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Student engagement in research in medical education

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Chapter 1

General introduction

1. General introduction

1.1 Introduction

Programmes that aim to involve students in research have become increasingly popular in university education worldwide in recent decades (e.g., Brew & Mantai, 2017 in Australia; Healey, Jordan, Pell, & Short, 2010 in the United Kingdom; van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013 in the Netherlands). Since the nineteenth century universities have continued to search for a balance between research and teaching (Esteban, 2016; Simons & Elen, 2007). The tradition of providing education through research is often used to indicate this balance, with von Humboldt being considered its main representative. This contrasts with the philosophy of Newman, who placed teaching at the core of the university system (e.g., Esteban, 2016). In contemporary research-intensive university education, the emphasis is on student engagement in research as integrated into teaching, which is considered to be a valuable means of preparing students to function in an increasingly complex society (Boyer Commission, 1998; Brew, 2003, 2010; Clark, 1997; Hattie & Marsh, 1996). Academics value the role of research in higher education and hence work to integrate research into current teaching practices at both research-intensive and teaching-intensive universities (Griffioen & de Jong, 2015; Hu, van der Rijst, van Veen, & Verloop, 2014; Verburgh, Schouteden, & Elen, 2013). It is expected that the trend towards strengthening the functional connections between research and teaching as a means of promoting student learning in a university setting will continue over the coming years (e.g., Fung, Besters-Dilger, & van der Vaart, 2017).

While policy makers, academics, managers and academic developers all place a high value on student engagement in research, attempts to bring research and teaching closer together in order to benefit student learning may be impeded by a number of factors. These factors include national and international policy issues concerning the status of teaching within universities (Halse, Deane, Hobson, & Jones, 2007; Malcolm, 2014), the characteristics of institutional research cultures (Spronken-Smith, Mirosa, & Darrou, 2014; Turner, Wuetherick, & Healey, 2008), the beliefs, knowledge and practices of teachers (Visser-Wijnveen, van Driel, van der Rijst, Visser, & Verloop, 2012) and students' beliefs regarding the purpose of university education (Robertson & Blackler, 2006). Furthermore, student numbers are increasing, while the student population is becoming more diverse (cf. Scott, 2010), which will influence the distance between students' learning experiences and research activities at universities. It could also affect the value of research for both professional practice and learning. These factors shape how research informs student learning, emphasising how the link between research and teaching is articulated by academics and experienced by students.

1.2 Student engagement in research

Studies investigating student engagement are generally concerned with the relations between the time, effort and other relevant resources invested by both students and their teachers, which are intended to enhance the student experience, learning outcomes and development, as well as the performance and reputation of the institution (Trowler, 2010). The concept of student engagement is based on the assumption that learning is influenced by how students participate in learning activities as well as how staff provides them with opportunities to become involved (Coates, 2005). This means that students' level of engagement can be used to monitor areas of good practice as well as areas that are in need of improvement within institutes (Coates, 2010; Kuh, 2009). The promotion of student engagement in higher education in general has various purposes, including explicating the relevance of the curriculum to students and enhancing student learning outcomes (Trowler, 2010). While there is agreement regarding the relevance of student engagement to student learning, this construct still needs to be carefully framed (Kahu, 2013). The concept of student engagement used in this thesis is based on previous work by Bryson and Hand (2008), which suggests that student engagement encompasses student perceptions and expectations of studying, in this case, occur in a research-rich learning environment. Student engagement in higher education generally focuses on specific aspects of

student learning, for example, student participation, interest and involvement in learning (for an overview see Trowler, 2010). This emphasises the relevance of student perceptions of teaching and their beliefs regarding learning to foster student engagement in research, in addition to ways in which teachers foster student learning. The studies presented in this thesis aim to understand student engagement in research. The term *student engagement in research* was chosen in order to emphasise a desire to actively involve students in disciplinary research in various ways, all of which aim to foster student learning about research, learning from research and learning to conduct research (e.g., Hodson, 1992; Healey & Jenkins, 2009).

Based on findings from previous studies concerning student engagement in higher education, student engagement in research is conceptualised in this thesis as promoting student learning through research practices, which is facilitated by how students perceive research to be integrated into teaching, as well as student beliefs regarding the value of research for both learning and professional practice. Student perceptions, beliefs and supervision practices are examined in the context of an undergraduate programme in medicine that strives to promote the integration of research into teaching. This thesis focuses on the perceptions of students and their supervisors, since perceptions of teaching influence knowledge acquisition as well as actual learning and teaching behaviour (Pajares, 1992). Perceived differences in the roles of research and learning in the learning environment may thus result in different actions in relation to learning and teaching in research-rich contexts (e.g., Hu, et al., 2014).

The concepts of perceptions, beliefs and practices are complex and should, therefore, be carefully defined (Pajares, 1992). In this thesis, *student perceptions* refer to the ways in which students experience research via teaching activities. Student perceptions are influenced by student beliefs. Such beliefs are generally referred to as a set of (partly implicit) suppositions or a lens through which students perceive the world, which remains relatively stable over time and courses (Pajares, 1992). The notion of *student beliefs* regarding the relevance of research actually refers to two types of beliefs. First, it refers to the extent to which students believe that research stimulates their learning, that is, beliefs regarding the relevance of research to learning. Second, student beliefs refer to the extent to which students believe that research is relevant to their future professional practice. Moreover, *supervision practices* refer to supervisors' teaching practices within students' research projects that aim to foster student learning through research. Furthermore, the word *teachers* is used to refer to academics who hold a teaching role in general, while the word *supervisors* is used to refer specifically to those who perform a teaching role in students' research projects.

This dissertation focuses on a single institute within the medical discipline. Student beliefs and perceptions of the integration of research into teaching depend on discipline-specific characteristics, for example, the ways in which knowledge is structured as well as shared conceptions of research and teaching within disciplines (Brew, 2003; Smeby, 2000). Medicine is an example of a hard-applied discipline (e.g., Biglan, 1973) in which research skills and attitudes, such as knowledge concerning research designs and a critical approach to knowledge (cf. Neumann, 1994), are important in clinical practice. This is especially true for physicians, since they must stay abreast of advances in the field to continuously improve patient care. In this thesis medicine provides the context for the investigation of research integration with the aim of promoting student engagement in research.

1.3 Theoretical background

1.3.1 The role of research in teaching

There are several reasons why research and teaching should be brought closer together in university education. First, a strong connection between research and teaching is reflected in the traditional and influential philosophies that inform higher education, which suggests that research-teaching integration is a key part of the mission of any university (Esteban, 2016; Robertson & Bond, 2005). Second, research is believed to further high quality teaching within universities (Brew & Ginns, 2008; Deem & Lucas, 2007; Hattie & Marsh, 1996). Third, close connections between research and teaching are seen as important in terms

of helping students to develop the ability to think critically, analyse problems and work in a complex knowledge society (Brew, 2003; Simons & Elen, 2007; Verburgh, Francois, Elen, & Janssen, 2013). Similar ideas are reflected in the literature concerning medical education. Medical teachers combine their roles in research and teaching in diverse ways building upon their academic identity (e.g., van Lankveld, et al., 2017). The combination of research and teaching promotes discussion about the quality of teaching in medical education (e.g., Ahmed, Farooq, Storie, Hartling, & Oswald, 2016; Suwanwela, 1995), which has led to investigations into the intended research competencies and student learning outcomes (Chang & Ramnanan, 2015; Ribeiro, Severo, Pereira, & Ferreira, 2015). Unsurprisingly then, the emphasis in the current research literature is on strengthening the role of research in teaching. In addition to the importance placed on the notion of research integration in order to foster a scientific mindset among students, the stronger integration of research into teaching is considered beneficial for improving teaching practices. In line with the emphasis seen in the existing literature, this thesis focuses on strengthening the role of research within teaching as opposed to, for instance, bringing teaching into research to a greater extent. For the sake of clarity, the term 'research integration' is used to refer to all the learning activities within medical teaching units in which the fostering of student engagement in research findings and processes is an essential element (cf. Healey & Jenkins, 2009).

Despite the general agreement regarding the relevance of research integration, there is still little agreement in terms of how to strengthen research integration within university education. One suggestion in this regard is to focus on the study programme (i.e., the meso level). The findings from previous studies indicate that research integration is influenced by the time allocated for research and teaching, availability of staff and the identification of the relations between the institutional research policy and the study programme (Hu, van der Rijst, van Veen, & Verloop, 2014; Jenkins, Blackman, Lindsay, & Paton-Saltzberg, 1998). Moreover, findings of studies concerning study programmes in medical education indicate that actively engaging in research can foster student outcomes, including research skills and attitudes, although these practices mostly constitute only a small proportion of the student activities (Bierer, Prayson, & Dannefer, 2015; de Oliveira, Luz, Saraiva, & Alves, 2011; Mullan, Weston, Rich, & McLennan, 2014). Other means of stimulating student learning through research integration focus on teaching and learning (i.e., the micro level), investigating the relations between teachers' practices within the classroom and various aspects of student learning. Previous studies have found that student learning is influenced by, for instance, the nature of the research integration practices and teacher beliefs regarding research and teaching (Schouteden, Verburgh, & Elen, 2014; Visser-Wijnveen, van Driel, van der Rijst, Verloop, & Visser, 2010). A common characteristic of these previous studies, whether at the meso or micro level, is the need to explicitly emphasise research in a way that stimulates student learning in contexts in which teaching, research and learning are connected, as opposed to more implicit ways of promoting student learning. However, engaging students in research practices is rarely that straightforward.

