigwell, Prosser, & Waterhouse, 1999). However, these insights are often used to explain the relationship between teaching and learning approaches. Although research has demonstrated that teachers hold an array of conceptions and approaches to teaching that might inhibit or support new approaches towards data use, these are largely ignored in research as well as in reform strategies focusing on data use (Day, 2002; Van Veen, Slegers, & Van de Ven, 2005). A greater degree of in-depth insight is therefore needed into why individual teachers still predominantly use data intuitively rather than rationally, despite initiatives to support data use at school level (Schildkamp & Lai, 2013; authors, 2016). Teachers' approaches to teaching may therefore be a valuable lens through which to view and explore this issue.

In this study, we will describe how teachers classified as either rational or intuitive collect different categories of data when they judge pupils' competencies. Thus, we will investigate how different approaches to teaching influence the way teachers collect data to inform their judgement.

Theoretical Framework

Teacher judgement: a dual process approach

Studying teacher judgement, different viewpoints can be found stressing the importance of either rational or intuitive processes. The last decade, there has been increased attention for data-based decision making in education, starting from the idea that data use enhances the quality of educational decisions (Mandinach & Jimerson, 2016; Schildkamp, Lai, & Earl, 2012). This application of rational decision models in an educational context describe optimal teacher judgement as a sequence of deliberate and systematic data collection, analyses and interpretation to evaluate alternatives before teachers make a decision (e.g. Datnow, Park, & Kennedy-Lewis, 2012; Schildkamp & Ehren, 2013; Strayhorn, Kowalski, & Lasley, 2009).

Meanwhile, a growing body of literature has explored teacher judgement as a contextualized and complex practice influenced by teachers' personal knowledge and experience, which does not necessarily follow a technical-rational model (Bertrand & Marsh, 2015; Coburn & Turner, 2011; Datnow et al., 2012). In practice, it appears that teacher judgement is still greatly based on intuitive processes. For example, authors (2017) found that intuition played a prevalent role when primary teachers make the decision for grade retention.

As many researchers in the field of decision making agree, it seems appropriate to assume that both rational and intuitive processes act as two parallel and concurrent systems that influence teacher judgement (Epstein, 2002; Evans, 2008; Ferreira, Garcia-Marques, Garrido, & Sherman, 2006; Goldstein & Hogarth, 1997; Klein, 2008; Myers, 2002; Tversky &

Kahneman, 1981). This dual process approach to teacher judgement (Evans, 2008), also described as ‘System 1 and System 2 Thinking’ (Kahneman & Frederick, 2005; Tversky & Kahneman, 1981) or ‘Cognitive Continuum Theory’ (Hammond, Hamm, Grassia, & Pearson, 1987) starts from the idea that the rational system enables teachers to collect and process data deliberately while the intuitive system involves a more spontaneous data gathering and processing. Although in empirical analyses these processes are separated for reasons of conceptual clarity, intuition is not the opposite of rationality. In practice rational and intuitive processes are expected to be intertwined and mutually influence each other (Hammond et al., 1987; Kahneman & Frederick, 2005).

In one point of view, evidence shows how rational data analyses can be used to detect and correct bias deriving from intuitive judgement (Earl & Louis, 2013; Kahneman & Frederick, 2005). On the other hand, studies in the field of naturalistic decision making show how experts are able to overcome the limitations of bounded rationality because they are able to recognize relevant data in all the information that surrounds them (Kahneman, 2003; Klein, 2008; March, 1994). Data collection has shown to be of decisive importance in the final decision since only data that are brought into the decision process can be taken into account (Schildkamp & Lai, 2012). Because teachers, as all decision makers, have limited time and cognitive capabilities with regard to information processing, data collection is guided by the expected value of the information for the decision maker. How teachers believe good teaching should be and their approaches to teaching is expected to influence how they collect data to a great extent. (March, 1994).

Starting from a dual process approach that takes into account both rational and intuitive processes of teacher judgement, following paragraphs will elaborate the role of data and intuition in the important phase of data collection and how data collection may be influenced by teachers’ approaches to teaching.

How do teachers collect data?

Rational data collection versus Intuitive data collection

Data use broadly refers to collecting, analysing and interpreting data before a decision is made (Mandinach & Gummer, 2013). Although all steps are important in this cyclic and systematic process of data use, how teachers collect data has shown to have an important impact on the final decision (Kahneman & Frederick, 2005). Since teachers, as all decision makers, have limited time and cognitive capabilities with regard to information processing, they will not consider all data, instead they filter data through existing knowledge and beliefs, paying attention to some data, and ignoring other (Spillane, Reiser, & Reimer, 2002; Weick, 1995). Therefore, the step of data collection is said to be of decisive importance in teacher judgement. Only the data that are brought into the decision process can be analysed, interpreted and used to evaluate alternatives in the final decision (Schildkamp, Poortman, & Handelzalts, 2016). The process in which teachers collect data can incorporate both rationality and intuition (Epstein, 2010; Kahneman & Frederick, 2005). Therefore, it is important to define the distinguishing characteristics that separate rational data collection from intuitive data collection.

In education, teacher judgement has been based predominantly on intuitive strategies for many years. Teachers collected data spontaneously during their daily practice (Creighton, 2007). Allal (1988), for example, used the term ‘spontaneous performance assessment’ to describe the intuitive judgement of effort or perseverance based on pupils’ daily assignments, along with unrecorded and occasional observations of attitudes and work habits. At elementary-school level, teachers’ spontaneous observations and overall impressions used to provide the main basis for official decisions (Airasian, 1994). Intuitive data collection refers to spontaneous, recognition-primed collection of data without any deliberate, systematic search. Throughout their careers, teachers develop a framework of personal knowledge based

on learning and experience (Kelchtermans, 2009; Klein, 2008). This personal expertise enables teachers to recognise patterns in the data that surrounds them and guides their attention when searching for data (Dane & Pratt, 2007; Klein, 2008). The recognition of data will create expectancies about future outcomes and enables teachers to identify a plausible conclusion without deliberate analyses (Klein, 2008).

