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### Inquiry-based leading and learning

*Inquiry-based working by school boards, school leaders and teachers and students' inquiry habit of mind*

Luijk, E.

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## CHAPTER 3

### The relationship between psychological factors and inquiry-based working by primary school teachers<sup>2</sup>

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#### Abstract

Inquiry-based working by teachers includes working with an inquiry habit of mind, being data literate, contributing to a culture of inquiry at the school level, and creating a culture of inquiry at the classroom level. Inquiry-based working has been found to contribute to educational improvements and the professionalization of teachers. This study investigates the relationship between psychological factors –attitude, experienced social pressure, self-efficacy, and collective efficacy – and inquiry-based working by teachers.

Questionnaire data were collected from a representative sample of 249 Dutch teachers. The results show a significant relationship between self-efficacy and all aspects of inquiry-based working. In addition, collective efficacy, attitude, and experienced social pressure are all related to aspects of inquiry-based working.

School leaders and teacher educators who aim to stimulate inquiry-based working should not only focus on increasing teachers' inquiry skills, but also on psychological factors related to inquiry-based working.

**Keywords:** inquiry-based working; teachers; self-efficacy; inquiry; data use

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<sup>2</sup> This chapter is based on Uiterwijk-Luijk, L., Krüger, M., Zijlstra, B., & Volman, M. (2017). The Relationship between Psychological Factors and Inquiry-based Working by Primary School Teachers. *Educational Studies*, 43(2): 147-164.

## Introduction

When teachers are asked on what basis they make decisions intended to improve their teaching, many of them indicate that their decisions are rooted in their own experiences. They rarely refer to theories or to instructional models (Elmore 2004). Schools collect a wide variety of data, both quantitative (such as learning outcomes or progression rates) and qualitative (such as interviews or observation reports), but they often do not use this data effectively (Earl and Fullan 2003; Krüger and Geijsel 2011; Lachat and Smith 2005; Wayman and Stringfield 2003). Apparently, teachers make scant efforts to gather and use evidence to improve teaching and learning. According to Earl and Katz (2006), a mind shift is needed: instead of only depending on experience (implicit, tacit knowledge) school leaders and teachers need to also rely on explicit, data-informed knowledge. Employing data for school improvement creates a culture of inquiry centered on the use of data to learn (Katz and Dack 2014). According to Krüger (2010a), inquiry-based schools are more conscious of their educational quality, are better able to perceive weak spots in their instructional processes, and make more focused adjustments to attain education improvements. In this paper we adopt a broad view on inquiry-based working, which involves working with an inquiry habit of mind, being data-literate and contributing to culture of inquiry at the school and classroom level (based on Earl and Katz 2006). This is broader than the much used view that focusses on the use of data in a technical way.

Cochran-Smith (2009) points out that there is a difference between a culture where evidence ‘drives’ decisions (suggesting a linear conception of the relationship between evidence and practice) and a culture where evidence ‘informs’ decisions (implying that evidence must always be interpreted and that evidence alone can never tell us what to do) (Cochran-Smith 2009). This second perspective mentioned by Cochran-Smith (2009) is consistent with our broad view on inquiry-based working.

The field of inquiry-based working in schools is relatively new. Existing research in this area predominantly focuses on conducting research and using data, while other aspects of inquiry-based working, such as contributing to a culture of inquiry and working with an inquiry habit of mind are not addressed. Earlier studies do, however, show the importance of psychological factors in explaining differences in inquiry-based working in the more narrow sense of data use (Ikemoto and Marsh 2007; Schildkamp and Kuiper 2010; Vanhoof, Vanlommel, Thijs, and Vanderlocht 2014). A positive or negative attitude towards inquiry-based working plays an important role in school leaders’ inquiring behavior (Vanhoof et al.

The relationship between psychological factors and inquiry-based working by primary school teachers (2014). Other psychological factors, such as perceptions of external expectations and self-efficacy, also have a relationship with school leaders' data use (Vanhoof et al. 2014). Self-efficacy regarding inquiry-based working has a significant relationship with both the inquiry habit of mind and teachers' data-literacy (Krüger and Geijsel 2011). The impact of psychological factors on teachers' inquiry-based working in a broader sense, however, remains a topic that clearly requires exploration. Therefore, this study investigates psychological factors that could influence inquiry-based working by primary school teachers.

## **Theoretical framework**

### ***Inquiry-based working by teachers***

Earl and Katz (2006) identify three key capacities for inquiry-based school leadership: having an inquiry habit of mind, being data literate, and creating a culture of inquiry. This study uses these capacities as a template for inquiry-based working by teachers. In this template, two aspects of creating a culture of inquiry are distinguished: contributing to a culture of inquiry at the school level and creating a culture of inquiry at the classroom level. This means teachers need four capacities to work in an inquiry-based manner: (1) having an inquiry habit of mind, (2) being data literate, (3) contributing to a culture of inquiry at the school level and (4) creating a culture of inquiry at the classroom level.

The first capacity for inquiry-based working – having an inquiry habit of mind – means that teachers do not base their teaching on tacit knowledge alone. Teachers with an inquiry habit of mind value deep understandings, reserve judgment, take a range of perspectives, and systematically pose increasingly focused questions (Earl and Katz 2006). They have the inclination to achieve (through passion and persistence), the inclination to be critical (through honesty and the ability to be critical to self and others), the inclination to know (through curiosity and excitement), and the inclination to understand (through the ability to take an overview of events and the desire to scrutinize) (Van der Rijst, Kijne, Verloop and Van Driel 2008).

