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Teachers' role in stimulating students' inquiry habit of mind in primary schools

Lisette Uiterwijk-Luijk [a, *], Meta Krüger [b], Bonne Zijlstra [c], Monique Volman [c]

[a] Marnix Academy, University for Teacher Education, PO Box 85002, 3508, AA, Utrecht, the Netherlands
[b] Penta Nova, Academy for Leadership in Education, PO Box 85002, 3508, AA, Utrecht, the Netherlands
[c] Research Institute of Child Development and Education, University of Amsterdam, PO Box 15776, 1001, NG, Amsterdam, the Netherlands

HIGHLIGHTS

- Teachers play a crucial role in developing students' inquiry habits.
- Teachers' inquiry-based work is related to students' curiosity.
- Teachers' inquiry-based work is not related to students' being critical.

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ABSTRACT

This mixed-method study examined the relationship between teachers' inquiry-based work and students' inquiry habit of mind. The study consisted of a survey, followed by a case study. Questionnaire data were collected from 1,104 students and 249 teachers at 31 primary schools. The case study was conducted in two primary schools. The survey data revealed a relationship between teachers' inquiry-based work and students' curiosity. However, no relationship was found between teachers' inquiry-based approach and students' critical thinking habits. The case study results illustrate how teachers' inquiry-based working can be related to students' curiosity and critical thinking habits.

1. Introduction

Nowadays, complex thinking and communication skills, are in greater demand than more basic skills (Levy & Murnane, 2005; Pellegrino & Hilton, 2012; Wagner, 2014). As early as 1999, Wells pointed out that young people need to develop an understanding and attitude that will help them become informed, critical, and responsible members of a changing world. He proposed to transform schools and classes into communities of inquiry for that purpose. Inquiry can affect conceptual understanding, vocabulary knowledge, cognitive outcomes, process skills, and critical thinking (Anderson, 2002).

Young children already have the capacity for scientific reasoning, involving understanding the nature of science, understanding theories, designing experiments, and interpreting data (Mayer, Sodian, Koerber, & Schwippert, 2014). A growing body of research has indicated that providing students with opportunities to explore authentic problems can enhance their understanding (Levy, Thomas, Drago, & Rex, 2013). In this approach, students' inquiries focus on finding answers and creating artifacts that are significant in their own lives (Dobber & Van Oers, 2015).

Creating a culture of inquiry in the classroom means creating an environment in which students are driven by curiosity, ask questions, make discoveries, and test their findings in a search for new understandings (Al-Sabbagh, 2009; Chin, 2002). Creating this culture of inquiry in the classroom requires changes in teachers' knowledge, skills, and attitudes. Teachers not only need to learn how to create new forms of student work, how to foster an environment that focusses on the questions students find interesting, and how to put students in new roles, they also need to value and

* Corresponding author.
E-mail address: l.uiterwijk@hsmarnix.nl (L. Uiterwijk-Luijk).

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believe in supporting an inquiry-based culture in the classroom (Anderson, 2002; Pardales & Girod, 2006). Researchers have suggested that engaging teachers themselves in a culture of inquiry can bring about these changes (Dobber & Van Oers, 2015; Wells, 2011). In such a culture, teachers systematically and intentionally investigate their own teaching as a means of quality improvement. Teachers use the results of such research to enhance their teaching and learning (Ellis & Castle, 2010; Gallimore, Ermeling, Saunders, & Goldenberg, 2009; Van der Linden, Bakx, Ros, Beijaard, & Vermeulen, 2012). To add to the knowledge in this area, this study investigated the relationship between teachers' inquiry-based work (involving creating a culture of inquiry in the classroom as well as contributing to an inquiry-based school culture) and students' inquiry habit of mind. To date, much studies focus on students' inquiry skills, this study however focusses on a students' inquiry habits, involving being curious and having a critical habit of mind.

2. Theoretical framework

Teachers' inquiry-based working involves creating a culture of inquiry in the classroom as well as contributing to an inquiry-based school culture. As mentioned in the introduction, creating a culture of inquiry in the classroom means creating an environment that stimulates students' inquiry habit of mind, including being curious and having critical thinking habits. Since earlier studies have shown the importance of psychological factors in explaining aspects of teachers working in an inquiry-based manner (Geijsel, Sleegers, Stoel, & Krüger, 2009; Ikemoto & Marsh, 2007), this study also examines these aspects.

2.1. Students' inquiry habit of mind

The concept "inquiry habit of mind" is strongly related to concepts such as "researcherly disposition" (Tack & Vanderlinde, 2014), "inquiry as stance" (Cochran-Smith, 2003), and "scientific research dispositions" (Van der Rijst, 2009). In their study on teacher educators, Tack and Vanderlinde (2014) defined a researcherly disposition as a triad of an inclination towards research (affective aspect), an ability to conduct research (cognitive aspect), and a sensitivity to research opportunities (behavioral aspect). Cochran-Smith (2003) who also focused on teacher educators, described "inquiry as stance" as a critical habit of mind; an intellectual perspective; and a way of questioning, understanding, and connecting one's day-to-day work to other's activities and larger contexts. In his study of scientific inquiry among university students, Van der Rijst (2009) found six different scientific research dispositions. These are the inclination to: know, understand, be critical, achieve, share, and be innovative. Earl and Katz (2006) have referred to school leaders' inquiry habit of mind as an ongoing process of seeking out and using evidence to make decisions. Moreover, Wells (1999) explained that an inquiry habit of mind entails being open to wondering and puzzlement, trying to construct and test explanations, and mastering information.

There does not appear to be a consistent definition of students' inquiry habit of mind. All studies agree, however, that an inquiry habit of mind involves being both curious and critical. This study investigates both of these aspects.

2.2. Students' curiosity

Curiosity can be defined as a desire to know, see, or experience that motivates exploratory behavior directed towards the acquisition of new information (Litman, 2005). Curiosity can be aroused by what Jirout and Klahr (2012, p. 125) called "uncertainty in the environment" based on their review of children's scientific curiosity, such as a sense of uncertainty regarding the existence of an item in a particular location.

Zion and Sadeh (2007) found that curious high-school students seek challenges and enjoy modifying their inquiries as they move through the inquiry process. Students' curiosity increased when they obtained unexpected results. Scardamalia and Bereiter (2010) pointed out that curiosity alone is not sufficient to motivate inquiry. Long-term goals are also necessary to guarantee intentional learning and knowledge building. Despite the emphasis on stimulating students' curiosity, Wagner (2014) demonstrated that the longer students are in school, the less curious they become. This implies that it might be expected that young (primary school) students will show a strong sense of curiosity. Wagner assumed that the main reason for this descent in curiosity is that teachers have not received training on teaching students how to think. Based on earlier research, Pellegrino and Hilton (2012) point out that textbooks cover many topics with little depth and teachers try to cover a broad curriculum. As a consequence, teachers tend to focus on procedures and superficial recall-level questions instead of focusing on deeper learning goals and paying attention to students' understanding of meaningful problems (Pellegrino & Hilton, 2012).