Although these intuitive strategies are an important aspect of expertise, judgement that is solely based on data collected intuitively may not be objective and fair as judgemental heuristics may produce a form of bias that jeopardises intuitive judgement (Kahneman & Frederick, 2005). For instance, confirmation bias may apply when teachers only observe what they expect to see and ignore any data that questions their assumptions (Harteis et al., 2008; Kahneman & Frederick, 2005). Thus, the nature and quality of data collection has an important impact on the quality of teacher judgement (Earl & Louis, 2013). Hence, rational data collection is considered to be a valuable alternative that prevents intuitive heuristics from leading to confirmation bias (Kahneman & Frederick, 2005).

Rational models of teacher judgement are embedded in theories on 'data use' and describe a cyclic process that is initiated by a pre-set goal or question. Subsequently, teachers decide what data they need to answer that question and will think about a plan or method to collect the data. They will then engage in a deliberate search for data, analysing and interpreting it before making any decision. If the data collected do not provide a sufficient answer to the question, a new cyclic process will then be initiated (Earl & Louis, 2013; Schildkamp & Ehren, 2013).

In contrast to a spontaneous recognition-primed collection of data, rational theories on data use describe a purposeful and cyclic process that follows a series of steps initiated by a pre-defined goal. At one end of the cognitive continuum are deliberate, systematic strategies of data collection as described in theories of data use (Hammond et al., 1987). At the other end

are non-deliberate, non-systematic recognition-primed strategies as described in theories of intuitive expertise (Klein, 2008).

In this study, a conceptual distinction will be made between rational and intuitive modes of data collection that will be based on the extent to which data are collected in a deliberate and systematic manner.

Deliberate data collection means that teachers will intentionally collect data when initiated by a pre-defined problem or goal (Schildkamp & Lai, 2012). For example, teachers may analyse pupils' writing exercises because they want to find out if the same mistakes are recurring.

Systematic data collection refers to the collection of data according to a pre-defined plan or using a specific method (Earl & Louis, 2013). For example, classroom observations may be conducted using an observation protocol that denotes a form of systematic data collection. On the other hand, classroom observations cannot be deemed systematic if they are conducted without a thoughtful, explicit method such as a protocol or a checklist. Given the likelihood of confirmation bias teachers may only see what they expect to see.

Data: the need for a clear definition

Literature on data-use often encompasses broad definitions of data, varying from cognitive to socio-emotional factors, and includes quantitative as well as qualitative indicators (e.g. Coburn & Turner, 2012; Schildkamp & Lai, 2013). In this study, we acknowledge the importance of different kinds of data that can be found in schools, however we will organise and categorise the data for reasons of conceptual clarity. The CIPO-framework provides a useful lens through which to view the cognitive and socio-emotional Context, Input, Process and Output data used by teachers (Kellaghan & Stufflebeam, 2003; Scheerens, 1990). *Context* data refer to all peripheral and external data relating to a specific pupil, for example parental expectations regarding pupils' future educational trajectories. *Input* data refer to the

characteristics of a specific pupil, such as a certificate denoting a learning disability. *Process* data are related to processes of learning and instruction in relation to a specific pupil, for example, the work ethic a pupil demonstrates during lessons. *Output* data comprise cognitive and non-cognitive output indicators such as test results. Arranging the broad definition of data in this framework leads to the following definition of data being adopted in this study: *data are all cognitive and socio-emotional context, input, process and output indicators, both quantitative and qualitative.*

Approaches to teaching

As described above, decision making is not a technical-rational process free of values and beliefs (Pajares, 1992; Rubie-Davies, 2010). Teachers engage in a decision-process with a set of cognitions that operates as a lens through which they look at teaching and give meaning to it. Teachers tend to fit the decision making process into a frame that is familiar (Kelchtermans, 2009). Teachers' approaches to teaching influence their behavior with regard to instruction and assessment (Postareff & Lindblom-Ylänne, 2008).

Studies examining the accuracy of teacher judgement when compared with objective measures point out that teacher judgment is subject to much individual teacher variation (Brookhart, 1994, 2013; Kaiser et al., 2013). Teachers use different standards and hold different values when they assess pupils' competences (Rubie-Davies, 2010). Because teachers have different understanding and beliefs about the purposes of their teaching, they use achievement and non-achievement factors differently in their judgement of pupils' competences (Brookhart, 2013; Randall & Engelhard, 2010). For example, teachers who believed that fair decisions needed to take into account socio-emotional factors such as effort and persistence, used more non-achievement factors in their judgement (Briscoe, 1991; Brookhart, 1994; Stiggins, 2005). This raises the expectation that teachers with a certain approach to teaching will collect different kind of data. In literature on teachers approaches to

teaching (eg. Lindblom-Ylänne et al., 2006; Trigwell et al., 1999; Williams & Coles, 2007) teachers have shown to differ into the extent in which they focus on the curriculum. While some teachers focus their teaching on curricular goals, other teachers focus more on the socio-emotional aspects of teaching (Pratt, 2002). That is why we assume that teachers' approaches to teaching will influence their mode of data collection. More specific, we assume that teachers who focus more on the socio-emotional aspects of teaching will use more non-achievement data to inform decision making. Further, our assumption is that teachers who focus more on curricular goals will use more achievement data to inform decision making. As previous research has shown that the use of non-achievement factors negatively influenced the accuracy of teacher judgement when compared with objective measures, it is important to explore this relation.