Within research-intensive university education in general, staff involvement in research is considered vital for stimulating student learning, although research integration can depend on the support received by the staff in relation to integrating research into their teaching as well as on the relevance placed on research integration by academics (Coate, Barnett, & Williams, 2001; Durning & Jenkins, 2005). For this reason it is expected that research and teaching will be more closely connected within study programmes than, for instance, at the institutional or departmental level. Furthermore, focusing on the meso and micro levels is of substantial practical relevance, since education managers, programme directors, academic developers and teachers in higher education in general and medical education specifically all strive to promote student engagement in research. The curriculum, which is comprised of the mainly predetermined teaching units that students follow during the study programme, can function as a starting point for dialogue among all stakeholders regarding research integration, by providing a framework for the inclusion of academics' research interests with a strong focus on student learning (Healey & Jenkins, 2009; Jenkins, 2004; Willison, 2012). When initiating a curriculum change, for example, it is not only the programme's mission that should change but also the study programme itself,

with student learning activities following on from this. At the same time, good practices within the programme will be reconsidered. The first studies included in this thesis, therefore, focus on the study programme. It can prove challenging for teachers to render teaching-research relations functional. Teachers' uncertainty regarding the extent to which research fits with students' interests and capabilities represents a reason for this (Brew & Mantai, 2017; Zamorski, 2002).

1.3.2 The role of research in medical education

Fostering learning through research integration places an emphasis on the relations between learning experiences and the characteristics of research and knowledge within academic disciplines (Brew, 2003; Visser-Wijnveen, et al., 2012). In hard disciplines in general, knowledge has a hierarchical cumulative structure that may also be reflected in the structure of curricula (Nederlandse Federatie van Universitair Medische Centra [NFU], 2009; Smeby, 2000). The Dutch national curriculum in medicine, as an example of a hard-applied discipline (e.g., Biglan, 1973), emphasises students' knowledge regarding research and research skills during the undergraduate phase, while, students' ability to conduct a research project is emphasised in the master's phase, and fosters the ability to make professional decisions based on research findings as a desirable learning goal (NFU, 2009). Specifically in medical education, these learning goals are related to societal expectations that future medical professionals should be able to both develop knowledge through conducting research and use research findings to enhance patient care (e.g., de Beaufort & de Goeij, 2013). The desired learning outcomes of undergraduate and postgraduate medical education (i.e., specialist training) in the Netherlands and abroad are framed around the necessary competencies of medical professionals (CanMEDS, 2015; GMC, 2015; NFU, 2009). In this thesis the focus is on medical students' perceptions, beliefs and actual learning outcomes, since these variables closely align with the intended learning outcomes.

A recent literature review concerning medical students' research activities (Chang & Ramnanan, 2015) indicated that previous studies mainly reported on data regarding the number of students involved in scholarly research, the development of research skills, students' positive perceptions after their research experiences and the research outcomes (i.e., productivity, research success). Taken together, the results suggest that students' research experiences may contribute to their interest in conducting research. Nevertheless, in most cases, medical students will go on to work as practitioners rather than scientists; hence the research practices applied within the study programme are important in terms of fostering student learning about the use of research in clinical practice (e.g., CanMEDS, 2015; GMC, 2015; NFU, 2009). This thesis aims to fill a gap in the literature by investigating students' contextualised perceptions of research, their beliefs regarding the relevance of research to both practice and learning, the learning outcomes within medical education and supervision practices aimed at fostering student engagement in research among large cohorts of students.

1.3.3 Studies into the research-teaching nexus

Previous studies investigating the so-called research-teaching nexus suggest that the relations between research and teaching within universities are complex. Findings from interview studies indicate that both students and teachers have strongly held beliefs regarding the relationship between research and teaching (Robertson & Blackler, 2006; Visser-Wijnveen, et al., 2012). In contrast, the findings from quantitative studies suggest that there are no empirical relations between teachers' research productivity and students' perceptions of the quality of teaching (Hattie & Marsh, 1996; Ramsden & Moses, 1992; Webster, 1985). A new impetus was given to the discussion of research integration by Healey (2005), who introduced a framework for implementing research into curricula that featured two dimensions (Healey & Jenkins, 2009). The first dimension involves the research elements that are integrated into courses. It extends from the research processes, such as data collection and analysis applied in courses, to the research content intended to improve students' understanding of research findings through coursework. The second dimension concerns the role of students in learning activities. It extends from students' involvement as an audience of research to students involved as participants in research. One of the strengths of this model is the intuitive way in which different modes of research integration

can be distinguished, although it could only be partly related to student and teacher perceptions of research in teaching in both qualitative and quantitative studies (e.g., van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013; Visser-Wijnveen, et al., 2012; Visser-Wijnveen, et al., 2016).

In higher education it is generally assumed that student perceptions of the learning environment are key to achieving high quality learning outcomes (Biggs, 1985; Prosser & Trigwell, 2014; Ramsden, 1991). Findings from a large-scale study by Lizzio, Wilson, and Simons (2002) support the proposition that student perceptions influence their learning outcomes, indicating that positive perceptions not only directly influence students' level of achievement but also improve the quality of the learning outcomes (e.g., generic skills). Further, the findings from previous studies concerning learning outcomes associated with research integration in particular suggest that student perceptions of research contribute to specific learning outcomes, for example, students' developing research dispositions, research skills and research awareness (Elton, 2001; Turner, et al., 2008; Visser-Wijnveen, et al., 2012). The learning outcomes associated with research integration are investigated in two chapters of this thesis. In line with previous studies concerning student learning outcomes, both the level of students' achievement and specific learning outcomes were chosen in accordance with the aims of the separate studies included in this dissertation.

Recent studies describing the numerous potential of research integration practices have led to multiple typologies reflecting the teaching approaches (e.g., Griffiths, 2004; Healey, 2005; Healey & Jenkins, 2009; Neumann, 1992; Schouteden, et al., 2014; Verburgh, et al., 2013; Visser-Wijnveen, 2013; Zamorski, 2002; Zimbardi & Myatt, 2014) and instruments used to capture student experiences of research (Spronken-Smith, Mirosa, & Darrou, 2014; Turner, et al., 2008; Roseaux , Verachtert, Spooren, van Petegem, & de Schepper, 2016; Visser-Wijnveen, et al., 2016). Furthermore, student perceptions of research can foster various learning outcomes (Elton, 2001; Visser-Wijnveen, et al., 2012; Turner, et al., 2008). Only very few studies have explored the relations between actual research integration practices, student perceptions and student learning outcomes. Student perceptions of research, for example, have been explored in

relation to teacher beliefs regarding research and teaching (e.g., Visser-Wijnveen, et al., 2012). Yet we still lack the appropriate evidence to evaluate the relation between student beliefs, perceptions and learning outcomes and actual research integration practices.

1.3.4 Research integrated into the curriculum

In higher education, the level of a study programme can influence research integration. Teachers, for example, may consider research integration to be more appropriate towards the end of undergraduate and master's programmes than in the earlier years of the study programme (Elen & Verburgh, 2008; Neumann, 1992; Taylor, 2007). The undergraduate curriculum, which consists of the teaching units within the study programme, provides space for strengthening the integration of research (e.g., Fung, 2017). Findings from previous studies suggest that effective integration lies in a considered diversity of approaches based on, for example, students' roles in learning activities, the breadth and depth of attempts to stimulate student understanding of research, the research practices that already exist within institutes, and the desirable student learning outcomes (Healey & Jenkins, 2009; Zimbardi & Myatt, 2014). This adds complexity to the process of determining the effectiveness of curriculum changes within study programmes intended to strengthen research integration.

Statements regarding the effectiveness of curriculum changes are generally made in light of examining the extent to which the goals of the change have been achieved based on relevant data (Kelly, 2004; Marsh & Willis, 2007). In this regard, the data can be considered relevant when multiple data sources are used and the data represents the ideas behind the curriculum development practices (Kelly, 2004; Tawney, 1973). Judgments concerning effectiveness that are solely based on student assessment data, for example, reflect whether the students exhibited the desired response to the curriculum but they do not provide insight into how the curriculum influences learning (Kelly, 2004; van den Akker, 2003). In order to determine the effects of the integration of research into the undergraduate curriculum, an emphasis is usually placed on the perceived as well as the attained curriculum (Fung, 2017; Healey & Jenkins, 2009; Visser-Wijnveen, et al., 2012; Zimbardi & Myatt, 2014).

Two of the studies included in this thesis aimed to provide insights into a curriculum change that was intended to strengthen the integration of research into the study programme. In addition to student perceptions of the integration of research into teaching (i.e., students' perceived curriculum), the studies in this dissertation focus on student learning outcomes and student achievement (i.e., attained curriculum) as well as the perceived practices and challenges in supervising students' research projects (i.e., teachers' perceived curriculum). In order to investigate the extent to which a curriculum change may influence student perceptions, beliefs and learning outcomes, comparisons are made between a previous curriculum and a curriculum intended to strengthen connections between research and teaching. The curricula are referred to in this thesis as the *previous* and *changed curriculum*, respectively. When compared with the previous curriculum, the changed curriculum places a stronger emphasis on research integration.

1.3.5 The relevance of student perceptions of research

Student perceptions of the learning environment and student characteristics can influence student learning outcome, with their perceptions promote both generic (i.e., student achievement) and specific (i.e., skill development) learning outcomes (Lizzio, Wilson, & Simons, 2002; Prosser & Trigwell, 2014; Ramsden, 1991). This notion places an emphasis on student perceptions of research in the teaching context.

Among the factors that influence student perceptions of research integration are the nature of the discipline, the course type and the opportunity to interact with academic staff (Lindsay, Breen, & Jenkins, 2002; Neumann, 1994). Students can experience both disadvantages (i.e., staff research takes priority over teaching, academics' specific interest narrow down the curriculum; Healey, et al., 2010; Lindsay, et al., 2002) and advantages of research integration (i.e., teachers' enthusiasm for research, increased interest in subjects, improvement of research skills; Neumann, 1994; Turner, et al., 2008). Importantly, student beliefs regarding, for example, the purpose of university education may mediate their perceptions. In the context of research integration, this is illustrated by

findings from a study by Robertson and Blacker (2006) which suggests that students who conceptualise the university being about teaching may experience research as being rather removed from their undergraduate learning activities. For these reasons, it is interesting to investigate student engagement in research by means of student perceptions regarding research in teaching within relation to their beliefs regarding the relevance of research.