2.3. Students' critical thinking habits

Research has indicated that even young children can engage in critical thinking and that school environments can promote the growth of these critical capacities (Murphy, Rowe, Ramani, & Silverman, 2014). According to Scriven and Paul (2008), critical thinking refers to a process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information to guide beliefs and actions. According to their definition, critical thinking is both a skill and a habit of mind. This means critical thinking is not only a set of skills but also a habit of using those skills to guide behavior. This study did not focus on critical thinking as a skill. Rather, it emphasizes its role as a habit of mind, which we call *critical thinking habits*. This means that we interpret being critical as the attitude necessary for performing critical thinking skills. This attitude is based on universal intellectual values that transcend subject matter divisions, such as: clarity, accuracy, precision, consistency and relevance (Scriven & Paul, 2008). This conceptualization is in line with Van der Rijst (2009), whose research has demonstrated that critical thinking habits include having a critical attitude towards others, but also towards observations. A self-critical attitude, being critical of one's own ideas and work, also fits within this category. Generally speaking, a critical thinking habit boils down to harboring sophisticated doubts, consistently double-checking results, and considering issues of accuracy. These kinds of reservations can initiate critical questions on all manner of topics.

2.4. Teachers creating a culture of inquiry in the classroom

According to Lipman (2003), a culture of inquiry in the classroom means that students investigate problems and engage in inquiry. Students collaborate, build on ideas of others, challenge one another to supply reasons for opinions and assumptions, and draw conclusions as a group (Lipman, 2003). The purpose of inquiry is to guide students in constructing their own knowledge by helping to develop their curiosity (Zion & Sadeh, 2007). A culture of inquiry in the classroom implies inquiry-based learning, involving learning how scientists think and why they think in that way. Many studies have focused on the teacher's role in inquiry-based learning. These studies have revealed that student-centered approaches are limited in their ability to boost student achievement. In contrast, combined student-centered and teacher-centered approaches can provide

structured support (Baeten, Dochy, & Struyven, 2012; Brown & Campione, 1994).

Jones and Eick (2007) described three forms of inquiry-based teaching. The first one is open-ended. With that approach, teachers put aside planned instruction to explore students' questions. The second form is project-based inquiry, in which teachers design projects for students based on the questions driving classroom discussions. The third form is guided inquiry, utilizing a curriculum revolving around fixed scientific concepts and lessons. These three forms create a continuum from open-ended inquiry to guided inquiry, and learners' responsibilities vary along this scale. According to Olson and Loucks-Horsley (2000), guided inquiry is the best fit for developing science concepts, while more open-ended approaches afford more appropriate opportunities for cognitive development and scientific reasoning. To be successful, teachers must continually diagnose student understanding (Brown & Campione, 1994). This is a difficult task, as it is nearly impossible to follow a single, standardized protocol for all students. It appears that teachers are unsure about the way to support their students and that they lack knowledge about what the focus of that support should be (Van Uum, Verhoeff, & Peeters, 2016). This impediment constitutes one of the key reasons that teachers face difficulties worldwide in implementing inquiry-based learning (Abrahams & Reiss, 2012; Flick, 2000; Osborne & Dillon, 2008).

Lazonder and Harmsen's (2016) meta-analysis found that teacher guidance has a significant positive effect on: (a) performance success, or the quality of the products students create during inquiry; (b) learning activities, or the embedded assessment of students' actions during inquiry; and (c) learning outcomes, which are assessed after the task by means of domain knowledge post-tests. Regarding *performance success,* their results suggested that less specific forms of guidance (like process constraints or status overviews) are useful for young learners with lower inquiry skills, while older, more experienced learners benefit from specific types of guidance, like scaffolds or explanations. Regarding *learning activities* and *learning outcomes,* less specific forms of guidance lead to comparable results as more specific forms (Lazonder & Harmsen, 2016). There appears to be little empirical evidence to help educators decide how to teach in ways that enhance critical thinking (Marin & Halpern, 2011; Murphy et al., 2014). Davis, Janssen, and Van Driel's (2016) study demonstrated that the extent to which lessons are inquiry-oriented is heavily influenced by how inquiry-oriented curriculum materials are.

In conclusion, creating an inquiry-based classroom culture means that teachers stimulate students' curiosity and critical thinking by arranging activities around students' questions, by consciously varying the extent of teacher support and by taking into account precursors like language skills and social-emotional skills.

2.5. Inquiry-based working by teachers at the school level

Creating a culture of inquiry in the classroom is one thing, but contributing to an inquiry-based school culture is a different matter. Teachers' inquiry-based working involves both aspects. In an inquiry-based school, teachers collaboratively and systematically investigate their own teaching and use internal data and external research results to improve their teaching and learning (Krüger, 2010b; Ellis & Castle, 2010; Gallimore et al., 2009; Van der Linden et al., 2012). To truly build knowledge in this type of culture, deep inquiry questions (i.e., *how* and *why*) are necessary, while shallower questions (i.e., *what* and *when*) are less important (Scardamalia & Bereiter, 2006). According to Earl and Katz (2006), school leaders must have an inquiry habit of mind, be data literate, and create a culture of inquiry. Translating this to teachers and considering that they work at both the classroom level and the school level means that teachers working in an inquiry-based manner must: (1) have an inquiry habit of mind, (2) be data literate, (3) contribute to a culture of inquiry at the school level, and (4) create a culture of inquiry at the classroom level.

A teacher's inquiry habit of mind has similarities with a student's inquiry habit of mind. In their study on teachers' inquiry habit of mind (or inquiry-based attitude, as they called it), Meijer, Geijsel, Kuijpers, Boei, and Vrieling (2016) found an internal reflective dimension and an external knowledge-sourcing dimension. This means teachers with an inquiry habit of mind critically reflect on their teaching and are curious about the evidence on which they base their decisions. An inquiry habit of mind involves valuing deep understanding, reserving judgment, obtaining a range of perspectives, and systematically posing increasingly focused questions (Earl & Katz, 2006).

Data literacy refers to knowledge regarding measurement and statistical concepts. Data literate teachers think about purposes, recognize different types and quality of data, prioritize the interpretation of data, and report to others (Earl & Katz, 2006). They can transform data into information, information into knowledge, and knowledge into action (Marsh & Farrell, 2014). Contributing to a culture of inquiry at the school level means that teachers must collaborate in making sense of all sorts of data, engage in joint action planning, and share instructional strategies (Datnow, Park, & Kennedy-Lewis, 2013). This "inclination to share" as Van der Rijst (2009, p.45) calls it, means being open to others, wanting to interact, and desiring to work cooperatively. While collaborating, teachers are influenced through their interactions and negotiations with others (Coburn & Turner, 2011). This cooperative use of internal and external data is a type of professional learning that enhances new understandings. These new interpretations can stimulate improved practices, which can, in turn, influence student learning (Katz & Dack, 2014). In addition, they can change teachers' attributions from external causes to their own teaching (Gallimore et al., 2009).