The second capacity needed for inquiry-based working – being data literate – refers to knowledge regarding measurement and statistical concepts. This does not mean that teachers need to become statisticians. Rather, they must think about purposes, recognize different types of data and their quality, make interpretation paramount, and report to others (Earl and Katz

2006). Mandinach and Gummer (2013) define data literacy as the ability to understand and use data effectively so as to inform decisions. According to their theory, data literacy includes knowing how to identify, collect, organize, analyze, summarize, and prioritize data. It also includes the skills to develop hypotheses; identify problems; interpret data; and determine, plan, implement, and monitor courses of action (Mandinach and Gummer 2013). Data literate teachers are able to transform data into information, information into knowledge, and knowledge into action (Marsh and Farrell 2014). Schildkamp, Ehren and Lai (2012) point out that data is often narrowly defined as quantitative, standardized assessment data. Assessment data are only one type of data. Data literacy, however, also requires knowledge about other data, such as perception, motivation, process, and behavior (Mandinach and Gummer 2013). Therefore, our research employs a broader definition of data. It defines data as all the relevant information that teachers and schools need for decision-making, including both qualitative and quantitative data at the school, class, and individual pupil levels.

The third capacity needed for inquiry-based working is creating a culture of inquiry at the school level. In a culture of inquiry, teachers work together and assist one another in making sense of data, in engaging in joint action planning, and in sharing instructional strategies (Datnow, Park, and Kennedy-Lewis 2013). This description is consistent with how Van der Rijst et al. (2008) depict the inclination to share: being open to others and wanting to interact and work together. While working together, teachers are influenced through their interactions and negotiations with others (Coburn and Turner 2011). Van der Linden et al. (2012) and Schenke, Van Driel, Geijsel, and Volman (in press) have shown how this process of working together can also involve external researchers.

A culture of inquiry is not as much concerned with learning how to use data (as a technical skill) but with how to collaboratively use data to learn (Katz and Dack 2014). Katz and Dack (2014) point out that this collaborative use of data is a way of professional learning that enhances new understandings, which can stimulate improved practices, which in turn can influence student learning. In this inquiry-driven culture, teachers systematically and intentionally research their own teaching and learning as a form of quality improvement. The results of such research are then used to improve their teaching and learning (Ellis and Castle 2010; Van der Linden, Bakx, Ros, Beijaard, and Vermeulen 2012). These cultures of evidence, as Cochran-Smith (2009) calls them, look different depending on the educational setting, the values and beliefs of participants, and the varying purposes and traditions of programs and projects.

Inquiry-based working by teachers at the classroom level – the fourth capacity necessary for inquiry-based working – can be defined as creating an environment where pupils are curiosity-driven, ask questions, make discoveries, and test these discoveries in a search for new understanding (Chin 2002; Al-Sabbagh 2009). A culture of inquiry in the classroom is often referred to as inquiry-based learning. In their study investigating how inquiry-based learning was defined and taught in different fields, Levy, Thomas, Drago and Rex (2013) identify a number of characteristics. These are: focusing on learners’ active investigation and analysis of data, including their pursuit of probing questions; having pupils carry out investigations and collect data to construct evidence-based explanations; encouraging pupils to analyze documents and artifacts to construct accounts of past events; and requiring learners to take ownership of their own learning. Davis, Janssen and Van Driel (2016) found in their review study that the extent to which lessons are inquiry-oriented is heavily influenced by how inquiry-oriented the curriculum materials are. Jones and Eick (2007) describe three forms of inquiry-based learning. The first one is open ended, involving suspending planned instruction to explore students’ questions. The second one is project-based inquiry, involving teachers designing projects for students based on driving questions from class discussions. The third form is guided inquiry, which is teacher centred and involves a curriculum in which science concepts and lessons are fixed (Jones and Eick 2007). These three forms from open to guided inquiry can also be seen as a continuum in which the responsibility that learners have vary. According to Olson and Loucks-Horsley (2000) students should have opportunities to participate in all types of inquiries. They point out that guided inquiry can best focus on the development of science concepts, while a more open inquiry will afford the best opportunities for cognitive development and scientific reasoning. Also Baeten, Dochy and Struyven (2012) point out that there are limited benefits of solely student-centred approaches on students’ achievement, whereas a combination of a student-centred and a teacher-centred approach can provide structured support. In line with Earl and Katz (2006), in this study, creating a culture of inquiry in the classroom means stimulating pupils’ inquiry habit of mind, as well as their data literacy. This can vary in the degree of guidance by teachers.

### ***Psychological factors influencing inquiry-based working***

It seems that individuals let their attitudes – rather than their knowledge – guide their behavior (Sanbonmatsu and Fazio 1990). A teacher’s attitude towards inquiry-based working can be defined as the tendency to respond with some degree of (un)favor towards inquiry-based

working – an evaluative dimension that ranges from negative to positive through a neutral point (based on Fishbein and Ajzen 2010). Research on school leaders not only has shown a relationship between attitude and data use (Ikemoto and Marsh 2007; Schildkamp and Kuiper 2010; Vanhoof et al. 2014), but also between attitude and aspects of inquiry-based leadership (Uiterwijk-Luijk, Krüger, Zijlstra and Volman forthcoming). Vanhoof et al. (2014) and Uiterwijk-Luijk et al. (forthcoming) point out that attitude relates to respectively data-use and inquiry-based leadership. School leaders' positive attitude towards data use appears to have a positive relationship with their actual use of data (Vanhoof, et al. 2014). In addition, school leaders' positive attitude towards inquiry-based leadership appears to have a positive relationship with their creation of a culture of inquiry in their schools (Uiterwijk-Luijk et al. forthcoming). Attitude is, therefore, also expected to be a key factor in explaining inquiry-based working by teachers.