1.3.6 The relevance of supervision practices

Student engagement in research is likely to be influenced by how their teachers articulate the links between teaching and research (e.g., Visser-Wijnveen, et al., 2012). Research supervision is an example of a teaching activity, since students are considered to be learners and it is assumed that their capabilities will develop during supervision (Boud & Lee, 2005; Brew, 2001; Hu, van der Rijst, van Veen, & Verloop, 2016; Manathunga, Lant, & Mellick, 2006). In recent years, there has been a trend towards studying research supervision (e.g., Anderson, Day, & McLaughlin, 2008; Harwood & Petrić, 2017; Maxwell & Smyth, 2011; Wichmann-Hansen, Thomsen, & Nordentoft, 2015). Previous studies concerning experienced supervisors have identified factors involved in the practice of research supervision that contribute to student learning, including responsiveness to students' needs and ways in which supervisor-student relationships are maintained (e.g., de Kleijn, Meijer, Pilot, & Brekelmans, 2014; Lee, 2008; Mainhard, van der Rijst, van Tartwijk, & Wubbels, 2009). These factors are useful for stimulating supervisors' reflections on their practices in direct relation to professional academic development activities as well as for the study of research supervision in general. However, students' research projects whether undertaken towards the end of their undergraduate education or during their postgraduate education are mainly supervised by PhD-students or immediate postdoctorates, especially in the medical discipline. This group of supervisors, in particular, may benefit from support in terms of exploring approaches to supervision, overcoming challenges and adapting pedagogies (e.g., Turner, 2015). It would hence be interesting to analyse how novice supervisors foster student engagement in practice as well as how this practice may be shaped by the dilemmas faced during actual research integration activities.

1.4 Outline of the dissertation

To sum up, findings from previous studies have emphasised the relevance of student perceptions of research within teaching. They have also indicated that student learning can benefit from the connections between research and teaching at several levels in higher education. Previous studies into higher education have focused, for example, on overcoming the disadvantages of research integration by means of higher education policy (e.g., Jenkins, et al., 1998) as well as on the visibility of research cultures within higher education institutes (e.g., Spronken-Smith, et al., 2014). Further, previous studies within the health sciences have emphasised the programme level as being particularly relevant to promoting students' research competencies (e.g., Bierer, et al., 2015; Mullan, et al., 2014). Other studies have focused on research integration at the teaching and learning level (Levy & Petrulis, 2012; Visser-Wijnveen et al. 2012). Taken together, the findings of all these previous studies suggest that research can stimulate student engagement by creating a challenging learning environment when research is made explicit to students (Rowe & Okell, 2009; Malcolm, 2014). The main interest of this thesis concerns the promotion of student engagement in research, with a focus on student perceptions of research within teaching activities, student beliefs regarding the relevance of research, student learning outcomes, and research supervision practices. The studies reported on in this dissertation involve components of student engagement in research as a concept, which is in line with the aims of fostering student engagement in research seen per study in this thesis. For this reason, importance is placed on student engagement in the introduction and discussion chapter rather than in the individual studies. The integration of research into medical university education is emphasised within the study programme in the context of a curriculum change as well as within teaching and learning in students' research projects.

Chapters 2 and 3 report on studies at the programme level and they are designed to provide insight into the role of research practices within the undergraduate study programme in the context of a curriculum change. Chapters 4 and 5 report on studies promoting student learning at the level of teaching and learning. The study in Chapter 4 is designed to explore relations between student perceptions, beliefs and student achievement. The interview study in Chapter 5 is designed to provide in-depth insights into how supervisors stimulate student learning during the conducting of students' research projects. To this end, an example of the complete integration of research, teaching and learning is chosen, namely research supervision during students' research projects. Figure 1.1 provides an overview of the four empirical studies presented in this dissertation.

In Chapters 2, 3 and 4, a questionnaire was used to gain insights into how as well as the extent to which students perceive research within undergraduate medical education. More specifically, insights were sought into students' familiarity with research conducted by teachers, their critical reflection on research in the medical discipline, their participation in research and their motivation for research. Three other factors were also considered in relation to student perceptions of research, namely the quality of the learning environment in general, the importance placed by students on research for learning and the value of research for professional practice.

Chapter 2 reports on a longitudinal, comparative study in which a group of students (n = 941) participated in data collection over the three years of their undergraduate medical education. The study presented in this chapter focuses on student engagement in research through its aim of providing insights into the relevance of the study programme as perceived by students and by describing the authentic elements of research integration practices. The research question addressed in this chapter is:

- What is the influence of authentic research practices, integrated into the study programme in the context of a curriculum change, on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning during the course of undergraduate medical education?

Chapter 3 reports on a comparative study of student perceptions of research and student learning outcomes. Student learning outcomes were chosen, since one

aim of fostering student engagement in in general is to improve student learning outcomes (Pascarella, Seifert, & Blaich, 2010). A comparison is made between a curriculum with a stronger emphasis on research integration and a previous curriculum with less emphasis on research within teaching. This chapter furthers our understanding of the findings presented in Chapter 2 by comparing student learning outcomes within the same domain of research. Specific research-related learning outcomes were compared before and after a curriculum change. The learning outcomes reflect student knowledge about research and the quality of student products (i.e., test items and student research reports) and they were similar in both curricula. Chapter 3 focuses on first-year students (n = 746) for two reasons. First, the transition from a secondary education learning environment to a research environment within a university has been identified as one of the critical factors in promoting student learning during their university education (Brew, 2010; Spronken-Smith, Mirosa, & Darrou, 2014). Second, it can be difficult to integrate research into subjects. Teachers and students may have different ideas about the need to address research during the first year of undergraduate education in order to foster a scientific frame of mind on the part of the students (e.g., Zamorski, 2002). This means that, particularly during the first year, there is space for innovative teaching methods that aim to engage students in research. Chapter 3 reports on a comparative study conducted before and after a curriculum change that aimed to strengthen the integration of research into the first year of undergraduate medical education. The following research questions are addressed:

- What is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student learning outcomes, especially student products and test scores within the domain of research?

- What is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning?

Chapter 4 reports on relations between first-year student perceptions of research (n = 304) and student achievement, in this case their grade point average (GPA) during the first year of university education. The findings detailed in this chapter complement the findings presented in Chapters 2 and 3 by exploring relations between student perceptions and student achievement within one study programme. It has previously been found that students' perceptions of the learning environment generally influence both their learning outcomes and achievement (e.g., Lizzio, Wilson, & Simons, 2002; Prosser & Trigwell, 2014; Ramsden, 1991). Findings from previous studies concerning relations between student perceptions of the learning environment and learning outcomes in higher education indicate that this relationship is reciprocal (e.g., Prosser & Trigwell, 2014). Furthermore, it has been argued that student perceptions of the learning environment in general provide a valid and adequate image of that learning environment (Marsh & Roche, 1997; Spooren, Brockx, & Mortelmans, 2013). Moreover, findings from previous studies suggest that there is a strong relation between student engagement in learning activities and student achievement (Kuh, Kinzie, Schuh, & Whitt, 2005; Pascarella & Terenzini, 2005). Chapter 4 aims to provide insight into the extent to which students' GPA reflects the research intensiveness of the learning environment using student perceptions of research within teaching. The research question is:

- To what extent are student achievement, specifically grade point average, and student beliefs regarding the importance of research related to ways in which students perceive research in the first year of undergraduate medical education?

Finally, an interview study was conducted in order to provide in-depth insights into how supervisors promote student learning in students' research projects conducted in the bachelor and master phase. This study relates to student engagement based on its focus on how supervisors guide student participation in purposeful learning activities in which research is integrated (e.g., Coates, 2005). Stimulated recall interviews were used to elicit supervisors' reflections on

their supervision practices ($n_{supervisors}$ = 11). In these interviews, the supervisors expressed difficulties they had experienced during research supervision. Chapter 5 aims to conceptualise these practices and difficulties within a dilemmatic space in which specific teaching situations will bring certain considerations regarding student learning more to the fore while leaving others in the background. The insights derived from this study can be used as input for development initiatives targeted at novice supervisors.

Students' research projects are particularly suitable for studying the integration of research in teaching for three reasons. First, students' research projects are a common practice in research-intensive university education in the Netherlands indicating that all students participate in research. Research is fully and explicitly integrated into students' research projects, as most students will individually conduct research under supervision. This is not necessarily the case with other types of research integration in teaching (van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013; Verburgh, et al., 2013). Second, students within the health sciences may be supervised by PhD students or immediate postdoctorates. This provides opportunities for studying the practices and dilemmas of novice supervisors, which should eventually support supervisors in attempts to deliberately enhance student learning. Third, the research projects conducted by students in the bachelor and master phase have similar learning goals, namely to promote student research competencies, for example, their critical and scientific thinking. The duration of research projects conducted during the two phases of medical education may differ, although all students individually undertake similar research activities (e.g., conducting a literature search, formulating research questions, writing and conducting a research plan and writing a research report). Chapter 5 aims to answer the following research questions:

- How do supervisors foster student learning in students' research projects in medical bachelor and master education and what is the relation between research supervision practices and the dilemmatic space in which novice supervisors negotiate research supervision?

In Chapter 6, the main findings and conclusions of the four studies are summarised, discussed and related to each other. Moreover, suggestions are made for further studies and the practical implications for teaching in higher education in general and medical education specifically, are described.