A teaching approach can be defined as a strategy teachers adopt when teaching, based on their beliefs of good teaching (Louws, Meirink, van Veen, & van Driel, 2017; Meirink, Meijer, Verloop, & Bergen, 2009; Trigwell, Prosser, & Taylor, 1994). These approaches often vary from a teacher-centred strategy, where the intention is to transmit knowledge to pupils, to a pupil-centred strategy aimed at facilitating learning (Trigwell et al., 1994). Teachers' approaches to teaching are frequently studied in relation to their conceptions of teaching, as conceptions of good teaching influence how teachers teach (Allal, 1988; Beijaard, Verloop, & Vermunt, 2000; Calderhead & Robson, 1991; Postareff & Lindblom-Ylänne, 2008). Given this, Kember and Gow (1994) identified two conceptions of good teaching possessed by teachers. Firstly, teachers with a knowledge transmission conception believe that good teaching focuses on transferring content to pupils and preparing them to achieve adequate grades. Teachers with a learning facilitation conception view good teaching as an approach that motivates pupils and guides learning processes. In subsequent research, Prosser and Trigwell (1999) combined conceptions of good teaching with their earlier findings regarding

the teacher-centred/pupil-centred approach, postulating an information transmission/teacher-focused approach and a conceptual change/student-focused approach. The same dimensions were combined by Pratt (2002) into a clear, descriptive framework where three different teaching approaches were based on a combination of a high/low focus on transmitting the curriculum on the one hand, and a pupil-centred/teacher-centred approach on the other.

Although, in practice, teachers may use elements from all the approaches, most tend to follow one particular approach (Pratt, 2002).

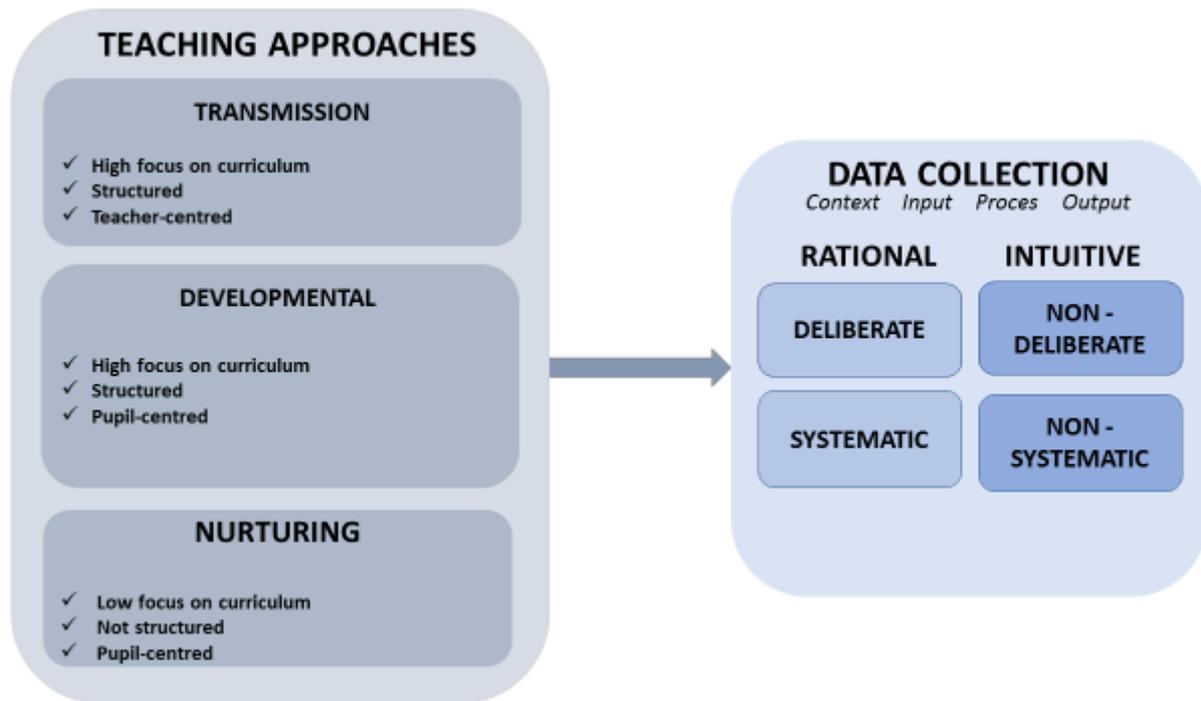
(1) Teachers with a *transmission* teaching approach believe that good teaching requires a focus on the curriculum and a systematic and structured approach. Pupils are seen as passive recipients of information transmitted to them by the teacher. Teaching is therefore founded on a teacher-centred approach.

(2) Teachers with a *developmental* teaching approach believe that effective teaching must be planned and conducted from the pupils' point of view. Good teachers must understand how pupils think and reason about the content and must therefore provide them with tasks that are meaningful. They consider each pupil's individual needs whilst teaching them as much of the curriculum as possible. Teachers are clear and structured in their delivery of the content because they believe this will create a supportive environment within which pupils will master increasingly complex curricular goals.

(3) Teachers with a *nurturing* approach believe that good teaching comes from the heart and that enhancing pupils' motivation is the key to learning. These teachers believe that pupils are motivated learners when they feel happy during class and enjoy coming to school. Therefore, nurturing teachers predominantly focus on the socio-emotional aspects of teaching rather than curricular goals. In order to be responsive to students' socio-emotional needs, these teachers place pupils at the centre of teaching (pupil-centred approach) and do not adhere to a structured teaching approach (Pratt, 2002).

These teaching approaches therefore reflect teachers' differing conceptions of good teaching. Given this, we will therefore investigate whether and how these approaches explain differences in the way teachers collect data to inform their judgement.

Figure 1: Overview of the theoretical framework



The approach of this study

In this study, we selected the transition from primary to secondary education as an appropriate case to show because this transition involves complicated decisions that are influenced by many factors, and will have a decisive impact on pupils' future position in society. Moreover, it is one in which the judgement of the individual teacher still plays a significant role.