Additionally, it seems that teachers do not use data unless the school leader advocates for its use, stimulating and encouraging them to do so (Earl and Katz 2006; Schildkamp, Lai, and Earl 2013). This can be seen as an instance of social pressure. Therefore, teachers' perceived social pressure could be expected to be related to their inquiry-based working. Social pressure, or subjective norm, has two aspects: injunctive and descriptive subjective norms (Fishbein and Ajzen 2010). Injunctive norms refer to social approval and to the belief that others do or do not want us to perform a given behavior. Descriptive norms refer to the popularity of the behavior and to the belief that others are performing or not performing a specific behavior.

According to Bandura (1997), self-efficacy can be defined as believing that one can successfully perform a specific behavior and the conviction that one is capable of organizing and executing the actions required to produce given levels of attainments. Significantly, it appears to play a major role in explaining behavior in schools. For example, Geijsel, Slegers, Stoel, and Krüger (2009) found that teachers' sense of self-efficacy is an important psychological factor for understanding teacher learning. Self-efficacy regarding inquiry-based working also appears to have a strong positive influence on secondary school teachers' inquiry habit of mind and on their data literacy (Krüger and Geijsel 2011). Regarding school leaders, research by Uiterwijk-Luijk et al. (forthcoming) shows a strong relationship between self-efficacy and inquiry-based leadership. Furthermore, Vanhoof et al. (2014) found a relationship between self-efficacy and data use by school leaders.

Following this line of reasoning, it could be expected that self-efficacy regarding

The relationship between psychological factors and inquiry-based working by primary school teachers inquiry-based working has an impact on primary school teachers' inquiry habit of mind and on their data literacy. That said, it is still unclear what the relationship is between self-efficacy regarding inquiry-based working and contributing to a culture of inquiry at the school level. Similarly, uncertain is the relationship between self-efficacy regarding inquiry-based working and creating a culture of inquiry at the classroom level. Given the important role of self-efficacy in explaining behavior in schools, these are topics that clearly necessitate exploration.

Since inquiry-based working requires teachers to work together in teams (Coburn and Turner 2011; Earl and Katz 2006; Katz and Dack 2014), teachers' beliefs about the ability of his or her team to work in an inquiry-based manner are also relevant. Such beliefs represent perceived collective efficacy (Bandura 1997; Goddard, Hoy, and Woolfolk Hoy 2004; Skaalvik and Skaalvik 2007). It is still unclear what the relationship is between collective efficacy regarding inquiry-based working and aspects of inquiry-based working by teachers.

### ***Background characteristics related to inquiry-based working***

Given the fact that variables such as gender, age, and class level taught have shown to be relevant variables in studies on teacher capacities (Lam, Tse, Lam and Loh 2010; Mueller 2013; Mullola et al. 2011; Rubie-Davies, Flint and McDonald 2012), it might be expected that background characteristics (such as gender, age, or class level taught) could explain the extent to which teachers work in an inquiry-based way.

### **Current study: problem statement, hypotheses, and variables**

This study investigates how psychological factors are related to inquiry-based working by primary school teachers in the Netherlands. The psychological factors investigated in this study are: attitude, experienced social pressure, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working. The research question is: "how are attitude, experienced social pressure, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working related to inquiry-based working by primary school teachers in the Netherlands?"

In this study, inquiry-based working includes the following capacities, which are based on the research of Earl and Katz (2006): (1) working with an inquiry habit of mind, (2) being

data literate, (3) contributing to a culture of inquiry at the school level, and (4) creating a culture of inquiry at the classroom level. Working with an inquiry habit of mind is here interpreted in a behavioral sense, such as reading literature to gain knowledge, or verifying assumptions. Therefore, it is different from the concept ‘attitude,’ which in this research is used as a psychological factor. In this study, being data literate means being able to formulate research questions before gathering data, as well as being able to analyze and interpret data and present the results to others (Earl and Katz 2006). A broad definition of data is used, concerning not just assessment data but multiple types of data, both quantitative and qualitative. Contributing to a culture of inquiry at the school level is interpreted as collaborating with colleagues in a culture of inquiry. In the context of this study, this specifically refers to teachers collaborating to conduct and utilize research (Krüger and Geijsel 2011).

Based on Earl and Katz (2006), creating a culture of inquiry at the classroom level means stimulating pupils’ inquiry habit of mind and pupils’ data literacy. In this study, stimulating pupils’ inquiry habit of mind is interpreted as encouraging curiosity (to seek out new knowledge) and being critical (to ensure the new knowledge is qualitatively good knowledge). Furthermore, stimulating pupils’ data literacy here means systematically teaching research skills, such as asking different kind of questions, practicing research methods, and presenting to others.

Based on the theory outlined above and given the background characteristics, we hypothesized the following: (1) Teachers with positive attitudes towards inquiry-based working tend to work in a more inquiry-based manner than teachers who are less positive. (2) Teachers who feel it is expected of them to work in an inquiry-based manner (experienced social pressure) work in a more inquiry-based manner than teachers who experience less social pressure. (3) A high sense of self-efficacy towards inquiry-based working allows teachers to work in a more inquiry-based manner than a low sense of self-efficacy towards inquiry-based working. (4) Similarly, a strong sense of collective efficacy towards inquiry-based working allows teachers to work in a more inquiry-based manner than a low sense of collective efficacy. Before researching these hypotheses, we will explore the relationships between background characteristics and inquiry-based working.