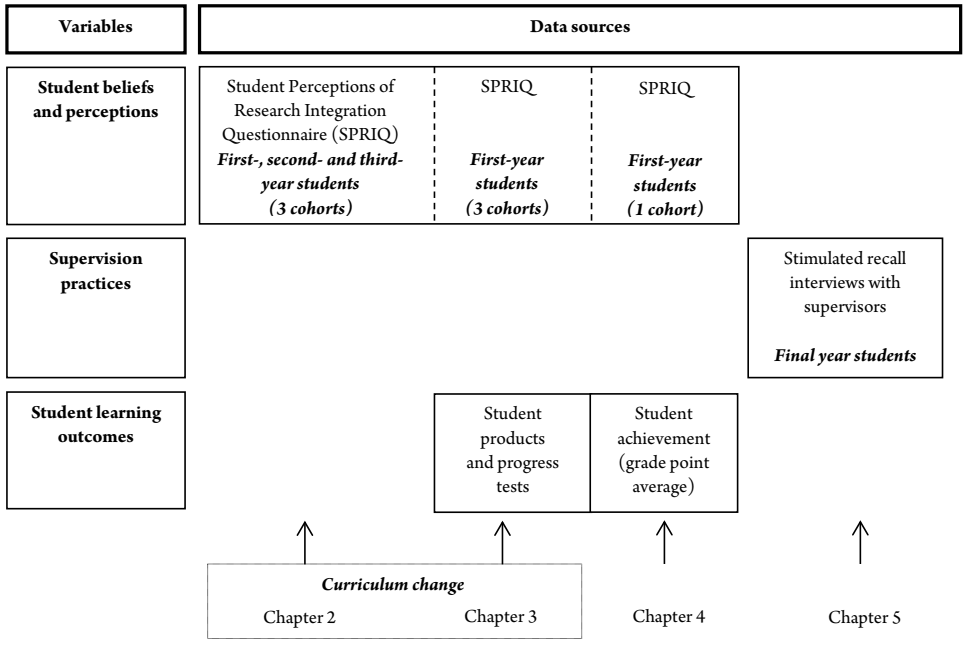
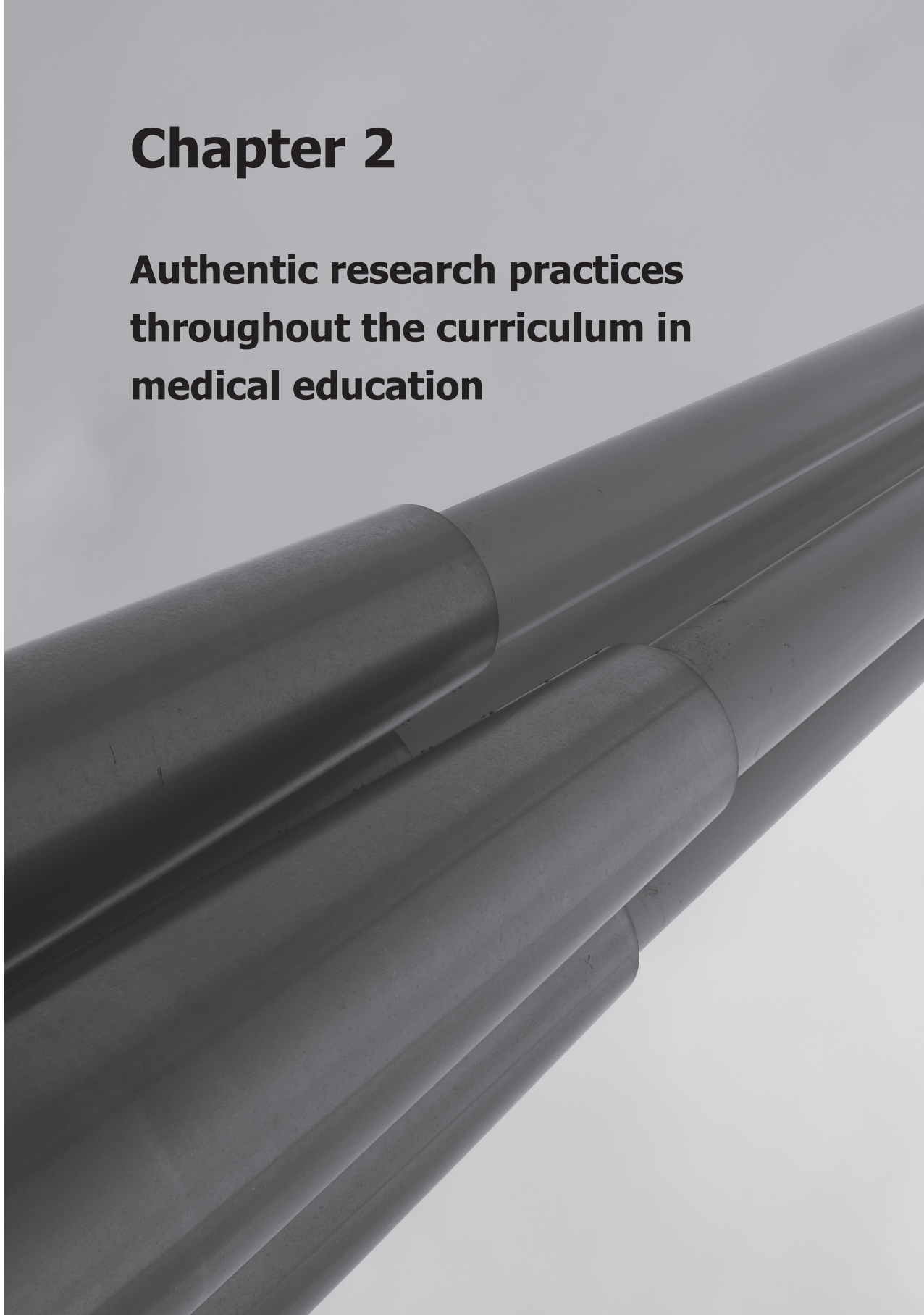


Figure 1.1. Overview of the studies at the programme level (Chapters 2 and 3) and the level of teaching and learning (Chapters 4 and 5).

Chapter 2

Authentic research practices throughout the curriculum in medical education



2. Authentic research practices throughout the curriculum in medical education.

Interest in integrating research into university teaching has been growing in higher education worldwide in recent years. Findings from previous studies indicate that opportunities for students to participate in research practices can promote student beliefs regarding the importance of research within their field. Yet, making research accessible to students is not a straightforward process. This study aims to assess the influence of authentic research practices on medical undergraduates' perceptions of research and their beliefs regarding the relevance of research to professional practice. A longitudinal study was conducted in the context of a curriculum change that aimed to strengthen the integration of research into teaching. To investigate the influence of authentic research practices, three successive cohorts of undergraduates participated in this study. In total, 941 students completed the Student Perceptions of Research Questionnaire. Our findings suggest that research practices within professional contexts not only promote student participation in research and motivation for research, but also foster the belief that research is relevant for learning. It is suggested that in order to foster student learning about research in hard-applied disciplines, it is beneficial to strengthen the integration of research, teaching and professional practice. Furthermore, we highlight the implications for further research as well as teaching practice aimed at fostering student beliefs about the value of research for professional practice.

This chapter was submitted in an adapted form as:
Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H , & Dekker, F.W. Authentic research practices throughout the curriculum in medical education: Student beliefs and perceptions.

2.1 Introduction

Interest in integrating research into study programmes has been growing in university education internationally in the recent decades (Brew & Mantai, 2017; Healey & Jenkins, 2009; Visser-Wijnveen, van der Rijst, & van Driel, 2016). A recent trend towards student involvement in research through learning activities has placed an emphasis on those activities that enable students to experience research within their field (Brew & Mantai, 2017; Healey & Jenkins, 2009; Hu, van der Rijst, van Veen, & Verloop, 2014). Findings from previous studies suggest that opportunities for students to engage in authentic research practices can, under conditions of good teaching, promote student reflections on the meaning of knowledge construction in their field (van der Rijst, 2017; Visser-Wijnveen, et al. 2012; Wald & Harland, 2017). Yet, engaging students in authentic research practices through undergraduate teaching in such a way as to make research visible and accessible to students is not that unambiguous (Brew & Mantai, 2017; van der Rijst, Visser-Wijnveen, van Driel, & Verloop, 2013; Visser-Wijnveen, et al. 2012). Our study hence aims to further our understanding of student perceptions of research and their beliefs regarding the relevance of research to learning and practice in relation to authentic research practices within the learning environment. A better understanding of student perceptions of research, beliefs and authentic research practices is important for those who aim to strengthen the role of research in teaching and learning. The results from this study can inform initiatives for fostering research-teaching integration in order to promote student learning within higher education institutes.

2.1.1 Authentic research practices

In this study the term 'authentic research practices' is used to indicate that learning activities reflect research practices within the discipline and to indicate that open-ended learning activities incorporating research are placed within the context of future use of research in professional practice. Examples of authentic research practices can be found, for instance, in science education, indicating that such learning activities are closely aligned with the way scientists do their work as

opposed to strongly guided science laboratory exercises (Crawford, 2015, p. 113). The term 'authentic research practices' was chosen to emphasise how research incorporated in learning activities mirrors the 'real world', especifically the way in which research is used in professional settings (Herrington & Herrington, 2006; Wald & Harland, 2017). Authentic research practices as defined in this study are different from pedagogies incorporating research into student learning, for example, problem-based learning and inquiry-based learning, which instead focus on an inquiry-based approach to knowledge application and exploration of subject matter (e.g., Savin-Baden, 2000; Spronken-Smith, Walker, Batchelor, O'Steen, & Angelo, 2012).

Our study was conducted within the medical discipline. Most medical students go on to work as practitioners rather than scientists; therefore, authentic research practices are important for fostering student learning about the use of research in clinical practice (e.g., CanMeds, 2015; GMC, 2015; NFU, 2008). The medical discipline was chosen as an example of a hard-applied discipline, in which knowledge construction can be characterised by a relatively high consensus concerning paradigms, research content and methods (Becher & Trowler, 2001; Biglan, 1973). Furthermore, medical research mainly focuses on applied, patient-related problems (Becher & Trowler, 2001; Biglan, 1973). The term 'authentic research practices' is hence used in this study to indicate that the research practices are intended to promote student learning and reflect ways in which knowledge is produced and communicated within professional settings in medicine.