2.6. Psychological factors related to inquiry-based working

Earlier research has revealed that teachers' inquiry-based working is strongly related to psychological factors, such as: attitude towards inquiry-based working, experienced social pressure to work in an inquiry-based manner, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working (Geijsel et al., 2009, Uiterwijk-Luijk, Krüger, Zijlstra, & Volman, 2017a).

According to Fishbein and Ajzen (2010), a person's attitude towards certain behavior can be defined as his or her tendency to respond with some degree of (dis)favor towards that behavior. This means that a teacher's attitude towards inquiry-based working can be defined as his or her tendency to respond with some degree of (dis)favor towards inquiry-based working. Experienced social pressure refers to the belief that significant others want us to work in a specific, in this case inquiry-based, manner, and that significant others are already doing so themselves (Fishbein & Ajzen, 2010). Self-efficacy refers to believing that one is capable of successfully executing certain actions (Bandura, 1997). Applied to this study it means that self-efficacy refers to believing that one is capable of successfully working in an inquiry-based manner. Finally, collective efficacy regarding inquiry-based working involves a teacher's beliefs about the ability of his or her team to take an inquiry-based approach to working. Uiterwijk-Luijk et al. (2017a) found that teachers' sense of self-efficacy regarding inquiry-based working is related to all aspects of that approach, namely, working with an inquiry habit of mind, being data literate, creating a culture of

inquiry in the classroom, and contributing to a culture of inquiry at the school level. In addition, teachers with a high sense of collective efficacy tend to engage in a culture of inquiry, at both the classroom level and the school level. Finally, a positive attitude towards inquiry-based working and a strong sense of social pressure to work in such a way appear to be valuable for teachers working with an inquiry habit of mind. Therefore, when studying teachers' inquiry-based work, investigating these related psychological factors is also important.

3. The present study

Previous meta-analyses have indicated a connection between inquiry-based teaching and student learning (Furtak, Seidel, Iverson, & Briggs, 2012). However, little is known yet about whether teachers' inquiry-based working is also related to an inquiry habit of mind in children. The present study is part of a larger study on school boards', school leaders', teachers', and students' inquiry-based working (see also Uiterwijk-Luijk et al., 2017a; Uiterwijk-Luijk, Krüger, Zijlstra, & Volman, 2017b). The research question of the present study is: What is the relationship between teachers' inquiry-based working and students' inquiry habit of mind? First, a survey investigated how teachers' inquiry-based working is related to students' inquiry habit of mind. Students' inquiry habit of mind includes curiosity (wanting to seek out new knowledge) and critical thinking habits (being critical of one's self and others). 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 by stimulating students' inquiry habit of mind and data literacy. As research has demonstrated that teachers' attitude towards inquiry-based working, experienced social pressure to work in an inquiry-based manner, self-efficacy regarding inquiry-based working, and collective efficacy regarding inquiry-based working are all related to their actual inquiry-based work (Uiterwijk-Luijk et al., 2017a), we also included these variables in the current study.

Since the role of the teacher appears to play a crucial role in helping students develop inquiry habits (Dobber & Van Oers, 2015), we hypothesized that the more teachers work in an inquiry-based manner, the stronger students' inquiry habit of mind at that school would be. In addition, we hypothesized that a positive attitude towards inquiry-based working, a strong sense of experienced social pressure regarding that approach, and a high degree of both self-efficacy and collective efficacy concerning inquiry-based working would correlate with high scores on students' inquiry habit of mind. To provide a more in-depth understanding of teachers' experiences with inquiry-based working and students' perceptions of their inquiry habit of mind, a case study was conducted in two different schools.

3.1. The Dutch education system

The Dutch education system consists of 8 years of primary education, intended for children between the ages of 4 and 12 years old. In primary education, a large segment of schools are government-funded private institutions, most of which are based on religious principles (Scheerens, 2016). The Netherlands does not have a national curriculum. This means that curricula are shaped in a variety of ways, which can influence the extent to which teachers work in an inquiry-based manner. At the central level, quality standards apply to all schools. These list the subjects to be studied, attainment targets, the number of teaching hours per year, teacher qualifications requirements, etc. However, these standards leave schools with a significant amount of freedom in terms of how to apply them. The national inspectorate is tasked with maintaining educational quality.

4. Method

4.1. Participants and procedures

An explanatory sequential mixed methods approach (Creswell, 2014) was used, involving a two-phase project. The first phase, which utilized a survey, gathered and analyzed quantitative data. The survey's purpose was to investigate the relationship between the different aspects of teachers' inquiry-based working and students' inquiry habit of mind. The case study's objective was to help explain the survey responses, explore and understand teachers' perceptions, and provide a more complete picture of students' inquiry habit of mind.

We invited all 1,046 primary school boards in the Netherlands to participate with their schools in the first phase of the study. Invitations were sent by mail, social media was used to draw attention to this study, and we used our networks to extend more personal invitations to school boards. In total, 33 school boards (3.2%) responded positively. This low response rate was expected due to research fatigue in Dutch schools. After the boards granted their permission, we sent a web-based survey to the school boards, school leaders, teachers, and students. For this part of the study, we received responses from 1,104 students (at 30 schools) and 249 teachers from grade 5 through grade 8 (8–12 years old) (at 61 schools).

The 1,104 students were spread quite evenly across grade 5 (24%), grade 6 (25%), grade 7 (30%), and grade 8 (22%), with slightly more students in grade 7. Of student respondents, 50.5% were male, and 49.5% were female. The teachers often indicated that they worked with more than one grade. In particular, 29% reported teaching in grade 5, while 30% taught in grade 6, 35% taught in grade 7, and 35% taught in grade 8. Of the responding teachers, 70% were female, thus slightly diverging from national figures. In the Netherlands, 78% of teachers are female (Ministry of Education, 2013).

In phase two, we ranked the schools based on their scores on inquiry-based working. To select the schools for the case study, we examined teachers and school leaders' scores on inquiry-based working and then contacted the selected schools by phone. If a school did not want to be involved in the study, we contacted another school with approximately equal scores. For the case study we selected two schools: Queen Beatrix Primary School with relatively high scores on inquiry-based working and Mosaic Primary School with average scores in that area. In order to gain a deeper understanding of teachers' perceptions regarding inquiry-based working and students' inquiry habit of mind, we collected data on different manifestations of inquiry-based working in everyday school practice. To maintain anonymity, all names used in this study are pseudonyms.