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### ***Background characteristics***

The background characteristics included in this study are gender, age, class level taught, function, fulltime-equivalent (FTE), and highest level of education. Function refers to differences in responsibilities of teachers in the Netherlands, which are related to scales (LA, LB, and LC). Beginning primary school teachers in the Netherlands work in function LA. Teachers with functions LB and LC are more experienced and/or are supposed to have a higher educational background and to be (co-)responsible for school policy and innovation. Therefore, we expected function to be related to inquiry-based working.

To indicate an individual's workload in terms of time, the unit full-time equivalent (FTE) is used in the Netherlands. An FTE of 1.0 is equivalent to one full-time worker.

### ***Psychological factors***

This study investigates the impact of four psychological factors on inquiry-based working. First of all, it examines attitude, or, teachers' positive or negative feelings towards inquiry-based working. Based on Sanbonmatsu and Fazio (1990) and Visser-Wijnveen, Stes, and Van Petegem (2012), attitude concerns to what extent a teacher enjoys inquiry-based working and is interested in it. The second psychological factor is experienced social pressure. This includes believing that others – for example, school leaders – want teachers to engage in inquiry-based working. Furthermore, experienced social pressure incorporates the belief that others – for example, colleagues – are also working in an inquiry-based manner (Fishbein and Ajzen 2010). The third factor is teachers' self-efficacy towards inquiry-based working. In this study, this factor refers to a teacher's belief that he or she is capable of successful inquiry-based working. In line with this and as a final factor, collective efficacy towards inquiry-based working is seen as teachers' beliefs about the ability of their teams to work in an inquiry-based manner.

## **Method**

### ***Participants***

Because of an expected low response rate (due to research fatigue in Dutch schools), this study invited all 1,046 school boards of primary schools in the Netherlands to participate with their schools. In total, 27 school boards with 71 schools responded positively. A web-based survey

was sent out to school boards, school leaders, teachers, and pupils. For this part of the study, respondents were 249 teachers from 61 primary schools, and these teachers taught grade 5 through grade 8. Most schools included in the study (66.2%) were situated in the East and South of the Netherlands. This in line with the figure for national coverage: 69.4% (source: [www.stamos.nl](http://www.stamos.nl)). Most participants (75.3%) were female, which is also in line with national numbers. In the Netherlands, 78% of teachers are female (Ministry of Education 2013). There is no reason to assume that the schools in this study are different than other schools in the Netherlands.

The background characteristics of the participants, as shown in Table 3.1, illustrate that a small majority of the participants (58%) were younger than 40 years and that the majority were female (75%) and had function LA (73%). A small majority of respondents worked more than 0.8 FTE (54%), and the most common educational level was bachelor's degree (79%).

### ***Procedures***

After both a school board and the school leader agreed to participate in this study, teachers received a link to the survey. Data collection lasted from November 2012 until March 2013.

### ***Instruments***

The eight scales measured in this survey consisted of 49 items rated on a 4-point Likert scale: completely disagree, partly disagree, partly agree, and fully agree. To verify the content validity of the items, experts (i.e., four teachers, two school leaders, and two educational consultants) reviewed item formulations. The instruments used to measure working with an inquiry habit of mind, being data literate, and contributing to a culture of inquiry at the school level were based on existing instruments (Earl and Katz 2006; Krüger 2010b). One item included in the instrument, however, was newly formulated. The items that measured creating a culture of inquiry at the classroom level were based on the work of Van Ledden (2011).

Psychological factors were measured using instruments based on the work of Fishbein and Ajzen (2010), Visser-Wijnveen, Stes, and Van Petegem (2012) and Krüger (2010b). Item formulation was adjusted to inquiry-based working.

Table 3.1. Background characteristics of sample.

		Outcomes	n	%
Background characteristics	Age	≤20	0	0
		21-30	75	30
		31-40	72	29
		41-50	44	18
		51-60	48	19
		≥61	10	4
	Gender	Male	61	25
		Female	186	75
	Class level taught*	Grade 5	72	29
		Grade 6	67	27
		Grade 7	82	33
		Grade 8	77	31
	Function**	LA	183	75
		LB	60	25
		LC	0	0
	FTE	≤0,2	1	.4
		>0,2 and ≤0,5	39	16
		>0,5 and ≤0,8	68	28
		>0,8	134	55
	Educational level	Master's degree	49	20
Bachelor's degree		196	79	
No master's nor bachelor's degree		4	2	

Notes. \*For Class level taught multiple answers were possible, because some teachers teach in more than one grade.

\*\*Since no participant responded LC on the question about their function this item is interpreted as: 'Does the participant have an LB function?' With the answers 0=no; 1=yes.

One item of the scale, namely experienced social pressure, was negatively formulated: 'Whether or not I work inquiry-based is completely up to me.' After recoding, this item was eliminated from the scale due to a negative correlation with the other four items. The preliminary analysis showed that the scale reliability of experienced social pressure was relatively low (Cronbach's alpha = .65), while the reliability of all other scales was good. Table 3.2 shows the number of items and the Cronbach's alpha of each scale. It also includes a sample item per scale. The reliability scores demonstrate that these scales could be trusted for use in

the study's further analyses.

Table 3.2. Overview of the survey instrument.