Previous studies into authentic learning, such as those conducted within communities of practice, have indicated that learning activities refer to the real professional world by simulating the context of the future use of knowledge or by placing knowledge within the original context of future use (e.g., Barab & Duffy, 2000; Vos, 2011). Furthermore, most learning activities will involve elements that are widely recognisable as originating from original professional practice (e.g., Vos, 2011). When describing authentic research practices, the focus is thus on the authentic aspects rather than on identifying research practices as authentic as a whole. Findings from previous studies have resulted

in the construction of frameworks characterising the components of authentic learning activities (Newmann & Wehlage 1993; Renzulli, Gentry, & Reis, 2004; Rule, 2006). Findings from Rule's (2006) review study have recently been used in higher education to bridge a gap between student learning activities within the classroom and in professional settings by revealing four factors that promote authenticity in learning activities (Diamond, Middleton, & Mather, 2011). First, authentic learning experiences are promoted by student engagement in real-world professional problems that target a real professional audience. Second, the learning activities should provide opportunities for students to practise their thinking skills. Third, authentic learning experiences enable discourse amongst a community of learners. Fourth, enhancing authenticity should encourage students to direct their learning in accordance with their own interests (Rule, 2006). In the present study we use this framework to focus our description of research practices on authentic aspects of the learning activities.

2.1.2 Student perceptions and beliefs

Student perceptions of the learning environment influence learning experiences as well as their learning outcomes and they can also mediate student behaviour (Biggs, 1985; Ellis, 2016; Pajares, 1992; Ramsden, 1991). Previous studies investigating the role of research within teaching in general have emphasised student perceptions of research in teaching in order to promote various learning outcomes, including research dispositions, research skills and awareness (Visser-Wijnveen, et al. 2012; also see Chapter 4). Yet, it can be difficult for students to perceive research as being integrated into teaching. Further, teachers may consider undergraduates in particular to be intellectually immature or not yet 'open' to research (Brew & Mantai, 2017; Zamorski, 2002). However, findings from previous studies suggest that undergraduates do perceive the benefits and disadvantages of the integration of research into teaching (Healey, Jordan, Pell, & Short, 2010; Lindsay, et al., 2002; Neuman, 1994). Examples of benefits are perceptions of the staff's enthusiasm for research within departments, participation in research and reflections on research products (Neumann, 1994; Robertson & Blackler, 2006; Turner, Wuetherick, & Healey, 2008; Visser-

Wijnveen, et al., 2016). Nevertheless, a strong focus on the research interests of staff may lead to narrow representations of the field at the expense of students' own interests (Healey, et al., 2010; Lindsay, et al., 2002; Neumann, 1994). Student perceptions of research in teaching can be influenced by their beliefs regarding, for example, the purpose of university teaching (e.g., Pajares, 1992; Robertson & Blackler, 2006). In this study, therefore, data is gathered on student perceptions of research integrated into teaching as well as student beliefs regarding the relevance of research to learning and professional practice.

The literature is ambiguous in terms of the influence of year of study on student perceptions and beliefs about research. Previous studies have provided point-in-time snapshots of student perceptions of research in the learning environment in a variety of disciplines and they suggest that there is no relation between the year of study and perceptions of research (van der Rijst, Visser-Wijnveen, Verstelle, & van Driel, 2009). These findings indicate that student perceptions of research remain stable regardless of the research practices employed in the learning environment, while student beliefs regarding the relevance of research integrated into student learning can become stronger over the years of study (Lindsay, et al., 2002; Neumann, 1994). However, Verburgh and Elen (2011) found that first-year students report more positive beliefs regarding research. Furthermore, previous studies into authentic research practices within study programmes have mainly focused on teaching in one-to-one settings, such as supervision in students' research projects or teaching in small group settings (e.g., Wald & Harland, 2017; Gardner, Forrester, Jeffrey, Ferzli, & Shea, 2015; Sadler, Burgin, McKinney, & Ponjuan, 2010). This large-scale study aims to contribute to the knowledge base by providing a longitudinal view of student perceptions and beliefs regarding research in relation to authentic research practices in undergraduate medical education.

2.1.3 Research aim

The aim of this study is to describe the influence of authentic research practices on student perceptions of research and student beliefs regarding the relevance of research to learning and practice. This large-scale longitudinal study was conducted in the context of a curriculum change within the medical domain, which serves as an example of a hard-applied discipline (Biglan, 1973). Furthermore, this study provides a longitudinal perspective on student perceptions and beliefs regarding research by focusing on a three-year undergraduate medical education programme. First, we describe characteristics of authentic research practices within the study programme. Second, we focus on relations between authentic research practices, student perceptions of research in teaching and student beliefs regarding the relevance of research for practice and learning. Results from this study will be of importance to teachers and academic developers who aim to strengthen the connections between research, teaching and student learning within higher education.

2.2 Educational context: the undergraduate medical programme and student research practices

Undergraduate curricula provide a space for strengthening the role of research within teaching, especially when the curricula reflect research processes and practices in the discipline (e.g., Fung, 2017; Healey & Jenkins, 2009). Findings from studies into research integrated into curricula indicate that fruitful integration relies on the use of a well-considered variety of approaches. These approaches may be based on students' roles in learning activities incorporating research, the chosen focus or topics for fostering student understanding of research, recent research conducted within institutes and the desired student learning outcomes (e.g., Healey & Jenkins, 2009; Verburgh, Schouteden, & Elen, 2013; Zimbardi & Myatt, 2014). This large-scale study was conducted in the context of a curriculum change that aimed to strengthen the integration of research into teaching through authentic research practices. The curriculum change involves all three years of undergraduate medical education at the Leiden University Medical Center (LUMC), which is part of the oldest research-intensive university in the Netherlands.

Academics employed at LUMC are responsible for patient care, research and teaching. The medical undergraduate programme is structured into a bachelor and master's phase. During the three-year bachelor phase students attend patient interviews in addition to attending predominantly theoretical classes augmented by learning activities in small groups. The master's phase consists of clinical placements and a final-year student research project with a minimum duration of twelve weeks. In both phases students are taught by academic staff who are involved in medical scientific research, clinical care and teaching undergraduate courses. Every academic year 330 students, with an average age of 19 years, start studying medicine at the LUMC. The students participating in this programme were admitted to medical education through a weighted lottery procedure based on their grade point average in secondary education until 2014. Students with a high GPA are more likely to be admitted to the programme. From the academic year 2012-2013 onwards, a curriculum change was gradually implemented starting from the first year of study.

Below we describe students' research practices within the previous and changed curriculum, based on course materials such as the online study guide (LUMC, 2017), study materials available to students (i.e., module books) and the experiences of the first and fourth authors, since both were involved in the development and implementation of student research practices in the changed curriculum. The fourth author is a teacher and coordinator of the student research practices. Table 2.1 summarises authentic elements of the student research practices per year of study in the previous and changed curriculum using the characteristics of authentic learning activities as identified by Rule (2006). The research projects conducted during the first and third year were developed within the changed curriculum. The second-year project was a component of the previous curriculum but, since it fits with the aim of the curriculum change, namely to strengthen the integration of research into teaching, it was kept.

When following the changed curriculum, first-year students participate in a small research project related to an early clinical experience in nursing homes. This three-week clinical internship takes place in September, just after the start of the academic year. As part of this project, every student collects data on three patients. In January, during a two-week course on scientific research skills, the students practise formulating a research question and they learn to understand the structure of a research paper in a small-group setting. The students attend lectures on epidemiology, basic statistics as well as a practical in simple data analysis. The students then analyse their data to answer their own research question using the aggregated dataset. They write a two-page research report and present their findings to their peers in a small group session. When designing this project, epidemiology teachers collaborated with primary care teachers.

During the second year of study for both curricula, the students participate as researchers in a three-week course that aims to describe the evidence base of drug advertisements in professional journals for general practitioners through the critical appraisal of the underlying scientific papers (Janmaat, et al., 2013). Again, in small-group sessions, the students apply disciplinary guidelines (Guyatt, Cook, Devereaux, Meade, & Strauss, 2002) in order to learn how to critically appraise research literature. After the small-group sessions the students individually read and appraise a paper. All the students are offered training in different study designs and the basics of statistical data analysis and are given integrated presentation skills training on presenting the results of a research study to peers (cf. simulation; Radinsky, Bouillion, Leton, & Gomez, 2001). This second-year research practice is developed by epidemiology teachers and teachers specialising in academic writing.

Third-year students' research practice is directly related to clinical practice. The students conduct a literature review with the aim of improving the treatment or diagnosis of a specific patient problem under the supervision of a resident. To do this, they use a disciplinary template that is known as a 'critical appraisal of a topic' (CAT; de Brouwer, Mommers, van Gool, Ferreira, & Kant, 2009). The patient problem is formulated by a specialist in training who also individually supervises the students; in this way every student works on an authentic problem. The duration of this project is five months and the students are also simultaneously enrolled in other teaching units simultaneously during those months. At the end of the project, the students present their piece of advice within their clinical department. They also hand in a written CAT report for grading.

Table 2.1. Description of authentic research practices within medical education per year of study (cf. Rule, 2006).

	Student engagement with real-world professional practice	Opportunity for practicing thinking skills	Discourse among learners	Element of students' choice directing learning
First year: Nursing homes (Changed curriculum)	Students participate in internship; research element is an 'add-on'	Formulating research question; practical research skills	Students collaborate in pairs; two small-group sessions	Variables in research question within limited set of variables
Second year: Drug advertisements (Previous and changed curriculum)	In 'ideal' professional practice; simulation	Practicing critical appraisal of research literature	Individual assignment; one small-group session	Research papers are assigned to students
Third year: Critical appraisal of a topic (Changed curriculum)	Students indirectly contribute to real-world patient care	Critical appraisal of research literature; scientific reasoning in a clinical context	Individual assignment; discourse between supervisor and student	Topics are assigned to students; students choose own focus within the topic

2.3 Method

2.3.1 Study design

In this study, a comparison is made between two curricula, (i.e., the previous curriculum and the changed curriculum) over a long period of time, that is, the three years of undergraduate education. Three cohorts of medical undergraduate students participated in this study, in which the authentic research practices are described using Rule's (2006) framework for authentic learning activities. Student perceptions of research and beliefs regarding the relevance of research were obtained using questionnaires. A previous curriculum and a changed curriculum, which incorporates more authentic research practices were compared so as to gain insight into effects of the curriculum on student perceptions of research and student beliefs regarding research.