In Flanders (Belgium), pupils typically make the transition to secondary education by the age of 12. Teachers therefore need to make the transition decision at the end of a pupil's primary education. Although, officially, the transition decision is made by a team, in practice it appears that the judgement of the sixth grade teacher is still of decisive importance (Bonvin, 2003; Goos, Van Damme, Onghena, Petry, & de Bilde, 2013). This highlights the importance

of questioning how the individual teacher makes the transition decision. As stated in the theoretical framework, rational data collection is viewed as a valuable approach that prevents intuitive heuristics from leading to judgement bias. Therefore, we will study how rational or intuitive teachers use data to inform their judgements about pupils' competencies in relation to the transition to secondary education.

Research Question 1 is therefore:

RQ 1: What kind of data do teachers collect rational or intuitive when they make high-stake decisions?

This question derives from an increasing expectation that teachers will collect data rationally to inform decision making. However, research has shown that teachers' conceptions of good teaching significantly influences their approach to teaching (Drake et al., 2001; Van Veen et al., 2005). These, in turn, will influence how teachers assimilate new models of teaching and evaluation as teachers will try to assimilate new norms into their existing conceptions of good teaching (Kelchtermans, 2009; Van Veen et al., 2005; Zembylas, 2003). Therefore, we will also investigate how teachers' approaches to teaching influence how they collect data to inform their judgement. This leads to the second research question, which is:

RQ 2: How do teaching approaches influence teachers' collection of data when judging pupils' competencies regarding the transition from primary to secondary education?

Method

Design

In our study we used a qualitative research design based on semi-structured interviews, because our focus is on understanding how teachers collect data to inform their judgement and how their teaching approaches influence data collection. This requires an in-depth description of the underlying processes and beliefs in a contextualised way (Yin, 1994). This

qualitative research design allows us to gain a rich understanding of the complexity of the phenomenon in a real-life context, trying to understand the viewpoint of the teachers.

Participants

The focus of this study was on 6th grade (pupils aged 11 – 12) primary education in Flanders (Belgium). In this research paper, we want to investigate how teachers collect data rationally or intuitively. Theories of naturalistic decision making suggest that only experts in a domain are able to recognize relevant cues spontaneously because they have developed mental models based on experience (Klein, 2008). Therefore, we wanted to include only expert teachers in our research. In previous research five years of teaching experience is often mentioned as the minimum criteria to identify expert teachers (Palmer, Stough, Burdenski & Gonzales, 2005). A purposive sampling strategy was adopted as the participants needed to be teachers in 6th grade with at least five years' experience as a teacher (Miles, Huberman & Saldana, 2014). Sixteen 6th grade teachers participated on a voluntary basis.

31% of the teachers were male (N=5) and 69% were female (N=11). 44% had between 5 and 10 years of teaching experience whilst 56% of the teachers had more than 10 years of experience. All teachers signed an informed consent form stating that they were informed about the goals of the research, that they understood their anonymity was guaranteed and that they could end their cooperation at any time.

Table 1: Descriptive Overview of the participants

	Teacher	Gender	Years of Teaching Experience
1	Emma	female	11
2	Frank	male	32
3	Bart	male	15
4	Roy	male	32
5	Amy	female	13
6	Ann	female	8
7	Joyce	female	5
8	Peter	male	4
9	Sophie	female	8
10	Bob	male	19
11	Julie	female	29
12	Lisa	female	7
13	Mary	female	25
14	Pamela	female	30
15	Liz	female	7
16	Katy	female	8

Interviews and Procedure

Participants answered open-ended questions that explored their judgements about pupils' competencies in relation to the transition from primary to secondary education. Example questions include: "You indicated that there might be a problem with the transition from primary to secondary education with 'pupil X'."; "What data did you use to inform this judgement?"; "How did you collect these data?" Questions related to their teaching approach were also included. For example, they were asked: "How do you see yourself as a teacher?", and "How would you describe your teaching approach?" All teachers discussed a transition problem involving 2 specific pupils, which meant that a total of 32 cases were discussed. The in-depth interviews lasted for an average of one hour and were conducted by a single researcher. The same interview protocol was used in all 16 interviews to ensure methodological consistency (Cohen, Manion & Morriison, 2008). All the interviews were audio-recorded and the files securely saved for reasons of reliability (Cohen et al., 2008).

Peer-debriefing sessions were then conducted in which the different methodological choices, data analysis procedures and interpretations were critically examined (Cresswell & Miller, 2000).

Analysis

The interviews were transcribed ad verbatim and analysed using the qualitative software package, NVivo 10. The aim was to capture variations in both data collection (rational versus and in approaches to teaching. In step one, all references to data collection and teaching approaches from half of the transcripts were listed, and any variation in these descriptions was then explored inductively. Researcher A (the first author) annotated interview fragments with an open code, staying as close as possible to the original text (Miles et al., 2014).

Subsequently, researcher A and B (second author) discussed these open codes to ascertain whether the codes were valid in terms of the text fragments surrounding them. In step three, researchers A and B discussed the extent to which these codes could fit into the theoretical framework. After both researchers had come to an agreement a deductive approach was then used. Two randomly selected interviews were analysed by both researchers and inter-rater reliability (Cohen's Kappa) was found to be 0.90 (Miles & Huberman, 1994). Based on the coding schema researcher A analysed all interviews in the last step of the coding process.

Table 2: Overview of the codes

CODE	Conceptual characteristics	Example
DATA	- Quantitative and qualitative cognitive and social-emotional context, input, process and output indicators	- Test results, conversations with pupils, observations, pupil files.
<i>Deliberate</i>	- Collection starts from a pre-defined goal or question	- A test taken to measure a specific curricular goal
<i>Systematic</i>	- Collection is carried out according to a pre-defined plan or method	- Observations using an observation protocol
<i>Context</i>	- Indicators that delineate influencing factors in the surroundings of a pupil	- Expectations from parents regarding further educational trajectories in secondary education
<i>Input</i>	- Indicators referring to specific characteristics of a pupil	- Certificate of a learning disorder
<i>Process</i>	- Indicators that describe how a pupil relates to processes of learning and instruction	- The work ethic a pupil displays during the lesson
<i>Output</i>	- (Non) cognitive output indicators	- Test results
TEACHING APPROACH		
<i>Focus on curriculum</i>	- The teacher considers transmitting the curriculum to be the main goal of teaching	- ‘Above all, pupils need to score at least 60% on all parts of the curriculum.’
<i>Structured</i>	- Teaching follows a daily and weekly routine that is planned beforehand and strictly adhered to by the teacher.	- ‘Every day, we start the day by discussing our routine so that every pupil knows what is going to happen.’
<i>Teacher-centred</i>	- Teaching starts from how the teacher believes the content should be delivered. Pupils are viewed as passive receivers of information.	- ‘I put a lot of energy in transmitting the knowledge the best way I can, so I expect pupils to be quiet and concentrated.’
<i>Pupil-centred</i>	- Teaching starts from the needs and perceived levels of the pupils.	- ‘I try to find out how what interests them, so I can use this as a starting point.’