Scale with example items	Number of items	Cronbach's alpha
Working with an inquiry habit of mind <i>In my work as a teacher I value deep understanding</i>	5	.70
Being data literate <i>I am knowledgeable about statistical concepts</i>	6	.77
Contributing to a culture of inquiry at the school level <i>My colleagues and I discuss about new teaching methods based on available research data</i>	5	.82
Creating a culture of inquiry at the classroom level - stimulating pupils' inquiry habit of mind <i>I stimulate pupils to share knowledge with each other</i>	6	.74
- stimulating pupils' data literacy <i>In certain exercises I let pupils keep a logbook</i>	6	.70
Attitude towards inquiry-based working <i>I enjoy inquiry-based working</i>	5	.89
Experienced social pressure regarding inquiry-based working <i>Most people whose opinion I value think I should work inquiry-based</i>	5	.65
Self-efficacy regarding inquiry-based working <i>I am confident I have the skills to work inquiry-based</i>	5	.87
Collective efficacy regarding inquiry-based working <i>I am confident my team has the skills to work inquiry-based</i>	5	.87

Note. The text in italics is a sample item for the scale in question.

The background characteristics were measured with seven items. Gender was coded as: 0 = female, and 1 = male. To measure age, respondents chose between five categories:  $\leq 20$ , 21-30, 31-40, 41-50, 51-60, and  $\geq 61$ , and these categories were coded as 0, 1, 2, 3, 4, and 5, respectively. To measure the class level taught, teachers were asked to indicate whether they taught in grade 5, 6, 7, or 8. These grades were dummy coded (i.e., 0 = no, and 1 = yes). To measure function, respondents could answer: LA, LB, or LC, coded with 0, 1, and 2, respectively. These function levels coincide with the different salary scales of primary school teachers in the Netherlands. FTE was measured using the scale:  $\leq 0.2$ ,  $>0.2$  and  $\leq 0.5$ ,  $>0.5$  and  $\leq 0.8$ , and  $>0.8$ , which were coded 0, 1, 2, and 3. Educational level was measured by asking whether teachers had a master's degree, where 0 = no master's degree, and 1 = master's degree.

### ***Statistical analysis***

Because the sample of teachers that participated in the present study was collected by first selecting the schools employing them, observations from teachers within the same school could be dependent. However, statistical tests of the intraclass correlations showed that multilevel analysis was not required with the existing dataset (working with an inquiry habit of mind:  $F(60,180) = .88, p = .71$ ; being data literate:  $F(60,183) = .93, p = .62$ ; creating a culture of inquiry at the school level:  $F(60,181) = 1.10, p = .31$ ; stimulating pupils' inquiry habit of mind:  $F(60,186) = 1.02, p = .45$ ; stimulating pupils' data literacy:  $F(60,185) = 1.24, p = .14$ ). Therefore, a standard regression analysis was performed utilizing the background characteristics as independent variables and the five aspects of inquiry-based working as dependent variables. Next, the relationships between the aspects of inquiry-based working and the four predictors from the hypothesis (attitude, experienced social pressure, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working) were explored. The possible effects of the significant background characteristics from the preceding analyses were taken into account.

Prior to the regression analyses, a confirmatory factor analysis was performed on the scales in the regression models to inspect their one-dimensionality. Because the items applied Likert scales, Sattora-Bentler corrected  $\chi^2$  fit statistics were computed along with their associated robust comparative fit index (CFI) and root mean square error of approximation (RMSEA). Generally, models with a CFI at or above .97 are considered to have a good fit, and models with a CFI between .95 and .97 are considered to have an acceptable fit. RSMEA values at or below .05 indicate a good fit, while values between .05 and .08 indicate a satisfactory model fit. Since all scales mentioned in Section 4.3 had CFI scores above .95 and RMSEA scores below .08, it was concluded that all scales were one-dimensional.

## **Results**

### ***Descriptives***

The descriptive statistics of the scales used (shown in Table 3.3) show that, on average, participants scored (moderately) positive on the aspects of inquiry-based working (scale means between 2.66 and 3.20 on a 4-point scale). For the four psychological factors, the mean scores

were between 2.69 and 3.19. Bearing in mind that the midpoint of the assessment scale was 2.5, the results indicated that respondents also scored (moderately) positive on the measured psychological factors.

Table 3.3. Descriptive results of used scales.

	Scale	n	m	sd
Inquiry-based working	Inquiry habit of mind	241	3.13	.46
	Being data literate	244	3.20	.46
	Culture of inquiry at the school level	242	2.77	.59
	Culture of inquiry at the classroom level:			
	- Stimulating pupils' inquiry habit of mind	247	3.02	.45
	- Stimulating pupils' data literacy	246	2.66	.50
Psychological factors	Attitude towards inquiry-based working	247	3.19	.55
	Experienced social pressure regarding inquiry-based working	242	2.99	.48
	Self-efficacy regarding inquiry-based working	243	2.90	.60
	Collective efficacy regarding inquiry-based working	248	2.69	.57

Notes. Answer categories: 1 = completely disagree; 2 = partly disagree; 3 = partly agree; 4 = fully agree. n = sample size, m = mean item scores, sd = standard deviation.

### ***Regression analysis***

Table 3.4 displays the regression coefficients (b) with their standard errors (s.e.). It also gives the p-values (p) for the regression analyses between the background characteristics and the five aspects of inquiry-based working.

The results show a significant relationship between teachers working in grade 7 and all aspects of inquiry-based working, except contributing to a culture of inquiry at the school level. The mean score of teachers working in grade 7 were higher on all aspects of inquiry-based working than the mean scores of teachers working in other grades. Furthermore, the results indicate a significant relationship between the two background characteristics of function and educational level and being data literate. Teachers with an LB function scored higher than teachers with an LA function, and teachers with a master's degree scored higher than teachers without a master's degree. The background variables of age, gender, and FTE had no significant

The relationship between psychological factors and inquiry-based working by primary school teachers relationship with any aspect of inquiry-based working by teachers.