To explore teachers' perceptions and provide a more complete picture of students' inquiry habit of mind, we conducted individual interviews with four teachers at each school (one teacher from each grade; four interviews per school; total $N = 8$ teachers). We also held four group interviews at each school, each with four or five students (one group of students from each grade; four group interviews per school; total $N = 34$ students). In addition, classroom observations were conducted. At Beatrix Primary students from grades 5 and 6 work together in one unit, and students from grade 7 and 8 work together in one unit. Two classroom observations were conducted at this school, one in each unit. At Mosaic Primary, grade 5, 6, 7 and 8 were observed ($n = 6$ classroom observations). Teachers were asked to act as normally as possible so that we could

view regular classroom activities. Individual interviews were approximately 50 min in length, while the group interviews with students were approximately 20 min long. Classroom observations took about 40 min and were videotaped.

Beatrix Primary is located in a small town in the Netherlands. Instead of working in grades, students and teachers work in units. Each unit has a large educational area with theme corners, quiet areas, and workplaces. Each unit contains a number of basic groups, composed of mixed grades and a classroom teacher. Teachers design the curriculum around certain themes, in which different subjects are explored. Students work with a development portfolio, in which they write down their targets, results, and reflections on each theme or subject. Mosaic Primary is located in a large city in the Netherlands. It is situated in a so-called "impulse area," which means it is in a zone with low incomes and a high unemployment rate. Therefore, Mosaic receives additional funds to reduce students' educational disadvantages. The school uses regular year groupings from grade 1 through grade 8, and each class has its own teacher(s).

4.2. Instruments

4.2.1. Phase 1 survey

4.2.1.1. Student questionnaire. We developed a questionnaire to investigate the degree to which students in grades 5 to 8 at Dutch primary schools (8–12 years old) have an inquiry habit of mind. Since there were no existing scales available for this measure, we designed all items specifically for this study.

The questionnaire contained 28 items divided across two instruments, one of which measured students' curiosity and the other of which measured their critical nature. We interpreted curiosity and critical thinking habits both in a positive manner, as the below examples underscore. Both instruments contained 8 propositions and 6 vignettes. The propositions utilized a 4-point response scale: completely disagree, somewhat disagree, somewhat agree, and completely agree. Table 1 depicts a sample proposition for each instrument. For the vignettes, students were asked to pick the answer that best matched their opinion. Each vignette had four answers, two of which represented an inquiry habit of mind and two of which did not. An example vignette from the instrument measuring curiosity is: "During math, you learned new complex sums. These sums can be calculated in several ways. What do you do?" Answers: "a. I would want to hear all the different ways, so I could choose the best one; b. I would be glad if I could figure out one method, and that would be enough for me; c. I would rather find out on my own whether there are other ways of calculating these complex sums; d. I would listen to other solutions but stick to my own method of calculating." In this example, answers a and c represent curiosity, whereas answers b and d do not. An example vignette from the instrument measuring critical thinking habits is: "You have to do a presentation about sharks. You found someone else's presentation about sharks on the Internet. What do you do?" Answers: "a. I would change a few words and use this presentation; b. I do not like that, I would rather find things out by myself; c. I would look at other Internet sites to see if I come across something like it and then I would take the best things; d. I would copy this presentation and be glad that I finished it quickly." In this example, answers b and c represent critical thinking habits, whereas answers a and d do not.

Table 1 provides the number of items and the Cronbach's alpha for each scale. The reliability scores demonstrate that these scales could be trusted for use in further analyses.

4.2.2. Teacher questionnaire

The questionnaire for teachers consisted of 49 items rated on a 4-point Likert scale: completely disagree, somewhat disagree, somewhat agree, and completely agree. The instruments for measuring whether, to their own perception, teachers worked with an inquiry habit of mind, were data literate, and contributed to a culture of inquiry at the school level were based on Krüger (2010a) existing instruments. All scales were constructed by averaging the item scores (for the construction of the scales, see Uiterwijk-Luijk et al., 2017a). As mentioned above, the present study used the mean scores per school. This means the study could draw conclusions about the schools but not about individual teachers. For this aggregated data, we deleted one item from the scale measuring teachers' inquiry habit of mind ("I read literature to gain knowledge for my work") and one item of the scale measuring whether teachers stimulated the students' inquiry habit of mind ("I let students evaluate each other on the basis of assessment forms"), which resulted in higher Cronbach's alphas for the scales. Table 2 provides the number of items, the Cronbach's alpha, and a sample item for each scale. The preliminary analysis demonstrated that the reliability of the scales for working with an inquiry habit of mind and experienced social pressure were relatively low (Cronbach's alpha = .62 respectively .61). In contrast, the reliability of all other scales was higher.

4.2.3. Phase 2 case study

Semi-structured interview schedules were used for the individual and group interviews, and these were based on the questionnaire items. When the mean questionnaire score from a particular school indicated either partial or complete agreement with a certain item on inquiry-based working, participants from that school were asked to give examples of that item Students were observed in terms of their inquiry habit of mind, while the teacher observations focused on whether they created a culture of inquiry in the classroom.

4.3. Analysis

There was no straightforward link between teachers and students, because we had the questionnaires filled in anonymously and students often had more than one teacher. Therefore, we aggregated both teacher data and student data at the school level. As mentioned above, we used the mean scores.

We calculated the correlations between both the five aspects of teachers' inquiry-based working and teachers' psychological factors, and students' inquiry habit of mind. Pearson product-moment correlation coefficients were also computed. We deemed results to

Table 1
Reliability of the student questionnaire at the school level.

Scale	Number of items	Cronbach's alpha
Curiosity *I like reading books to learn about new things.*	14	.71
Critical thinking habits *I usually believe what I read on the Internet.* (R)	14	.66

Notes: The text in italics is a sample proposition for each scale. "R" indicates that the item scores were reversed coded.

Table 2
Reliability of the teacher questionnaire at the school level.

Scale	Number of items	Cronbach's alpha
Working with an inquiry habit of mind *In my work as a teacher, I value deep understanding*	4	.62
Being data literate *I am knowledgeable about statistical concepts.*	6	.69
Contributing to a culture of inquiry at the school level *My colleagues and I discuss new teaching methods based on the available research data.*	5	.88
Creating a culture of inquiry at the classroom level		
- Stimulating students' inquiry habit of mind *I encourage students to share knowledge with each other.*	5	.73
- Stimulating students' data literacy *In certain exercises, I let students keep a research log.*	6	.74
Attitude towards inquiry-based working *I enjoy inquiry-based working.*	5	.93
Experienced social pressure regarding inquiry-based working *Most people whose opinion I value think I should work in an inquiry-based manner.*	5	.61
Self-efficacy regarding inquiry-based working *I am confident that I have the skills to work in an inquiry-based manner.*	5	.93
Collective efficacy regarding inquiry-based working *I am confident that my team has the skills to work in an inquiry-based manner.*	5	.93

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

be statistically significant when their p-values were at or beneath 0.05. Although the statistical power was low due to the small number of schools, we used hierarchical multiple regression with the correlating variables, to assess the ability of a mediation model with teachers' psychological factors as the independent variables, teachers' inquiry-based working as the mediator variable, and students' inquiry habit of mind as the dependent variable.