To answer research question 1 we binarised the qualitative data according to the level of headcodes for each participant. Score 1 was allocated to a participant if a headcode was present in one of the cases, score 0 if this was not the case. Each of the 16 teachers discussed 2 cases, so 32 cases were discussed in total. Binarisation provides a clear overview into the appearance of phenomena across participants, removing individual differences between participants (e.g., talkative versus introverted participants) (Onwuegbuzie, 2003). This technique was suitable for the present dataset because all the conceptual topics were questioned in all semi-structured interviews. Starting from our theoretical framework, we calculated the use of context, input, process and output data for both cognitive and socio-emotional indicators (Kellaghan & Stufflebeam, 2003; Scheerens, 1990). We used

binarisation, as a quantitative method for data reduction, merely as a starting point for further qualitative in-depth analysis.

To answer the second research question – the influence of approaches to teaching on teachers’ data collection - we studied the text fragments that described teachers’ approaches to teaching. Based on insights derived from the theoretical framework, we used a deductive approach to cluster teachers into three different categories (transmission/developmental/nurturing) based on (1) high or low focus on the curriculum, (2) high or low structured teaching approach and (3) teacher centred versus pupil centred approach.

Results

Teachers’ data collection when judging pupils’ competencies.

Table 3 provides an overview of the data teachers used to make their judgement. As explained in the methodology, the results were binarised. Each of the 16 teachers described 2 individual cases, 32 in total. For each case, we scored a (1) in that category if teachers used at least one data source of that sort or (0) when teachers did not use that kind of data. No teacher mentioned the use of context data, therefore we did not include this category in the table.

Table 3: Overview of teachers' data collection

DATA COLLECTED	RATIONAL DATA COLLECTION		INTUITIVE DATA COLLECTION	
	Cognitive	Socio-emotional	Cognitive	Socio-emotional
Input	8	2	0	0
Process	2	1	19	24
Output	13	0	1	0

The first issue to focus upon is what kind of data do teachers use rationally, and how do they

use it to inform their judgements regarding transition decisions? The interviews showed that teachers predominantly use cognitive output indicators rationally, mainly by referring to the results of non-standardised tests. For example, Pamela describes how the test results for French show her that Ruby has not mastered the curricular goals. Like most teachers, Pamela's tests are based on a teaching method and are part of the teachers' manual that comes with pupils' schoolbooks. In many cases, teachers adapt these tests according to their own needs. This often means that teachers will only use the parts of the test they find relevant, or that corresponds with what they have taught. Furthermore, in many of the interviews teachers reported the use of tests they developed themselves to quickly test a small part of the curriculum. In exceptional cases, rational cognitive output data referred to homework or assignments pupils completed in the classroom. Just two teachers referred to the results of standardised tests. For example, Emma mentions a very low score on a standardised reading test taken by Jake. Because Jake is new in school, she found these results highly informative in judging his competencies.

Teachers also reported collecting test results to establish the extent to which a pupil has reached specific curricular goals, or to what extent they have progressed in certain subject areas. Given that teachers describe a deliberate and systematic collection of cognitive output data, this can be defined as rational data collection.

Teachers also collected cognitive input data to inform their judgement. Rational input data are related to information about pupils' (learning) disorders, SES-indicators and the situation at home. According to some teachers, they search for information in the pupils' files or will consult colleagues from previous years to determine the right approach for pupils with (learning) disorders or with problems at home. For example, Bob goes to see the care coordinator to find out which compensation strategies work best for Jake, a boy with dyslexia. However, in the interviews, many teachers did not mention a deliberate search for cognitive

input data as they are presented with them passively at the start of the year in pupils' files or during a meeting where the transition from one grade to the other is prepared.

In general, the interviews show that the predominant use of rational data refers to cognitive indicators that were collected deliberately and systematically. Teachers seldom collect socio-emotional data rationally to inform their judgement regarding the transition decision. In the interviews, intuitive data collection exclusively referred to observations made during daily practice when teachers' attention was drawn by certain cues. According to the teachers, they had not deliberately planned to investigate certain aspects of pupils' competencies beforehand. No teacher mentioned the use of an observation protocol, a check list, or any other kind of method or system to guide their observations. Because the observations discussed by the teachers were neither carried out deliberately nor systematically, these observations are believed to be collected intuitively.

'I noticed him slouching in his chair, he showed no interest in what so ever. You can recognize that kind of pupil, their attitude is different from the average 11-year old. We sometimes say that their eyes don't twinkle. I noticed that when I looked at him immediately. I knew this passive attitude would be a problem.' (Frank, male teacher, 32 years of teaching experience)

According to the teachers, their expertise as a teacher, as well as the personal connection they have with their pupils, allows them to recognise the most important indicators relating to pupils cognitive and socio-emotional progress as well as any problems they may have. Teachers often mention the word 'intuition' when they describe how they spontaneously recognise the most important data that proved to be decisive in their judgements regarding transition decisions.