2.3.2 Participants

Three successive cohorts of students were invited to participate in this study, one following the previous curriculum and two following the changed curriculum. The students were enrolled in the medical programme as first-year students in the academic years 2011-2012, 2012-2013 or 2013-2014, respectively. We distributed hardcopy questionnaires to all first, second, and third year students during lectures at the end of the academic year, that is, between April and June from 2012 until 2016. The questionnaires are explained further below. The students had completed their research practices in the months before. The students were asked to complete the questionnaire for all the subjects they had been enrolled for up till that point. They were asked for permission to use their unique student identification number, which meant we could send questionnaires to those students not present at the lecture. A reminder was sent by e-mail to those students who did not respond to the initial invitation. Ethical approval for the study was granted by the LUMC Research Ethics Committee. Not all students completed consecutive questionnaires. Ultimately, 941 students completed the questionnaires at least once during the course of the bachelor programme, while some 228 students completed the questionnaires once per year during their three years of study. In total 322 students following the previous curriculum participated in this study as well as 619 students following the changed curriculum. 72.3% of the students were women, indicating that the sample is representative of the medical student population (van der Velden, Hingstman, Heiligers, & Hanssen, 2008). The students were between 16 and 35 years old in the first-year of their study (n = 796; M = 19.6; SD = 1.72). Some of the students had previous experiences of research (n = 213), for example, extracurricular research as part of prior studies before studying medicine or in pre-university colleges.

Table 2.2. Scales, reliability and sample items of the Student Perception of Research Integration Questionnaire for undergraduates following the previous and changed curricula.

Scales	N items	Sample items during this academic year…	α*
Student perceptions			
Critical reflection on research	4	… attention was paid to research methods.	.83
Participation in research	5	… as a student I felt involved in research.	.88
Familiarity with current research	5	… I became familiar with the research carried out by my teachers.	.83
Motivation for research	4	… I became enthusiastic about research in medicine.	.89
Other			
Beliefs regarding the value of research for practice	6	Scientific skills are important for being a doctor.	.92
Beliefs regarding the value of research for learning	3	… the research culture within the institute stimulates my learning.	.87
Quality of learning environment	3	… the teachers carried out their instruction adequately.	.77

*Cronbach's alpha indicates an acceptable to strong internal consistency of scales (Cohen, 1998).

2.3.3 Instrument and procedure

In order to study undergraduate student perceptions of research within teaching we administered an adapted version of the Student Perception of Research Integration Questionnaire (SPRIQ) (Visser-Wijnveen, et al., 2016; also see Appendices 1 and 2). Adaptations were made to particularly fit the medical context and we added a scale about beliefs regarding the relevance of research for clinical practice. For example, we replaced general item wordings such as 'scientific domain' with 'medicine' (see Chapter 4). The version of SPRIQ adapted for medical education is included in Appendix 1. The scales included student perceptions of teaching via (1) critical reflection on the way research results are produced; (2) research participation as a student; (3) familiarity with current staff research; (4) fostering interest and motivation for research and; (5) student beliefs regarding the relevance of research for learning and (6) perceived quality of the learning environment (see Table 2.2 for sample items). We also added a scale concerning beliefs regarding the relevance of research to clinical practice. All 30 items were answered on an agreement scale, that is, a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The quality scale was included because students' opinions on the general quality of teaching during the academic year could influence their scores on the other scales. Table 2.2 shows the scales, reliability for this sample and sample items of the version of SPRIQ that we used.

The aim of this study, to describe the influence of authentic research practices on students' perceptions of research and their beliefs regarding the relevance of research, guided our attention towards particular scales of SPRIQ. The description of authentic elements of research practices (Table 2.1) puts the emphasis on student engagement with real-world professional practice which should enrich their learning experiences with situational, contextual and cultural information about the use of research. It was expected that authentic research practices would foster student motivation for research. Furthermore, immersing students in research practices in a professional setting may serve to foster their beliefs regarding the relevance of research to practice. All students participated in research activities (i.e., data collection, critical appraisal of literature). The

research practices employed during year two and three were designed to promote critical appraisal of research literature and to foster students' thoughts on the use of research in clinical contexts; therefore, it was expected that student perceptions of critical reflection to increase over the years of study. The authentic research practices might have provided opportunities for students to familiarise themselves with staff research, although this was not a primary goal of the curriculum change. For a similar reason, there were no expectations regarding possible changes in the perceived quality of the learning environment. For example, the quality scale was concerned with teaching quality, while the curriculum change did not focus on professional development initiatives intended to foster individual staff members' approaches to research-teaching integration. Finally, it was not expected that the student beliefs regarding the relevance of research to learning would change, since the authentic research practices were more strongly related to the use of research in a clinical context than to, for example, the culture in which scientific research was conducted within the LUMC. For these reasons, we have reported the students' scores on all scales of the SPRIQ in the results section, although we have highlighted the scores for the students' *participation* in research, *motivation* for research, *critical reflection* on the way results are produced and *beliefs regarding the relevance of research to practice*.

2.3.4 Analysis

To assess the influence of authentic research practices on student perceptions of research over the course of an undergraduate programme, a mixed model approach to a repeated measures analysis of variance (ANOVA) was used. This method of analysis allowed us to include students who had completed the questionnaire once or twice during their undergraduate education. The three time points, one per year of study, were used as the repeated factor and student identification numbers were used as subjects. In order to compare the two curricula, the separate student perception and beliefs scales per curriculum were used as the dependent variables. Due to the large number of students included in this study, an unstructured covariance type was used to estimate six parameters by which the observed and the expected scores for all students were compared.

A confidence interval of 95% was applied for all effects. The results we show are the confidence intervals, indicating the size of the effects (e.g., Seltman, 2015).

In order to compare the student perceptions of research practices in the changed curriculum with the previous curriculum, additional t-tests for independent means were conducted. Again, a confidence interval of 95% was applied for all effects.

2.4 Results

First, the student scores for the SPRIQ scales are shown, namely promoting students' sense of *participation* as researchers in learning activities; fostering student *motivation* for research; and student *beliefs regarding relevance to practice*. Figure 2.1 presents the main results, that is, the student scores on *participation, motivation, critical reflection* and *beliefs regarding the relevance of research to practice* over the years of study, with the scores being plotted for both the previous and changed curricula. Second, the descriptive statistics are presented for all the SPRIQ scales in both curricula in Table 2.3.

With regard to *participation, the* students felt more involved in research during the course of the undergraduate programme, although the scores were less than 3 on a five-point Likert scale (see Table 2.3). The scores regarding *participation* were higher for those studying the changed curriculum [$F(2,292.96) = 58.95$, 95% $CI_{yr3\text{-}yr1}$ [-.70, -.47], 95% $CI_{yr3\text{-}yr2}$ [-.71, -.48]] than for the previous curriculum [$F(2,187.38) = 19.42$, 95% $CI_{yr3\text{-}yr1}$ [-.50, -.24], 95% $CI_{yr3\text{-}yr2}$ [-.18, .08]]. The results for the participation scale indicate that students following the changed curriculum participated more strongly than they had done previously, specifically during the first and third years. This may be explained by the practical, clinical contexts in which the research practices associated with the nursing homes and CAT, respectively, were carried out.

The students' *motivation* for research increased as they progressed through the undergraduate programme when following the changed curriculum [$F(2,305.84) = 19.97$, 95% $CI_{yr3\text{-}yr1}$ [-.35, -.17], 95% $CI_{yr3\text{-}yr2}$ [-.40, -.19]], but not when following

the previous curriculum [$F(2,190.76) = 2.03$, 95% $CI_{yr3\text{-}yr1}$ [-.26, .00], 95% $CI_{yr3\text{-}yr2}$ [-.21, .05]]. When comparing the scale means between the curricula, students following the changed curriculum reported a stronger *motivation* for research in medicine, particularly during the first and third years (Table 2.3).

The mean scores for the perceived *critical reflection* presented in Table 2.3 show that students following the changed curriculum experienced a stronger focus on research processes than those following the previous curriculum from the first year onwards ($M_{difference\ yr\ 1} = 0.33$). Prior to the curriculum change, the student perceptions of *critical reflection* in year one were similar to those in the third year, although they decreased a bit in the second year [$F(2,182.45) = 2.90$, 95% $CI_{yr3\text{-}yr1}$ [-.11, .14], 95% $CI_{yr3\text{-}yr2}$ [-.23, .00]]. After the curriculum change, the perceived *critical reflection* increased slightly over the years [$F(2,327.28) = 34.88$, 95% $CI_{yr3\text{-}yr1}$ [-.42, -.25], 95% $CI_{yr3\text{-}yr}$ [-.22, -.03]].

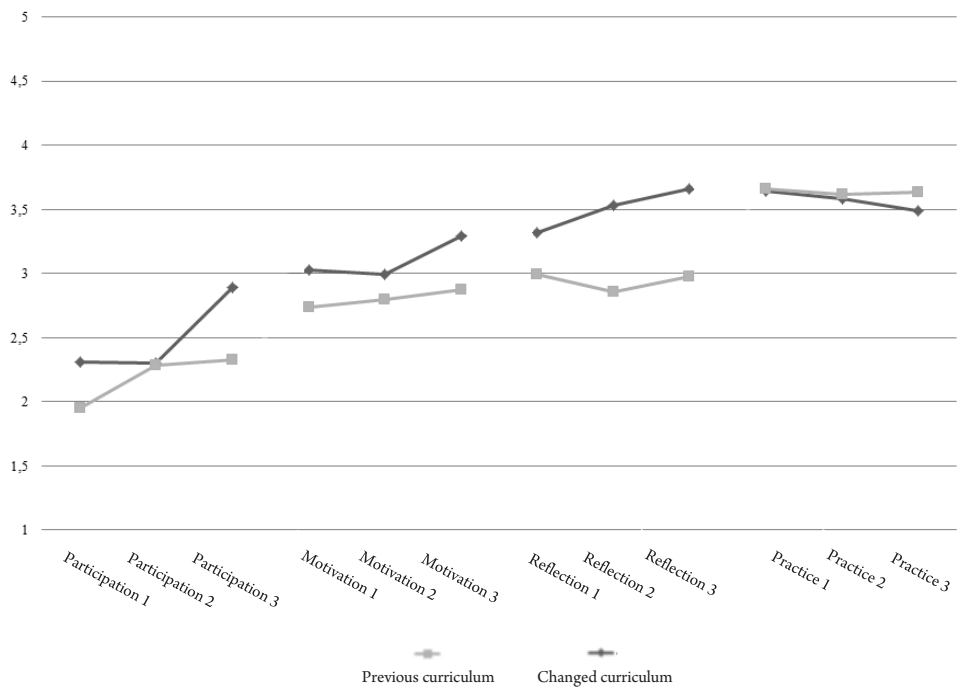


Figure 2.1. Student scores on the scales participation, motivation and beliefs regarding relevance for practice of the Student Perception of Research Integration Questionnaire.