Table 3.4. Regression analysis of inquiry-based working by teachers on background characteristics.

	Working with an inquiry habit of mind		Being data literate		Contributing to a culture of inquiry at the school level		Creating a culture of inquiry at the classroom level by:			
	b (s.e.)	p	b (s.e.)	p	b (s.e.)	p	Stimulating pupils' inquiry habit of mind		Stimulating pupils' data literacy	
Intercept	2.87 (.14)	.00	3.02 (.14)	.00	2.69 (.19)	.00	2.79 (.14)	.00	2.38 (.15)	.00
Age	.03 (.03)	.26	-.03 (.03)	.20	-.04 (.04)	.22	-.01 (.03)	.72	.04 (.03)	.23
Gender	-.10 (.08)	.23	-.02 (.08)	.78	.01 (.11)	.94	-.00 (.08)	1	.01 (.09)	.93
Grade 5	-.08 (.07)	.24	.03 (.07)	.72	.09 (.10)	.36	-.01 (.07)	.87	-.11 (.08)	.16
Grade 6	-.05 (.07)	.52	-.00 (.07)	.99	-.15 (.09)	.10	.05 (.07)	.51	.02 (.08)	.77
Grade 7	.15 (.07)	<b>.03</b>	.13 (.06)	<b>.04</b>	.09 (.09)	.32	.13 (.07)	<b>.04</b>	.15 (.14)	<b>.04</b>
Grade 8	-.02 (.07)	.74	.03 (.07)	.68	-.05 (.09)	.56	.12 (.07)	.09	.05 (.05)	.49
Function	.13 (.07)	.08	.20 (.07)	<b>.01</b>	.15 (.10)	.13	-.06 (.07)	.39	.02 (.08)	.77
FTE	.06 (.05)	.16	.05 (.04)	.28	.07 (.06)	.27	.08 (.05)	1	.06 (.05)	.21
Ed. level	.12 (.08)	.13	.23 (.08)	<b>.00</b>	-.04 (.10)	.73	.01 (.08)	.87	.05 (.09)	.57

Note. Significant p-values ( $\leq .05$ ) are reported in bold type.

Table 3.5 shows the correlations ( $r$ ) and the p-values ( $p$ ) between the measured psychological factors and inquiry-based working. There is a strong positive correlation between all independent and all dependent variables, suggesting quite a strong relationship between the measured psychological factors and inquiry-based working.

There are also strong, positive relationships between attitude, experienced social pressure, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working (ranging from  $r = .26$  to  $r = .71$ , all with  $p < .001$ ). This indicates that high scores on attitude, high scores on experienced social pressure, high scores on self-efficacy regarding inquiry-based leadership, and high scores on collective-efficacy regarding inquiry-based working are associated with each other.

Table 3.5. Correlations between inquiry-based working and psychological factors.

	Working with an inquiry habit of mind		Being data-literate		Contributing to a culture of inquiry at the school level		Creating a culture of inquiry at the classroom level by:			
							Stimulating pupils' inquiry habit of mind		Stimulating pupils' data literacy	
	r	p	r	p	r	p	r	p	r	p
Attitude	.54	<.001	.54	<.001	.32	<.001	.35	<.001	.32	<.001
Experienced social pressure	.54	<.001	.56	<.001	.47	<.001	.39	<.001	.34	<.001
Self-efficacy	.61	<.001	.67	<.001	.47	<.001	.45	<.001	.50	<.001
Collective efficacy	.27	<.001	.31	<.001	.55	<.001	.35	<.001	.37	<.001

Table 3.6 shows the results of the regression analyses of psychological factors on inquiry-based working. The significant background characteristics from the previous analyses were taken into account.

Self-efficacy regarding inquiry-based working appears to be significantly related to all five aspects of inquiry-based working. Collective efficacy regarding inquiry-based working is significantly related to contributing to a culture of inquiry at the school level and to both aspects of creating a culture of inquiry at the classroom level. Attitude and experienced social pressure are significantly related to working with an inquiry habit of mind. Furthermore, the results show a significant relationship between teachers working in grade 5 and stimulating pupils' data literacy. Function appears to have a significant relationship with stimulating pupils' inquiry habit of mind, while educational level and being data literate seem to be related to each other as well.

Table 3.6. Regression analysis of inquiry-based working by teachers on significant background characteristics and psychological factors.

	Working with an inquiry habit of mind		Being data literate		Contributing to a culture of inquiry at the school level		Creating a culture of inquiry at the classroom level by:			
	b (s.e.)	p	b (s.e.)	p	b (s.e.)	p	Stimulating pupils' inquiry habit of mind	p	Stimulating pupils' data literacy	p
Intercept	1.34 (.17)	.00	1.35 (.16)	.00	.72 (.23)	.00	1.59 (.19)	.00	1.42 (.20)	.00
Grade 5	-.10 (.06)	.09	-.01 (.06)	.80	-.03 (.08)	.76	-.06 (.07)	.37	-.17 (.07)	<b>.02</b>
Grade 6	-.01 (.06)	.82	.03 (.05)	.60	-.06 (.08)	.40	.09 (.06)	.15	.10 (.07)	.14
Grade 7	.05 (.05)	.33	.05 (.05)	.31	-.01 (.07)	.90	.07 (.06)	.27	.08 (.06)	.22
Grade 8	-.07 (.06)	.23	-.04 (.05)	.40	-.13 (.07)	.09	.08 (.06)	.22	-.00 (.07)	.97
Function	.01 (.07)	.90	.13 (.06)	<b>.03</b>	.04 (.09)	.68	.06 (.07)	.41	.02 (.08)	.81
Ed. level	-.05 (.06)	.39	-.02 (.06)	.68	.04 (.08)	.67	-.18 (.07)	<b>.01</b>	-.03 (.07)	.68
Attitude	.17 (.07)	<b>.01</b>	.11 (.06)	.08	-.04 (.09)	.63	.06 (.07)	.42	-.06 (.08)	.46
Soc. Pressure	.18 (.08)	<b>.03</b>	.12 (.08)	.10	.12 (.11)	.24	.09 (.09)	.32	-.11 (.09)	.24
S-efficacy	.29 (.07)	<b>.00</b>	.38 (.06)	<b>.00</b>	.25 (.09)	<b>.01</b>	.21 (.07)	<b>.01</b>	.42 (.08)	<b>.00</b>
C-efficacy	-.03 (.06)	.54	-.00 (.05)	.98	.42 (.08)	<b>.00</b>	.14 (.06)	<b>.02</b>	.20 (.07)	<b>.00</b>