To better understand our qualitative results, one-sample t-tests were conducted to determine whether a statistically significant difference existed between the questionnaires' total mean scores and: (1) students' curiosity and critical thinking habits at the case study schools, (2) teachers' inquiry-based working and related psychological factors at the case study schools, and (3) school leaders' inquiry-based working at the case study schools.

We transcribed and coded all the interview data according to a coding scheme using MAXQDA. To analyze the data from the 8 teacher interviews, we began by utilizing deductive coding, with a coding scheme based on the theoretical framework. However, we permitted other codes to emerge from the data (inductive coding). To create the coding scheme, two researchers independently created categories and codes based on a random set of 4 teacher interview transcripts. Disagreements were settled through discussion, and the meanings of codes were carefully adjusted. Once the categories and codes had been clearly defined, both researchers then labeled the remaining 4 transcripts on their basis. Random sampling was used to check for similarities and differences in the remaining transcripts, and discussions settled any inconsistencies. Following coding, 6 categories emerged, and these were subdivided into 29 codes on teachers' inquiry-based working. In the results section, Table 7 provides an overview of these categories and codes.

Based on the theory outlined above, the data gathered from the student interviews were independently coded by two researchers into two categories: curiosity and critical thinking habits (both aspects of students' inquiry habit of mind). Disagreements were settled through discussion.

Once the coding scheme had identified trends in teachers' creation of a culture of inquiry in the classroom and students' inquiry habit of mind, these guided the analysis of the data from the observations. Specifically, we evaluated whether the observations reinforced or contradicted these trends. The data from the observations indicated whether classroom practices supported our interview results. We used the coding scheme to find examples of students working (or not working) with an inquiry habit of mind and teachers creating (or not creating) a culture of inquiry in the classroom. Relevant quotations were selected and interwoven with the findings.

5. Results

In this section we first describe the descriptive statistics (5.1) and correlations (5.2) of all schools investigated in general and of Beatrix and Mosaic more specifically. In section 5.3 both quantitative and qualitative results are presented of Beatrix and Mosaic, first we present the results of the students, second the results of the teachers. The qualitative quotes of students and teachers are intended to be illustrative.

5.1. Descriptive statistics

The instruments measuring students' curiosity and students' critical thinking habits both contained two types of questions. Specifically, each had 8 propositions and 6 vignettes. Each type of question had two different answer categories. Whereas the propositions utilized a 4-point Likert scale (1, 2, 3, and 4), the vignettes had 4 answers, two of which represented an inquiry habit of mind and two of which did not (0 or 1). Therefore, we used the mean of the sum scores in our descriptive results (see Table 3). With 8 propositions and 6 vignettes each instrument has a minimum sum score of 8 and a maximum sum score of 38. As Table 3 demonstrates, the mean sum score of all schools on both curiosity (27.19) and critical thinking habits (24.76) were moderately high.

Table 4 provides descriptive statistics for the scales used to measure teachers and school leaders' opinions at the school level. Since the respondents filled out the questionnaire on their own, all scores reflect teachers and school leaders' perceptions, aggregated at the school level. All scales were constructed by first averaging the item scores and then averaging these scores at the school level. The mean scores for the scales fell between 2.70 and 3.39, as the "total scores" column in Table 4 makes clear. Bearing in mind that the midpoint of each scale was 2.5, the results indicated that at the school level, teachers and school leaders had (moderately) positive scores on the scales measuring inquiry-based working.

Table 3
Descriptive results of used scales of students at the school level.

Scale	n	total mean sum	SD	Min	Max	mean sum Mosaic	mean sum Beatrix
Being curious	30	27.19	1.73	23.99	33.00	26.17	27.39
Being critical	30	24.76	1.73	20.00	28.33	25.06	23.74

Notes. n = sample size, SD = standard deviation, Min = minimum score, Max = maximum score.

Table 4
Descriptive statistics at the school level of used scales of school leaders and teachers from all schools and from the two schools selected for the case study.

		Total scores (all schools)	Scores case study schools				
			Beatrix			Mosaic	
		M(SD)	t(df)	M	p	t (df)	M	p
School leaders (n = 58 schools)	Inquiry habit of mind	3.39(.34)	-.24(54)	3.40	.81	4.15 (54)	3.20	**.00**
	Data literacy	3.36(.39)	.55(56)	3.33	.59	1.72 (56)	3.27	.09
	Creating a culture of inquiry by:							
	• Communicating a vision	3.18(.49)	−5.00(57)	3.50	**.00**	−2.36 (57)	3.33	**.02**
	• Stimulating teachers' inquiry habit of mind	3.33(.41)	-.05(55)	3.33	.96	.87 (55)	3.28	.39
	• Stimulating teachers' data literacy	3.10(.55)	−9.60(56)	3.80	**.00**	-.44 (56)	3.13	.66
Teachers (n = 61 schools)	Inquiry habit of mind	3.16(.29)	−9.14(60)	3.50	**.00**	1.16 (60)	3.12	.25
	Data literacy	3.24(.30)	−8.80(60)	3.58	**.00**	−1.55 (60)	3.30	.13
	Contributing to a culture of inquiry by:							
	• Collaborating in a culture of inquiry	2.81(.42)	−7.33(60)	3.20	**.00**	2.44 (60)	2.68	**.02**
	• Stimulating students' inquiry habit of mind	3.06(.30)	−15.85(60)	3.67	**.00**	−1.76 (60)	3.13	.08
	• Stimulating students' data literacy	2.70(.34)	−8.60(60)	3.08	**.00**	3.96 (60)	2.53	**.00**

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. Significant p-values (≤0.05) are reported in bold type.

5.2. Correlations

Table 5 provides the correlations (r) at the school level between elements of teachers' inquiry-based working and students' inquiry habit of mind, and it also contains the p-values (p). As can be seen in Table 5, there was a significant relationship at the school level between students' curiosity and both teachers working with an inquiry habit of mind ($r = .38$), and teachers stimulating students' data literacy ($r = 0.61$), with high levels of teachers working with an inquiry habit of mind and high levels of teachers stimulating students' data literacy associated with high levels of students' curiosity. In terms of teachers' psychological factors, in line with our hypothesis, there appeared to be a significant relationship between several of teachers' psychological factors and students' curiosity. At the school level, teachers' attitude towards inquiry-based working ($r = .46$), their self-efficacy regarding inquiry-based working ($r = 0.52$), and their collective efficacy regarding inquiry-based working ($r = 0.42$), were all related to students' curiosity, with high levels of teachers attitude, self-efficacy, and collective efficacy regarding inquiry-based working associated with high levels of students' curiosity. However, none of these teacher variables were significantly related to students' critical thinking habits.