'At the end, there is no pupil in my classroom of whom I thought: I hadn't noticed that myself, I hadn't seen that. Apparently, I observe a lot unconsciously. It is impossible to teach and to observe pupils deliberately at the same time. But I know I get the essence implicitly. The trouble is that it is hard to formulate, because it's mostly an intuitive way of information gathering. For me, it is an important aspect of my teaching'. (Peter)

In the interviews, only Frank mentioned a deliberate and systematic search for information on interactions, this was between one pupil and a group of others when he observed them in the playground one week. Frank suspected that Tom, a boy in his class, was unfairly blamed by a group of other pupils for things happening in the classroom. This case is the only example we found in the interviews on the rational collection of process data related to socio-emotional indicators. In this study, intuitive data collection almost exclusively refers to a spontaneous, recognition-primed collection of process data. Only Lisa refers to the spontaneous recognition of a specific mistake in a writing task that might indicate a learning disorder. In this case, her intuitive recognition triggered a deliberate search for more data. In summary, a large amount of the data that informs teachers' judgements in relation to transition decisions is collected intuitively through observations during daily practice. Intuitive data collection is complemented by rational data collection to a certain extent, mainly regarding output indicators such as the results of non-standardised tests and, to a certain extent, input indicators such as reports on (learning) disorders.

Teachers' approaches to teaching and their influence on data collection.

To answer RQ 2 we will first describe differences in teachers' approaches to teaching. Following this, we will then explore how differences in such approaches influence data collection.

Table 4: Elements of teaching approach, gender and years of teaching experience (N=16)

Teacher	Sex	Years of Experience	High focus on Curriculum	High on Teacher Centred	High on Structured approach
Transmission Approach					
5 Amy	F	13	+	+	+
6 Ann	F	8	+	+	+
9 Sophie	F	8	+	+	+
15 Liz	F	7	+	+	+
16 Katy	F	8	+	+	+
Developmental Approach					
1 Emma	F	11	+	-	+
7 Joyce	F	5	+	-	+
11 Julie	F	29	+	-	+
12 Lisa	F	7	+	-	+
Nurturing Approach					
2 Frank	M	32	-	-	-
3 Bart	M	15	-	-	-
4 Roy	M	32	-	-	-
8 Peter	M	5	-	-	-
10 Bob	M	19	-	-	-
14 Pam	F	30	-	-	-
No Fit					
13 Mary	F	25	-	-	+

Five out of 16 teachers can be defined as teachers with a transmission approach to teaching. According to these teachers, good teaching requires a clear structure, for example, a fixed daily and weekly schedule. In this way, they make efficient use of class time, enabling pupils to master the content. The teachers describe how they try to prepare their pupils for secondary education and how they see it as their duty to assist them as far as possible in achieving the goals of the curriculum. In the interviews, most of these teachers believed that good teachers were experts in the subject matter who can teach their pupils in a competent way. Pupils are mainly seen as passive recipients of information.

'I'm a strict teacher, I'm aware of that. But I have learned that pupils need structure in order to learn. I experienced the transition to secondary education as a gigantic step myself. In secondary education, I was confronted with so much at the same time, organisation, ... self-dependence. (...) It (the approach) doesn't make me the most popular teacher, but afterwards, parents often come to me and thank me because their children were well-prepared. That, I

find more important. I am a teacher, not their best friend, I have to teach them as much as possible.’ (Emma)

Four out of 16 teachers can be identified as teachers with a developmental approach to teaching. These teachers believe it is important that pupils learn as much as possible, and they try to be responsive to pupils’ individual needs. They claim that good teachers try to understand what is happening with pupils, not only in school, but also at home. In the interviews, the teachers described how they tried to set high standards that were then adapted to the capabilities and life context of each pupil. Therefore, according to these teachers, good teaching is based on the needs and potential of each pupil. Furthermore, these teachers believe that all pupils benefit from a structured and comprehensive approach, as this creates a safe learning environment.

‘Wellbeing, I think it is very important, but there needs to be hard working too. We are in 6th grade, they need to work more independently. Each day, they know what their assignments are, it is the same method every week, and they know they will have to finish all their tasks by the end of the week. I can see that Tim’s motivation has grown, he has opened up. Sometimes I notice that he did not make his homework. I know the situation at home, I know it’s not easy for him. I will talk with him about it, be understanding, try to find a solution, but he knows he will still have to do his homework.’ (Joyce)

Six out of 16 teachers can be defined as teachers with a nurturing approach as they generally believe that good teaching involves caring, listening to, and motivating pupils. These teachers describe how they believe good teaching involves loving your pupils as a parent, and making them feel safe and happy when they come to school. Thus, they do not see the curriculum as the focal point of teaching. According to these teachers, the socio-emotional aspects of teaching are very important as they will enhance pupils’ motivation to learn, which in turn will be a lever for better achievement in the curriculum. In their daily routine, these teachers

try to be responsive to the needs of their pupils and to what is happening in the group; they do not believe in, and do not like, a rigid structure or routine. For example Roy describes how he approaches George.

'I believe you can solve most issues using humour. If something happens in the class, I have to be responsive. I try to make a little joke, ... Do not seek direct confrontations, or use punishment, ... Otherwise, you create a stressful situation and that has the reverse effect. (...) I know it is related to who I am, people say that humour is part of my personality. I don't like to punish, it gives me a bad feeling. Getting a connection with my pupils, it is one of the most important elements for me as a teacher. When I succeed in getting through to Georges personal wall, I hope that he will make some efforts because he finds it important to do it for me, and... maybe I can still get him there (transition general secondary education).'

For Mary, we were not able to determine a dominant perspective. On the one hand, Mary describes herself as a teacher with a structured and consistent teaching approach. On the other, Mary believes that good teaching comprises open and warm interactions with pupils, rather than delivering the curriculum and addressing pupils' needs. Therefore, Mary could not be assigned to any one of the three categories.