Note: Significant p-values ( $\leq .05$ ) are reported in bold type.

## Discussion

Inquiry-based working is assumed to contribute to improving educational quality (Krüger 2010a). It is further expected to stimulate professional learning (Katz and Dack 2014). Earlier research has shown that psychological factors can contribute to explaining differences in the use of data between school leaders and between teachers (Ikemoto and Marsh 2007; Schildkamp and Kuiper 2010; Vanhoof et al. 2014). This study adopted a broad perspective of inquiry-based working and, in addition to a focus on data use, looked at aspects of inquiry-based working such as creating or contributing to a culture of inquiry. The study investigated relationships between inquiry-based working in this broad sense and psychological factors that are known to explain people's behavior (based on Fishbein and Ajzen 2010).

Our research question was: how are the psychological factors attitude, social pressure, self-efficacy and collective efficacy related to inquiry-based working by primary school teachers in the Netherlands? Our first hypothesis was that teachers' positive attitudes towards

inquiry-based working would make them work in an inquiry-based manner. Earlier research on school leaders has shown a relationship between attitude regarding data use and the actual use of data by school leaders (Ikemoto and Marsh 2007; Schildkamp and Kuiper 2010, Vanhoof et al. 2014). This study reveals that primary school teachers who had strong positive attitudes towards inquiry-based working also scored high on working with an inquiry habit of mind. However, this study did not establish a direct relationship between attitude and other aspects of inquiry-based working.

Based on earlier research (Earl and Katz 2006; Schildkamp, Lai, and Earl 2013), which made clear that teachers do not use data unless it is encouraged by the school leader, our second hypothesis stated that experienced social pressure would be related to inquiry-based working. This study indeed shows that teachers who strongly felt that others expected them to work in an inquiry-based manner also had a stronger inquiry habit of mind. However, experienced social pressure was not found to have a significant relationship with other aspects of inquiry-based working.

In line with research of Krüger and Geijsel (2011), our third hypothesis was that a high sense of self-efficacy towards inquiry-based working should allow teachers to work in a more inquiry-based way. According to our study results, self-efficacy regarding inquiry-based working is a factor that appears to be related to all aspects of inquiry-based working. Teachers with a strong sense of self-efficacy towards inquiry-based working also had a strong inquiry habit of mind, possessed high skills related to data literacy, strongly contributed to a culture of inquiry at the school level and strongly created a culture of inquiry in their classrooms. It seems that in order to work in an inquiry-based manner it is necessary for teachers to believe that they are able to successfully perform behaviour related to the different aspects of inquiry-based working. Teachers need to be convinced that they are capable of organizing and executing the actions required for inquiry-based working.

In addition, and in line with our fourth hypothesis, collective efficacy regarding inquiry-based working appears to be related to three aspects of working in a culture of inquiry: at the school level through collaboration with colleagues in a culture of inquiry and at the classroom level through stimulating pupils' inquiry habit of mind and through stimulating pupils' data literacy. Apparently, teachers' beliefs about the ability of his or her team to work in an inquiry-based manner are relevant for contributing to a culture of inquiry on the school level and for creating a culture of inquiry in the classroom. As opposed to self-efficacy regarding inquiry-

The relationship between psychological factors and inquiry-based working by primary school teachers based working, there was no significant relationship between collective efficacy regarding inquiry-based working and working with an inquiry habit of mind or being data literate.

We found support for all of our hypotheses in the strong positive correlation among the four predictors and between: (1) each psychological factor and (2) all aspects of inquiry-based working by teachers. It means that attitude, experienced social pressure, self-efficacy and collective efficacy are indeed related to all aspects of inquiry-based working. That said, some of the psychological factors have a unique significant relationship with aspects of inquiry-based working, while others are related through the other predictors.

Looking more closely at the differences and similarities between these psychological factors and their relation with the several aspects of inquiry-based working, the following stands out. It seems that a positive attitude and a high sense of social pressure are both needed for teachers to work with an inquiry habit of mind, whereas these two factors do not make them more data-literate, nor do they contribute to a culture of inquiry at either the school or the classroom level. These results might be interpreted as follows. Teachers who work with an inquiry habit of mind value deep understanding, read literature to gain knowledge, appreciate a thorough understanding and try to verify assumptions. All these aspects are, in one way or another, aimed at the person of the teacher him- or herself. A positive attitude and a high sense of social pressure turn out to affect working with an inquiry habit of mind. They do not necessarily affect one's data-literacy skills, because for the acquisition of such skills training is also needed. However, working with an inquiry habit of mind in itself does not necessarily lead to actual actions to promote an inquiry-based culture at school or classroom level. For this, self-efficacy and collective efficacy are also needed. So, it seems that a positive attitude and social pressure are important for working with an inquiry habit of mind, whereas for teachers to engage in activities at the school or classroom level, self-efficacy and collective-efficacy are needed. The psychological factor that stands out the most is self-efficacy. Self-efficacy has an impact on working with an inquiry habit of mind, on data-literacy, as well as on contributing to a culture of inquiry on school and classroom level. Findings from other research on the impact of self-efficacy on data use or on inquiry-based working confirm that belief in one's capacities to work inquiry-based contributes to working in such a manner (e.g. Geijsel et al. 2009; Krüger and Geijsel 2011; Uiterwijk-Luijk et al. forthcoming; Vanhoof et al. 2014).