Attitude, self-efficacy, and collective efficacy regarding inquiry-based working were entered at step 1 of our hierarchical multiple regression, explaining 28% of the explained variance in students' curiosity. After entry of working with an inquiry habit of mind, and stimulating students' data literacy at step 2 the total variance explained by the model as a whole was 43%, $F(5,24) = 3.55$, $p = .02$. In the final model, only teachers stimulating students' data literacy was statistically significant ($b(SE) = 0.49$, $p = .03$).

5.3. Beatrix Primary and Mosaic Primary

5.3.1. Students at Beatrix and Mosaic

One-sample t-tests indicated that students at Beatrix scored close to the mean sum score on curiosity ($t(30) = -0.67$, $M = 27.39$, $p = .51$) and below the mean sum score on critical thinking habits ($t(30) = 3.42$, $M = 23.74$, $p = .00$). The scores for students at Mosaic demonstrated the opposite trend. Their scores on curiosity were below the mean sum score on that variable ($t(30) = 3.43$, $M = 26.17$,

Table 5
Correlations at the school level between teachers' aspects regarding inquiry-based working and students' inquiry habit of mind.

Teachers' aspects regarding inquiry-based working	Students' inquiry habit of mind			
	Curiosity		Critical thinking habits	
	r	p	r	p
Working with an inquiry habit of mind	.38	**.04**	-.16	.41
Being data literate	.30	.10	-.03	.88
Stimulating students' inquiry-habit of mind	.34	.07	-.22	.25
Stimulating students' data literacy	.61	**.00**	-.29	.13
Contributing to a culture of inquiry at the school level	.35	.06	.08	.68
Attitude towards inquiry-based working	.46	**.01**	-.15	.42
Experienced social pressure regarding inquiry-based working	.07	.72	.14	.45
Self-efficacy regarding inquiry-based working	.52	**.00**	-.20	.30
Collective efficacy regarding inquiry-based working	.42	**.02**	-.09	.63

Notes: $n = 30$ schools. Significant p-values (≤0.05) are reported in bold type.

$p = .00$), while they were close to the mean sum score on critical thinking habits ($t(30) = -1.01$, $M = 25.06$, $p = .32$) (see Table 3).

In the case study, students were asked during the group interviews if they thought of themselves as curious and critical thinkers. When the students interpreted these traits as negative habits, we also utilized supplementary and more indirect questions. The answers indicated a difference between both schools regarding students' curiosity and critical thinking habits. Students at Beatrix gave many examples of being curious and critical, while students at Mosaic provided few illustrations of either trait. Regarding curiosity, students from Beatrix gave examples, such as: *"I always talk a lot with other people, because I am curious about their opinions,"* or: *"I am always curious about other countries and other cultures and that kind of stuff."*

One student at Mosaic mentioned his curiosity during history lessons about events that happened in the past. Three others mentioned looking up unknown words as an example of being curious.

Students from Beatrix also offered many examples illustrating their critical thinking habits. These especially involved facts about which they had heard or read: *"On the Internet, everybody can just write anything, so that's why I do not just believe anything that is on there", "I am critical, because we are all human, and humans make mistakes, so… for example, books are also made by humans, and so, yes, I am always critical", and: "Usually, I go to more than one website. When something is mentioned on two or three sites, then it is probably true."*

Although the survey scores of students at Mosaic were close to the total mean in terms of critical thinking habits, the case study data highlighted the same pattern for this variable as for curiosity. In contrast to students from Beatrix, students at Mosaic gave very few examples of critical thinking habits.

5.3.2. Teachers at Beatrix Primary and Mosaic Primary

As Table 4 demonstrates, the results of a one-sample *t*-test revealed that teachers from Beatrix scored significantly higher on all aspects of inquiry-based working than the total mean scores of teachers at other schools. Teachers from Mosaic scored around the total mean in terms of working with an inquiry habit of mind, data literacy and stimulating students' inquiry habit of mind. They scored below the mean on collaborating in a culture of inquiry and on stimulating students' data literacy.

Table 6 contains the results of one-sample t-tests assessing differences between the total mean scores for teachers and the mean scores for teachers at Beatrix and Mosaic on psychological factors related to inquiry-based working. As can be seen, teachers at both schools scored above the average mean in terms of their attitude, and their collective efficacy regarding inquiry-based working. In addition, teachers at both schools scored around mean on self-efficacy regarding inquiry-based working. However, they differ on their experienced social pressure: teachers at Beatrix score below the mean and teachers at Mosaic score above the mean. This indicates that teachers at Mosaic experience more social pressure than teachers at Beatrix.

In the case study, the results from the teacher interviews illustrated several ways in which teachers express their commitment to inquiry-based working. Teachers at both schools mentioned most of the same aspects related to working with an inquiry habit of mind, being data literate, and contributing to a culture of inquiry at the school level. Table 7, which provides an overview of all elements mentioned by the teachers, demonstrates these similarities. For example, a teacher at Beatrix cited wanting to thoroughly understand an issue as an aspect of working with an inquiry habit of mind:

> There is an on-going discussion about teaching and assessing math. How can we teach math? We are not quite satisfied with our course books. So, we are looking around to see what else is out there. My colleague and I often look for articles or literature to read about it, to see what is considered a good way of teaching math and how we can look at it from different angles.

A teacher at Mosaic gave the following example of wanting to thoroughly understand an issue:

> When you look at the assessment data and see that the whole group had difficulties with one particular aspect, then you know either I have not done enough or I have done quite a lot, but it did not have the desired effect. Maybe I should do it in a different way to reach my goals.

According to Table 7, the two schools differed in terms of how teachers create a culture of inquiry in the classroom. Teachers from Beatrix mentioned a greater variety of aspects during the interviews than teachers from Mosaic. To stimulate students' inquiry habit of mind, teachers from both schools mentioned that they encourage students to be critical, do not immediate answer students' questions, and are open to students' ideas. In addition, teachers at Beatrix mentioned that they encourage students to be curious, have high expectations for students, and work with so-called learning questions. Each student formulates a question involving what he or she wants to learn about a specific theme or subject.

> We always start with the children's learning questions. What do you want to learn from this subject? Then, we look at how the student can formulate that question somewhat more broadly or more narrowly to make sure the core objectives are addressed. For example, a girl wanted to know about fashions during World War II. During interviews with elderly people, she found out that there was no fashion, and sometimes even no clothes at all, during the war. She had a wonderful learning experience, because she had to let go of something in her head. (Teacher at Beatrix)

Table 6
Comparison of total mean scores and scores of the case study schools on teachers' psychological factors.