Subsequently, to answer research question 2, we will explore how the three teaching approaches described above influence the way teachers use data to inform their judgement. Regarding research question 1, the results showed that teachers mainly use input and output data that were collected rationally, and process data that were collected intuitively. Based on these findings, and to provide a clear overview, only these categories will be listed in Table 5. The extent to which teacher judgement was based on at least one output or process indicator (1) or was not used by the teacher (0) for each case is documented in the table below. Because each teacher described two cases, scores can vary from 0 to 2.

Table 5: Use of rational and intuitive data in relation to teaching approaches (N=15)

TEACHER IDENTITY	RATIONAL DATA COLLECTION		INTUITIVE DATA COLLECTION
	INPUT	OUTPUT	PROCESS
TRANSMISSION APPROACH			
Amy	1	1	1
Ann	2	2	1
Sophie	2	0	2
Liz	0	1	2
Katy	1	2	1
	6/10	6/10	7/10
DEVELOPMENTAL APPROACH			
Emma	2	2	2
Joyce	0	1	2
Julie	1	1	2
Lisa	0	2	2
	3/8	6/8	8/8
NURTURING APPROACH			
Frank	1	0	2
Bart	1	0	2
Roy	0	0	2
Peter	0	0	2
Bob	1	1	2
Pamela	1	1	2
	4/12	2/12	12/12

Table 5 suggests that data collection differs according to the teaching approach used.

Firstly, teachers with a transmission approach use data that were collected both rationally and intuitively. In at least half the cases, these teachers use input and output data collected rationally as well as process data collected intuitively. We see similar results for developmental teachers. All these teachers referred to the use of process data that was collected intuitively. Moreover, these teachers rationally collected output data in 6 out of 8 cases and input data in 3 out of 8 cases. Joyce's story can be used as an example. She describes how she judges the competencies of Roman:

'I am afraid he lacks cognitive capacities as well as motivation to make it in secondary education. He scores below average on Dutch language and mathematics. When I compare test results, especially when he needs to study big parts of the curriculum, he fails. He regularly does not make his homework. On the other hand, when he is attentive and active during the lessons, he is often able to give the right answer. I believe he is not motivated to

work and to study at home. Partly, I understand, his parents are divorced and I sometimes notice that he did less for school when he was with his mother. So, for now, he does not meet the curricular goals, but I think he might be smarter. (...) I think that because occasionally, he gives smart answers during class. I will do the best I can to get him motivated, I noticed that my approach made him feel safe enough to be involved, but in the end, he will still need to do it himself.'

However, Table 5 offers a different view of teachers with a nurturing approach to teaching. All nurturing teachers use process data that was collected intuitively. However, data collected rationally was used in less than half of the cases. In the interviews, teachers collect output data rationally in 2 out of 12 cases and input data in 4 out of 12 cases. Moreover, 2 out of 6 nurturing teachers made no mention of the use of data that was collected rationally in their judgement of pupils' competencies related to transition decisions. Nurturing teachers preferred to focus on socio-emotional elements and wanted to care for their pupils. However, as the example of Bob shows, when nurturing teachers do not experience a personal connection with a pupil, they feel they are not able to help them properly.

'Tim, he lacks motivation to make it in general secondary education if you ask me. For example, they had this recitation and he gave me his preparation on this sloppy piece of paper... Not even printed, handwritten without a margin. Then I think: do I need to keep investing all this extra effort in supporting him, when he can't even make an effort to do his assignment properly? I tried to have a conversation with him about his assignment, but he didn't seem to care. (...) I feel like a father for my pupils, really, I feel the responsibility to help them the best I can, but it's a responsibility that goes both ways.'

Conclusion and discussion

Main Findings

With the aim of enhancing the quality of teachers' judgement, research studies on data use show how data can be used in a way that complements intuitive judgements (Earl & Louis, 2013). In this study, we first needed to arrive at a clear conceptual distinction between the rational and intuitive bases of teacher judgement. Although concepts of data and intuition are often used in research, the broad definitions under which they are mostly reported inhibit the use of a clear lens that would enable us to study both concepts unambiguously. Based on theories of data-based decision-making and intuitive expertise, we defined rational data collection as deliberate and systematic strategies of data collection and distinguished it from intuitive data collection which we defined as non-deliberate, non-systematic recognition-primed strategies of data collection. Subsequently, we used insights into teaching approaches to investigate how teachers differ in the way they use data to inform their judgement.

First, our results show that intuitive data collection still plays a dominant role in teachers' judgement. This form of judgement is largely based on recognition primed observations during daily practice. These non-deliberate and non-systematic observations relate to attitudes, work pace, concentration, emotional wellbeing or social interactions. In our study, none of the teachers mentioned the use of an observation protocol, or had deliberately planned systematic observations beforehand. Based on a non-deliberate recognition of data, teachers recognised patterns which directly led to expectancies that informed their judgement. These findings coincide with strategies described in models of intuitive expertise. Klein (2008), for example, established how experienced firefighters, military commanders or pilots were able to make decisions under time pressure because they could simulate plausible outcomes based on data they recognised in the immediate situation. Similarly, the value of intuitive expertise is often studied and described in fields where time pressure calls for quick decision-making strategies. Although these frameworks provide valuable insights into the study of intuitive

expertise in the field of education, these models cannot be transposed without adjustment to any context. Our study suggests that teachers use the same intuitive strategies to recognise the most important cues and then identify a plausible course of action using, to a lesser extent, the deliberate and systematic collection of data. Although these strategies may be valuable for many decisions teachers make daily under time pressure, they are not appropriate for high-stake decisions that require thoughtful analysis. Whether teachers adopt different decision strategies for high-stake decisions compared to low-stake decisions, or whether they will unconsciously use the same decision strategy regardless of the stakes involved, remains a matter for speculation.