The student *beliefs regarding the relevance of research to practice* decreased slightly from year one to year two following the curriculum change and then increased, while the student beliefs about the relevance of research to practice did not change towards their third year [$F(2,291.02) = 4.81$, $CI_{yr3\text{-}yr1}$ [.05, .23], 95% $CI_{yr3\text{-}yr2}$ [-.01, .18]]. The data concerning the previous curriculum showed a somewhat similar result [$F(2,159.33) = 0.51$, 95% $CI_{yr3\text{-}yr1}$ [-.06, .12], 95% $CI_{yr3\text{-}yr2}$ [-.10, .08]].

Table 2.3 presents the descriptive statistics for all of the SPRIQ scales used in this study. When following the previous curriculum, the student *beliefs regarding the relevance of research to learning* decreased slightly over time [$F(2,117.11) = 0.69$, 95% $CI_{yr3\text{-}yr1}$ [-.07, .19], 95% $CI_{yr3\text{-}yr2}$ [-.05, .19]], while the students following the changed curriculum believed that research was more important for learning towards the end of the undergraduate programme [$F(2,303.73) = 26.27$, 95%

Table 2.3. Descriptive statistics per scale of the Student Perceptions of Research Integration Questionnaire for undergraduates following the previous and changed curricula

	Previous curriculum ($n = 322$)			**Changed curriculum** ($n = 619$)		
Scale	M_{year1} (sd)	M_{year2} (sd)	M_{year3} (sd)	M_{year1} (sd)	M_{year2} (sd)	M_{year3} (sd)
Participation	$1.95^{c,d}$ (.69)	2.28 (.81)	$2.33^{c,e}$ (.84)	$2.31^{a,d}$ (.73)	2.30^{b} (.75)	$2.89^{a,b,e}$ (.83)
Critical reflection	2.99^{d} (.67)	2.86^{e} (.70)	2.98^{f} (.65)	$3.32^{a,d}$ (.62)	$3.53^{b,e}$ (.58)	$3.66^{a,b,f}$ (.61)
Motivation	2.74^{c} (.78)	2.80^{d} (.82)	2.87^{e} (.81)	$3.03^{a,c}$ (.79)	$2.99^{b,d}$ (.87)	$3.29^{a,b,e}$ (.69)
Familiarity	$2.66^{b,d}$ (.68)	$2.89^{c,e}$ (.65)	$3.11^{b,c,f}$ (.63)	$3.06^{a,d}$ (.63)	3.21^{e} (.61)	$3.24^{a,f}$ (.66)
Quality	3.80 (.51)	3.85^{b} (.59)	3.84^{c} (.59)	3.75 (.56)	$3.52^{a,b}$ (.59)	$3.75^{a,c}$ (.59)
Beliefs relevance to learning	3.04 (.80)	3.05^{c} (.82)	2.98^{d} (.88)	3.06^{a} (.81)	$2.89^{b,c}$ (.85)	$3.31^{a,b,d}$ (.88)
Beliefs relevance to practice	3.66 (.67)	3.62 (.73)	3.63^{b} (.72)	3.64^{a} (.73)	3.58 (.76)	$3.49^{a,b}$ (.79)

Means within the same row that share superscripts differ at $p < .05$

$CI_{yr3\text{-}yr1}$ [-.36, -.15], 95% $CI_{yr3\text{-}yr2}$ [-.53, -.30]]. Students consider research to have the least relevance on research to their learning during the second year.

The students who conducted the research activities as part of the changed curriculum felt more *familiar* with their teachers' research from their first to their third year [$F(2,308.04) = 10.85$, 95% $CI_{yr3\text{-}yr1}$ [-.27, -.08], 95% $CI_{yr3\text{-}yr2}$ [-.11, .07]]. When following the previous curriculum the perceived *familiarity with teachers' research* grew gradually [$F(2,201.19) = 28.89$, 95% $CI_{yr3\text{-}yr1}$ [-.57, -.33], 95% $CI_{yr3\text{-}yr2}$ [-.34, -.11]].

Overall, the perceived *quality of the learning environment* was lower when following the changed curriculum than before; the scores for the *quality of the learning environment* decreased somewhat during the second year when compared to the first and third year [$F(2,341.66) = 19.18$, 95% $CI_{yr3\text{-}yr1}$ [-.08, .08], 95% $CI_{yr3\text{-}yr2}$ [-.32, -.14]]. When following the previous curriculum the perceived *quality of the learning environment* was similar from year to year [$F(2,195.53) = 0.76$, 95% $CI_{yr3\text{-}yr1}$ [-.13, .06], 95% $CI_{yr3\text{-}yr2}$ [-.09, -.11]].

2.5 Conclusions and discussion

This study aimed to assess the influence of authentic research practices within undergraduate medical education on student perceptions of research and student beliefs regarding the relevance of research to both learning and practice. In order to achieve this goal, a comparison was made between a curriculum that aimed to strengthen research integration through authentic research practices and a previous curriculum. Authentic elements within the research practices in this study were described based on a framework for authentic learning (Rule, 2006). This enabled us to create a 'post-hoc' image of research practices within the undergraduate curriculum (cf. Healey & Jenkins, 2009; Zimbardi & Myatt, 2014). The data indicates that students' participation in research, their motivation for research, their perceptions of critical reflection on research findings and their familiarity with staff research all increased following the curriculum change. The results suggest that student beliefs regarding the relevance of research to practice

remain stable over the course of their undergraduate education, regardless of the curriculum change. Furthermore, the findings indicate that students believe research to have greater relevance for learning in authentic research practices towards the end of their undergraduate education.

The analyses of the data revealed that students' sense of active involvement in research and their motivation for research increased modestly towards the end of their undergraduate medical education. Differences found between the curricula with regard to student participation in research and student motivation for research can be explained by the roles that the students played in the authentic research practices. All the research practices actively engaged students in either using or doing research in a clinical, professional setting. This is in line with findings from previous studies into research integrated into teaching which indicate that the students' role, on a dimension from observing to participating in research, is a defining characteristic of learning activities incorporating research (e.g., Healey & Jenkins, 2009). The students who participated in this study were involved in learning activities in medicine. The findings of this study indicate that, in the case of the hard-applied disciplines, the integration of research into student learning activities can benefit from connections with professional practice in diverse settings. Furthermore, the results indicate that a curriculum that includes authentic research practices can promote student motivation for research from the first undergraduate year onwards.

Previous studies concerning students' learning experiences in relation to research in university teaching suggest that students experience both tangible and intangible aspects of research (Neumann, 1992; 1994). Tangible aspects of research-teaching integration involve, for example, the promotion of research skills, while the intangible aspects involve fostering enthusiasm and curiosity (e.g., Neumann, 1994). The findings of this study indicate that, by participating in authentic research practices, the students perceived both tangible (i.e., participation) and intangible (i.e., motivation, critical reflection) connections between research and teaching. The research practices associated with the drug advertisements during the second year and the CAT during the third year were especially designed to foster critical reflections on the research literature. The

data also suggests that the teachers found ways to familiarise students with their own research. Furthermore, the findings indicate that students may perceive a decrease in the quality of teaching within a curriculum designed to integrate real-world research activities into teaching, which in this case, happened during the second year. This implies that the relatively new curriculum could have affected coherence within the study programme due to the unclear expectations of both teachers and students at the time of implementation (e.g., van den Akker, 2003). At the same time, the items from the teaching quality scale were quite generic for the purpose of this study, since they were intended to assess the influence of authentic research practices on student perceptions of research within the study programme.

The student beliefs regarding the relevance of research to professional practice remained stable during the course of their undergraduate education. The findings suggest that the importance placed by students on research in relation to practice is less malleable than their perceptions of research in relation to teaching, which depend more strongly on the curriculum. Our data show that student beliefs regarding the value of research for learning became stronger after the third-year CAT, which indicates that their beliefs regarding the value of research for learning might change over a longer period of time. Previous studies into student beliefs have suggested that beliefs are relatively stable in nature and reflection on one's own beliefs can be fostered through, for example, a reflection on previous learning experiences (Mezirow & Associates, 2000; Pajares, 1992). Based on our findings we suggest that the effectiveness of authentic research practices, in terms of fostering student beliefs about the importance of research for learning, can be enhanced by continuous attention being paid to integrating research into the study programme. This can be achieved, for instance, by adopting a programmatic approach to the implementation of authentic research practices. In line with this, it might be beneficial for future research and teaching to focus on learning activities which allow students to relate their learning experiences to their beliefs regarding research in practice in order for students to connect rather individual pieces of knowledge about the use of research in medical professions.