		Total scores (all schools)	Scores case study schools					
			Beatrix			Mosaic		
		M(SD)	t(df)	m	p	t (df)	m	p
Teachers (n = 61 schools)	Attitude	3.23(.41)	−11.00(60)	3.80	**.00**	−5.61 (60)	3.52	**.00**
	Experienced social pressure	3.01(.36)	5.61(60)	2.75	**.00**	−9.68 (60)	3.45	**.00**
	Self-efficacy	2.95(.42)	-.99(60)	3.00	.33	.49 (60)	2.92	.62
	Collective efficacy	2.69(.42)	−9.49(60)	3.20	**.00**	−2.73 (60)	2.84	**.01**

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. Significant p-values (≤0.05) are reported in bold type.

Table 7
Teachers approaches to working in an inquiry-based manner.

Aspects	Mosaic	Beatrix
Display an inquiry habit of mind		
• *Want to thoroughly understand issues*	X	X
• *Be critical*	X	X
• *Read literature*	X	X
• *Explore a range of perspectives*	X	X
• *Be ambitious*	X	
Be data literate		
• *Collect data*	X	X
• *Analyze and interpret data*	X	X
• *Present research results to others*	X	X
• *Complete a course or a training that addresses research*	X	X
Create a culture of inquiry in the classroom by stimulating students' inquiry habit of mind		Have high expectations for students
• *Work with learning questions*		X
• *Stimulate students' curiosity*		X
• *Encourage students to be critical*		X
• *Avoid giving immediate answers to student questions*	X	X
• *Open to students' ideas*	X	X
• *Have high expectations for students*	X	X
Create a culture of inquiry in the classroom by stimulating students' data literacy		
• *Teach students how to write a research question*		X
• *Teach students how to collect data*		X
• *Teach students how to present research results*	X	X
• *Encourage students to share knowledge*	X	X
• *Teach students how to evaluate/reflect*	X	X
Create a culture of inquiry in the classroom by supporting inquiry		
• *Provide materials*		X
• *Have students working in learning corners*		X
• *Have students collaborate in groups*		X
• *Give students space and trust to conduct research*	X	X
Contribute to a culture of inquiry at the school level		
• *Conduct research with colleagues*		X
• *Discuss data together*	X	X
• *Share knowledge*	X	X
• *Be open*	X	X
• *Observe colleagues in other classrooms working with students*	X	X

To stimulate students' data literacy, teachers from both schools show students how to collect data, present results, and evaluate the research process. Teachers from Mosaic mentioned that this happens once a year when students must gather information on a self-chosen subject and present their findings to the class. Teachers from Beatrix claimed that this approach is part of their daily teaching practice. Therefore, they teach students how to formulate research questions and encourage them to share knowledge in various ways. To support inquiry, teachers give students adequate space and trust. In addition, teachers at Beatrix provide various research materials (e.g., a telescope, an old typewriter for students to take apart, and bulbs to investigate and plant), and every afternoon students work in so-called learning corners in which they collaborate in small groups. The observational data also presented two different pictures, with teachers performing in more inquiry-focused, student-centered roles at Beatrix and adopting more traditional, teacher-centered roles at Mosaic.

5.3.3. Teacher guidance at Beatrix

The lessons observations at Beatrix revealed a large educational area in which small groups of students moved from corner to corner. In each corner (which was not a literal corner but more of a small workspace), the student groups read the assignment for that station and followed the instructions. For example, during a project on Leonardo da Vinci, Shirley and Jessica had to write like he did, with their left hands and mirrored. The teacher had placed mirrors, colored felt-tip pens, instructions, and practice sheets in this corner in advance. Shirley and Jessica discussed the problem, tried to mirror their writing with their right hands, made mistakes, looked in each other's mirrors, held the mirrors in different positions, asked the teacher for pointers, became frustrated, erased their mistakes in anger, started over, and were excited when they finally got it right. Meanwhile, Tom made a paper helicopter in the hallway and enthusiastically wanted to show his teacher how well it worked. After he let go of the helicopter at the top of the stairs, it dropped straight down and did not work properly. Tom was disappointed. A teacher asked him: "*What have you found out so far?*" Tom explained what he had learned, tried again, and failed again. The teacher mentioned the helicopter's relationship with leaves from some specific trees. At the same time as they were gathering in a very loose setting and running up and down the stairs, the students were discussing issues like weight and the ability to fly. Later, another teacher, asked them: "*What have you found out, and what can you write about it in your research log?*" After discussing the important issues, the group of five students wrote these down in their research logbooks. This approach is in line with Zion and Sadeh (2007), who pointed out that the purpose of inquiry is to lead students to construct their own knowledge, which involves developing a sense of curiosity. Most assignments at Beatrix seemed designed to encourage student inquiries. The friendly atmosphere left students free to express their opinions, and teachers emphasized coaching rather than lecturing. A teacher at Beatrix said:

> Children are curious by nature, and I think at school we really encourage that. We want children to have ownership, so that they receive education based on their needs. But I also think it is very important that the children can let their curiosity run free. That is why we sometimes have something like a demolition corner or a corner with microscopes.

At Beatrix, all of the types of teacher guidance mentioned by Jones and Eick (2007) were observed: open-ended, project-based inquiry, and guided inquiry. The evidence suggests that the teachers at Beatrix focus on inquiry, with teachers' guidance ranging from open-ended to guided inquiry and students' responsibility levels varying accordingly. Teachers did not follow curriculum books. Rather, continual learning lines spanned subjects, and teachers concentrated on inquiry. This is in line with the previously mentioned theories of Dobber and Van Oers (2015), and Levy et al. (2013), who pointed out that learning through inquiry can be applied across all sorts of subjects.

5.3.4. Teacher guidance at Mosaic

Observations at Mosaic indicated that both teachers and students predominantly adhered to traditional roles during whole-class instruction. Most class time was devoted to transferring knowledge, with a one-way interaction from teacher to students. For example, a sixth-grade teacher, read a chapter from a book while all students read along in their own copies. Next, she pronounced the difficult words, with the students repeating after her. An eighth-grade teacher, explained math problems to the class, asking questions and writing down the answers on the board in front of the classroom. After the instruction, all students quietly worked to finish the math problems by themselves. In both cases, two or three students did not participate in the classroom instruction, because they had individual learning programs. However, most observed class time at Mosaic was used for what Weimer (2002) identified as the most common teacher-centered methods: lecturing, explaining, demonstrating, questioning, and seat work. In all observed classes, students sat in rows facing the teacher in front. Each classroom at Mosaic had a traffic light. When the teacher turned on the red light, students were supposed to work silently. When the teacher turned on the yellow light, students were allowed to work together and ask each other for help. When the green light was turned on, students could ask the teacher questions. When teachers were asked how they stimulated students' inquiry habit of mind, they often mentioned the yellow traffic light, intended to encourage students to collaborate with each other.