Our study also shows that teachers differ in the way they use data to inform their judgement, and such differences depend on their approach to teaching. Despite the expectation that teachers use data rationally to enhance the quality of their judgement, some teachers in our study did not do so to any great degree. Teachers who were less concerned with transmitting the curriculum (a nurturing teaching approach) made little to no use of data collected rationally in their judgement of pupils' competencies. Teachers with a high focus on the curriculum (transmission and developmental approaches) used data that were collected both rationally and intuitively. In these cases, non-deliberate and non-systematic observations were complemented, to a certain extent, by deliberate and systematic data collection. This implies that intuitive data collection does not necessarily exclude or replace rational data collection. We concluded that teachers with a high focus on achieving the goals of the curriculum use a wide array of data, collected both intuitively and rationally, when they judge pupils' competencies. It is sometimes suggested that teachers prefer to use their intuition rather than data (Spillane, 2012). In our study, this only applies to teachers with a low focus on transmitting the curriculum as they predominantly focus on the socio-emotional aspects of teaching. Although teachers with a nurturing approach firmly believe that intuitive data

collection allows them to be responsive to pupils' individual needs, research shows that valuable capabilities are wasted when teachers ignore data collected rationally. For example, Timperley and Phillips (2003) found that when teachers relied on their own assessments of pupils' knowledge rather than on (standardised) test results, they underestimated what pupils could do and were targeting their instructions at levels lower than those students were capable of achieving.

Limitations

However, we do have to acknowledge some limitations in this study. It proved very difficult to assess the quality of the teachers' decisions. In this regard, we can only describe the extent to which teachers collect data rationally or intuitively, we cannot assess the quality of data collection processes in relation to the quality of the decision made. Regarding confirmation bias, we can only highlight the possible pitfalls that have been outlined in various lines of research. In our study, the conclusions that teachers complement intuitive data collection with rational data, albeit to a limited extent, helps to raise awareness of potential errors in decision making. Furthermore, our conclusions are based on the statements and narratives teachers provided during the interviews. This contextualized and personal view of teachers' ways of thinking enabled us to obtain deep and rich insights into the processes underlying teachers' judgement. The same applies to statements about different approaches to teaching. We explored how the teachers in our study perceived themselves and what they believed good teaching should be. In this regard, our conclusions are based on teachers' self-perceptions; we did not triangulate our data by, for example, giving pupils questionnaires. Although this might appear to be a shortcoming, we found it especially important to gain insight in teachers' personal beliefs because these beliefs are said to influence changes in practice (Day, Kington, Stobart, & Sammons, 2006). Our study did not involve teachers with little in the way of teaching experience because they would lack the knowledge and experience needed in the

field of intuitive expertise (Klein, 2008). This means, however, that we have no insight into the modes of data collection and approaches to teaching of novices. For further research, it would be interesting to study if and why novices and expert teachers differ in data collection and approaches to teaching, and how this affects their judgement. It would also be interesting to establish whether this was the case across different contexts and cultures. External expectations, (data use) policies or the curriculum in teacher education may all influence teachers' conceptions of what it means to be a good teacher and thus their approaches to teaching.

Implications

Our conclusions highlight the importance of gaining further insight into the processes and beliefs underlying teachers judgements, and the quality thereof. For further research, it would be useful to explore how teachers' approaches relate to personal characteristics that have been shown to influence data use such as self-efficacy, attitude, motivation or data-literacy (Mandinach et al., 2006; Schildkamp & Ehren, 2013; Spillane, 2012; authors, 2016). This study contributes to the existing knowledge base by showing that approaches to teaching can be used to understand differences in the way teachers use data to inform their judgement. All the teachers in our study strongly rely on process data collected intuitively, but teachers with a clear focus on the curriculum will also use data rationally as a valuable complement.

However, teachers who focus their teaching on interpersonal relationship with their pupils and on loving, supporting and motivating pupils, might unwillingly compromise pupils' potential because they ignore rational data that challenges their intuitive judgement. Given the growing body of evidence suggesting data use enhances the quality of educational decisions, understanding why teachers differ in the way they use data is an important matter. Further research is needed to broaden our understanding of the complexity of teaching approaches that influence the quality of teacher judgement. In theoretical terms, this implies that teachers'

decision making is more complex than simply applying a rational decision model, as it also involves personal dimensions concerning what it means to be a good teacher (Hargreaves & Fullan, 1992; Kelchtermans, 2009).

For the purposes of policy and practice, it is important to offer frameworks for guidance on teacher judgement at an early stage during teacher training, a time when teachers' conceptions and approaches to teaching have yet to be fully formed. Once teachers' conceptions and approaches are established, they are resistant to change (Elbaz, 1983; Kelchtermans, 2009; F. Pajares, 2003). This means that awareness of, and explicit attention to, different conceptions and approaches are needed when educating teachers, as this is an important phase in forming a conception of what it means to be a good teacher.

For data use policies, it is important to consider differences in teachers' approaches to teaching. Because teachers differ in the way they use data to inform their judgement, different interventions and support will be needed. Our conclusions show that teachers' modes of data collection is not just a matter of data literacy, it also depends on what teachers believe good teaching should be. Because teachers differ in their approaches to teaching, there is no one size fits all intervention model. Furthermore, given that intuitive data collection still appears to be an important aspect of teacher judgement, awareness of the pitfalls of confirmation bias needs to be raised in schools, especially in teacher education. Overconfidence in one's own judgement might lead to severe bias, such as self-fulfilling prophecies (Agirdag, Van Avermaet, & Van Houtte, 2013; Sharma & Sharma, 2015). In the face of demands for objectivity and fairness, rational data use is an important complement to the intuitive bases of teacher judgement.

In summary, we conclude that teacher judgement is largely based on the intuitive collection of process data complemented, to a certain extent, by the rational collection of input and output data. Although research stresses the importance of challenging and complementing the

intuitive bases of teacher judgement through the use of rational data, this was only the case to a limited extent. Teachers who focused their teaching approach on socio-emotional processes rather than on transmission of the curriculum made little use of data collected rationally to inform their judgement. Given that teachers' individual judgements still have a significant influence on important decisions that are made regarding pupils' educational trajectories, these conclusions raise critical questions concerning the quality of teachers' judgement.

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