We explored how a number of background characteristics are related to inquiry-based working by primary school teachers in the Netherlands. This study revealed that there is a

relationship between the background characteristics class level taught, function, and educational level, and inquiry-based working by primary school teachers.

What stands out is that teachers who teach in grades 5 and 7 seemed to work in a more inquiry-based way than teachers who teach in grades 6 and 8. When looking solely at the background characteristics teachers in grade 7 seem to work in a more inquiry-based manner than teachers in other grades. However, in interaction with the measured psychological factors the effect of teaching in grade 7 disappeared and the effect of teaching in grade 5 emerged. Teachers in grade 5 seem to stimulate pupils' data literacy more than teachers who teach in other grades. Perhaps teachers' expectations of pupils' inquiry habit of mind and data literacy depend on the grade they teach, or the teaching methods used by teachers differ per grade when looking at the way they stimulate pupils' to work in an inquiry-based manner. Teachers working in grades 6, 7 and 8 might think pupils already possess skills like keeping a logbook or carrying out an interview. Further research is necessary to find out what causes these differences between teachers teaching in different grades and working in an inquiry-based manner.

In the Netherlands, teachers with function LB are supposed to have a higher educational background than teachers with function LA. In addition teachers with function LB are supposed to be (co-)responsible for school development. Therefore, one might expect function to be related to inquiry-based working. Consequently, it is remarkable that the study only found that teachers with function LB stimulated pupils' inquiry habit of mind more, but they did not, for example, contribute more to a culture of inquiry than teachers with function LA.

Teachers with a master's degree appeared to be more data literate than teachers without a master's degree, but they did not stand out on any other aspect of inquiry-based working. Apparently, having a master's degree means that a teacher acquired skills to conduct research, but this is not related to having an inquiry habit of mind, contributing to a culture of inquiry at the school level, or creating a culture of inquiry at the classroom level.

### ***Limitations***

Only a small number of the invited school boards participated in this study with their schools. It is possible that school boards and schools that agreed to participate were already more focused on inquiry-based working than were others. This is in line with the relative high scores regarding inquiry-based working that appear in this study's descriptive results. However, since

The relationship between psychological factors and inquiry-based working by primary school teachers this study attempted to relate aspects of inquiry-based working to psychological factors, it could be regarded as an advantage that the teachers participating in this research were involved in inquiry-based working to a certain degree.

Another limitation concerns the fact that self-reports were utilized (see e.g. Schwartz 1999). Thus, the results reflect teachers' own perceptions. The use of qualitative methods – such as observations of teachers' actions – could overcome this limitation in future research and, thus, contribute to a deeper understanding of inquiry-based working by primary school teachers. The use of qualitative research such as interviews with teachers could also contribute to more data on how teachers understand inquiry-based working at both the school level and the classroom level.

The concept of being data literate was investigated with items such as, 'I am knowledgeable about statistical concepts,' and, 'I am capable of interpreting research data.' One could question the extent to which teachers should develop this capacity. Do we want all teachers to become scientific researchers and statisticians? Or, is it enough if teachers can interpret and act on pupil achievement data? These are challenging questions. One thing is clear: if we want teachers to be able to make informed decisions, they must at least be able to interpret and use data to some degree. And, if we want teachers to really engage in inquiry-based working, we should also take into account their capacity to work with an inquiry habit of mind and their capacity to create and contribute to an inquiry-based culture.

## **Conclusions**

This study enriches our understanding of inquiry-based working by teachers. From a theoretical perspective, these findings offer new insights in how psychological factors are related to whether and how teachers work in an inquiry-based manner. Valuable conclusions can be drawn about self-efficacy and collective efficacy. Both psychological factors appear to be important for inquiry-based working by teachers. Teachers with a high sense of self-efficacy regarding inquiry-based working tend to be involved in all five aspects of inquiry-based working. Furthermore, teachers who experience a high sense of collective efficacy tend to engage in working in a culture of inquiry, both at the classroom and at the school level. A positive attitude and a strong sense of social pressure are valuable for working with an inquiry habit of mind.

From a practical perspective, these findings are relevant for school leaders who want to

encourage inquiry-based working of teachers in their schools and are applicable to the design of teacher training and professional development initiatives. Our findings confirm the conclusions of Vanhoof et al. (2014) that if we want to increase inquiry-based working by teachers, it is not enough to focus on using data and on providing knowledge and skills regarding data use. We also need to enhance their self-efficacy and collective efficacy, as well as their attitude. Social pressure also helps. Self-efficacy and collective efficacy can be enhanced by teachers collaborating in peer groups. School leaders and educators can, for example, give positive feedback and encourage collaboration among teachers. In order to promote a positive attitude and enact social pressure school leaders and educators can emphasize the value added by inquiry-based working and point out the benefits of it for educational quality.