6. Discussion and conclusions

This study sought to investigate the relationship between teachers' inquiry-based working and students' inquiry habit of mind at the school level. We sought to answer: (a) What is the relationship between teachers' inquiry-based working and students' curiosity? and (b) What is the relationship between teachers' inquiry-based working and students' critical thinking habits? We hypothesized that the more teachers worked in an inquiry-based manner, the stronger the students' inquiry habit of mind (curiosity and critical thinking habits) would be. In addition, we hypothesized that high scores on teachers' attitude, experienced social pressure, self-efficacy, and collective efficacy regarding inquiry-based working would correlate with high scores on students' curiosity and critical thinking habits. We first discuss the results on students' curiosity and then address students' critical thinking habits.

Looking at students' *curiosity*, the survey results partly supported our hypotheses. Indeed, the more teachers worked with an inquiry habit of mind at the school level, the more curious the students were at the school level. Moreover, in line with the results of Furtak et al.'s (2012)meta-analysis, the more teachers stimulated students' data literacy, the more curious the students appeared. Although earlier research has suggested that teachers could more effectively create a culture of inquiry in the classroom by working in such a culture themselves (Dobber & Van Oers, 2015; Wells, 2011), collaborations with others during inquiry, but also teachers' data literacy, and efforts to stimulate students' inquiry habit of mind did not seem to influence student curiosity. The finding that teachers' data literacy or collaborative research efforts did not appear to enhance students' curiosity could be because these elements of inquiry-based working usually take place outside the classroom. Thus, they might affect students' inquiry habit of mind to a lesser degree. However, an unexpected finding was that, when teachers see themselves as encouraging students' inquiry habit of mind, this is not necessarily reflected in students' curiosity scores. Perhaps teachers overestimate themselves, lack sufficient knowledge or reflect insufficiently on their own skills.

In terms of teachers' psychological factors regarding inquiry-based working, the study revealed that three factors are very important for students' curiosity: (1) teachers' positive attitude towards inquiry-based working, (2) a strong sense of self-efficacy regarding inquiry-based working, and (3) collective efficacy regarding inquiry-based working. However, bearing in mind that teachers' inquiry-based working is related to all four investigated psychological factors (Uiterwijk-Luijk et al., 2017a), it might be that social pressure indirectly influences student curiosity and therefore could be as important as the other measured variables.

Regarding students' *critical thinking habits*, the survey results indicated that none of the aspects of teachers' inquiry-based working or related psychological factors appeared to be related. Perhaps, stimulating students' inquiry-habit of mind for teachers means encouraging curiosity, with less emphasis on promoting critical thinking. Another reason might be that teachers find it difficult to enhance critical thinking. While teachers appear to be heavily influenced by curriculum materials (Davis, Janssen, & Van Driel, 2016), there is hardly any evidence to help educators decide how to teach in ways that stimulate critical thinking (Marin & Halpern, 2011; Murphy et al., 2014). It is unclear whether curriculum materials do pay attention to student curiosity, or that teachers do not need support from curriculum materials on this part.

The results of the case study illustrated that the classroom culture at Beatrix is in line with what Lipman (2003) described as a classroom community of inquiry. At that school, teachers encourage various forms of inquiry, from guided to open-ended. In line with our hypothesis, students have plenty of space to investigate, be curious, and be critical. At Beatrix, students think of themselves as both curious and critical, and they offered many examples to support their opinion. At Mosaic, where teaching is teacher-centered, students felt less encouraged to be either curious or critical. Students at that school could think of very few examples either of curiosity or critical thinking.

One would expect that Beatrix, with its high scores on teachers' inquiry-based working within an inquiry-centered culture, would have also produced high scores on students' curiosity and critical thinking habits. However, these scores were close to the mean and below the mean scores, respectively. This suggests that an inquiry-based classroom culture does not automatically imply that students are curious and critical thinkers. On the other hand, the case study schools were situated in quite dissimilar areas and served different populations. This dissimilarity could have affected teachers' approaches and students' inquiry habit of mind. It also means that the results on students' inquiry habit of mind could have been influenced by other variables, such as the style of upbringing by their parents. It would be interesting to investigate the relationship between inquiry-based working and factors such as school environment and the socio-economic status of the parents.

The survey findings and the case study results seemed to diverge. The survey suggested that when teachers indicate that

they strongly stimulate students' inquiry habit of mind, it does not affect students' critical thinking abilities. However, the case study illustrated that in a school in which teachers continuously focus on stimulating students' inquiry habit of mind students indeed were both more curious and more critical. The reason for this difference might be that the survey results measured the mean scores of all teachers at one school, while the case study revealed the actions of individual teachers. Research has indicated that even young children can engage in critical thinking (Murphy et al., 2014). However, to read about certain cases, and envisioning what you would do, as they had to do while filling in the questionnaire, might be difficult for young children to carry out. While we used validated instruments to measure teacher variables, it is good to bear in mind that the instruments used to measure students' inquiry habit of mind were developed especially for this study. Items of the student questionnaire like: 'I do not like that, I would rather find things out by myself" which we interpreted as critical thinking, might also be seen as stubbornness. Future research could further develop our instruments. Another limitation of the survey is that the teacher questionnaire relied on self-reports (see, for example, Schwarz, 1999). Thus, the results reflect teachers' own perceptions. The case study provides more insight into teachers' actual inquiry-based working and students inquiry habit of mind, but a larger research study is necessary to overcome these limitations.

While the used literature might suggest causality of relationships between variables, it is important to emphasize that the methods used in this study were not intended to validate the causal nature of these relationships. This means caution is advised regarding the interpretation of the findings. The findings show correlations instead of causalities.

6.1. Implications

The findings of the present study contribute to our understanding of teachers' inquiry-based working and students' inquiry habit of mind. As the results demonstrate, teachers' inquiry-based working and their related psychological factors relate to students' curiosity. This implies that teacher educators and school leaders who want to stimulate an inquiry-based culture in schools, and (indirectly) enhance students' curiosity, should encourage (student) teachers' inquiry-based working. They can do this by prompting teachers to discuss results together, sharing knowledge, and modeling behavior. Moreover, they could encourage teachers to take a positive attitude towards inquiry-based working by, for example, pointing out the educational benefits of such an approach and being enthusiastic about it. Educators and school leaders could add to each teacher's sense of self-efficacy and collective efficacy regarding inquiry-based working by enabling teachers to work in peer groups and creating a safe environment in which they feel free to investigate their own teaching practice (see also Uiterwijk-Luijk et al., 2017a; 2017b).

To promote students' curiosity, teachers can create a culture of inquiry in the classroom. This means, for example, teaching students how to work with learning questions, being open to students' ideas and questions, and facilitating inquiry by providing research materials and having students work together in small groups.

This study added to the literature on the relationship between teachers' inquiry-based working and students' curiosity. Future research could provide additional insights into how teachers can stimulate students to become critical thinkers. Meanwhile, educational publishers can support teachers by making students' inquiry habit of mind a key issue in curriculum materials.

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