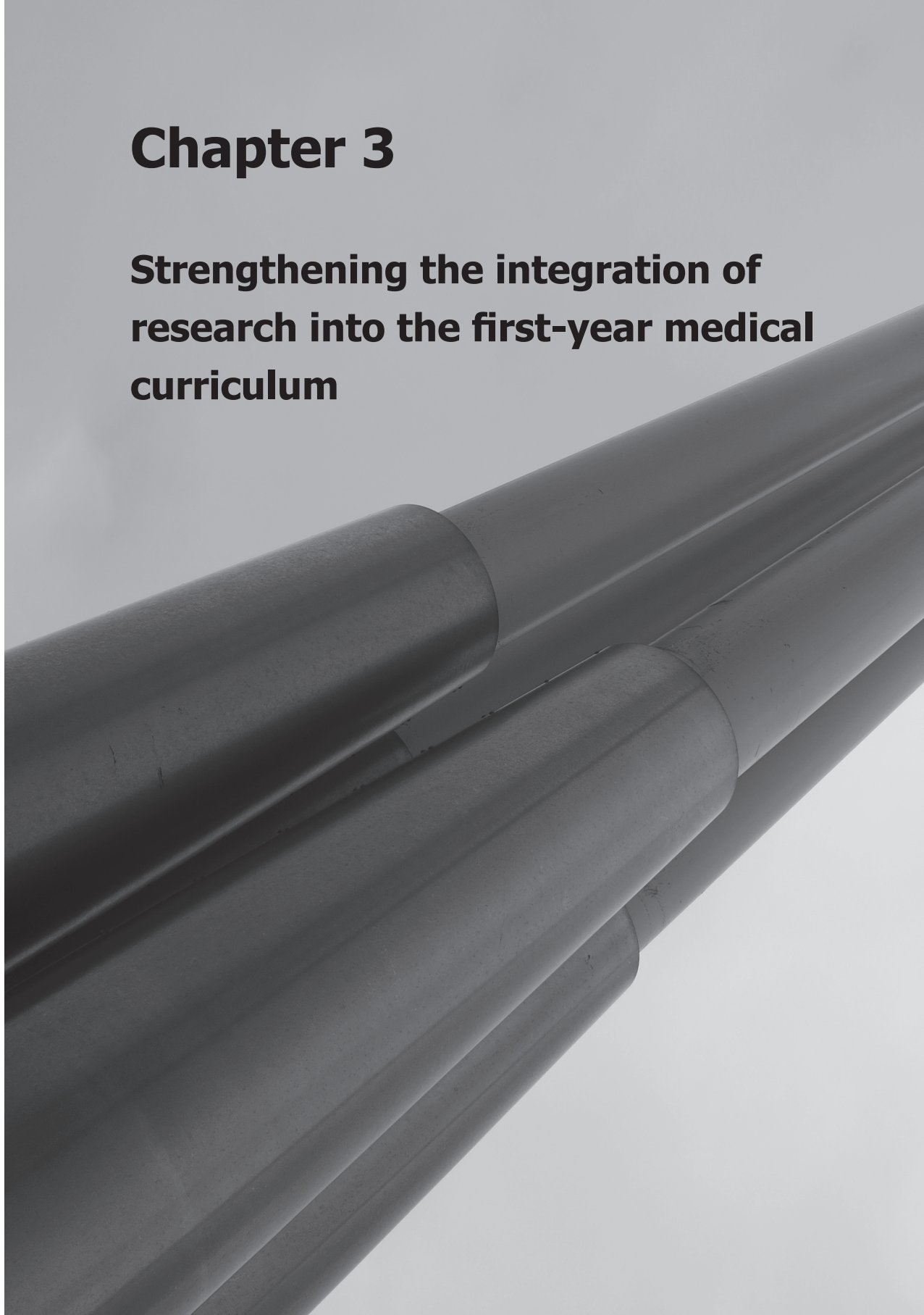
Questionnaires were used in this study in order to obtain information about student perceptions of research and beliefs regarding the value of research within a large-scale, three-year undergraduate programme. Student perceptions of the learning environment represent a valuable source of information for those involved in strengthening the integration of research into study programmes. Student beliefs function as a lens through which they perceive the learning environment (e.g., Pajares, 1992) and student perceptions of the learning environment can foster learning outcomes (Biggs, 1985; Lizzio, Wilson & Simons, 2002; Prosser & Trigwell, 2014). We suggest that future studies into student perceptions and beliefs regarding research could benefit from further exploration of relations between beliefs, perceptions and student learning outcomes. The use of a questionnaire as part of a longitudinal study design was considered most appropriate due to the scale of the study programme and the curriculum change. Not all the students completed the consecutive questionnaires, which is typical for longitudinal studies. In order to encourage students to participate, all students within the study programme were invited to participate both in class and via email. Furthermore, the method of data analysis was deliberately chosen in order to include all the completed questionnaires.

The description of authentic elements within the research activities highlights student engagement in real-world professional practice. In this case, the first- and third-year research practices stand out, since both were conducted in a clinical professional context. The research practice in the second year was different, since its central goal was to critically appraise research literature in a classroom setting as opposed to conducting research activities in a clinical setting. The description of authentic elements in all three research practices suggests that further exploration of the discourse among learners, either in small-group settings or informally in professional practice could promote authenticity in research activities. Furthermore, student learning could benefit from students being provided with opportunities to follow their own interests, for example, by involving them in the selection of research papers and patient problems within the described research practices.

The results of this study support previous research findings in suggesting that integrating research, in ways that resemble research activities in professional contexts in one of the hard-applied disciplines is effective from the first undergraduate year onwards (cf. Brew, 2010; Spronken-Smith, Mirosa, & Darrou, 2014; Zamorski, 2002). The findings of the present study further suggest that strengthening the role of research in teaching through authentic research practices fosters student participation in research, stimulates students' enthusiasm for research and focuses attention on the ways in which research findings are produced. The findings also indicate that authentic research practices can offer ways for teachers to familiarise students with staff research. In addition, our results suggest that students find research practices that incorporate the use of research in professional practice to stimulate their learning particularly towards the end of the undergraduate programme.

Chapter 3

Strengthening the integration of research into the first-year medical curriculum



3. Strengthening the integration of research into the first-year medical curriculum.

The integration of research into the undergraduate study programme is important in order for medical students to understand and value research for their later clinical practice. Therefore, attempts are being made to strengthen the integration of research into teaching during the first undergraduate year and beyond. However, first-year students may interpret attempts made to strengthen research integration differently than expected by their teachers. This difference might be explained by student beliefs regarding learning and research as well as student perceptions of the learning environment. In general, student perceptions of the learning environment play a pivotal role in fostering student learning outcomes. This study aims to determine whether a curriculum change intended to promote the integration of research into the study programme fosters student learning outcomes and student perceptions of research integrated into teaching. To serve this purpose, three subsequent cohorts of first-year students were compared, one before and two after a curriculum change. Learning outcomes of these students (n = 921) were measured using their scores on a national progress test and assessments of a sample of 100 research reports produced as part of the first-year student research projects. Some 746 students filled out the Student Perceptions of Research Integration Questionnaire. The findings suggest that the learning outcomes of these students, that is, their scores on research related test items of the progress test and the quality of research reports, were better than those of students prior to the curriculum change. Moreover, the students perceived a stronger research focus in the curriculum.

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3.1 Introduction

The promotion of undergraduate students' understanding of research is an important aim of medical education worldwide (Association of American Medical Colleges [AAMC], 1998; CanMeds, 2015; GMC, 2015). It puts emphasis on strengthening the integration of research into teaching in undergraduate medical education, for example, through curriculum interventions to promote students' understanding of research (Mullan, Weston, Rich, & McLennan, 2014; Pruskil, Burgwinkel, Georg, Keil, & Kiessling, 2009). Medical students consider the integration of research into their study programme to stimulate their learning process (Murdoch-Eaton, et al., 2010), although such students might be less enthusiastic about strengthening that research integration by means of conducting their own research projects. Indeed, previous studies have emphasised students concerns about research endeavours that could delay the completion of their medical education (Funston, et al., 2016; Siemens, Punnen, Wong, & Kanji, 2010). Medical teachers are therefore challenged to explicate research in all their teaching in order for students to understand and value research in relation to routine clinical practice, not just for physician-scientists (Laidlaw, Aiton, Struthers, & Guild, 2012; Ribeiro, Severo, Pereira, & Ferreira, 2015). The aim of this study is to determine the effects of strengthening research integration into teaching on student learning outcomes and student perceptions of research within undergraduate education among large cohorts of students. The term 'research integration' is used to refer to all learning activities in which the fostering of student engagement in research findings and research processes is an essential part of first-year undergraduate courses in the medical domain (cf. Healey & Jenkins, 2009).

Several studies already highlighted the importance of strong research integration for student learning. Research integration, for example in students' research projects, traditionally takes place towards the end of the undergraduate medical study programme (de Oliveira, Luz, Saraiva, & Alvez, 2011; Oliveira, et al., 2013; Siemens, et al., 2010). First-year students in particular might find it difficult to experience aspects of research in courses within their undergraduate

education in a way that influences their learning outcomes (Burgoyne, O'Flynn, & Boylan, 2010; Oliveira, et al., 2013). Additionally, teachers may feel that first-year undergraduates in higher education are not yet 'open' to research (Zamorski, 2002). Furthermore, first-year students see themselves as an audience for research rather than considering themselves to be involved in knowledge production (Jenkins, Blackman, Lindsay, & Paton-Saltzberg, 1998). First-year students have positive expectations about doing research later in their degree (Smith & Rust, 2007). However, students also report disadvantages of research being integrated into teaching, such as staff needing to overcome their own challenges when dealing with teaching and research responsibilities (Healey, Jordan, Pell, & Short, 2010). Thus, first-year students may interpret the efforts made by teachers to explicate research differently to what their teachers intended (e.g., van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013). The present study therefore compares cohorts of first-year students when research is more prominently incorporated into undergraduate courses using student perceptions of research integration and student learning outcomes as concepts.

The integration of research into undergraduate courses can take different forms based on two dimensions (Healey & Jenkins, 2009). The first dimension concerns the focus of the research elements that are integrated into courses and it extends from research processes (e.g., data collection and analysis in regular courses) to the research content (e.g., focus on student understanding of research findings through coursework). The second dimension describes the extent to which students are actively engaged in research through their courses and it extends from students involved as an audience for research to students involved as participants in research in the sense that students engage in research activities during their courses. These dimensions result in four basic ways in research can be integrated into courses (see Figure 3.1).

It has previously been argued that these different ways to integrate research complement each other in order to promote student perceptions of research and perceived student learning outcomes (Healey & Jenkins, 2009).

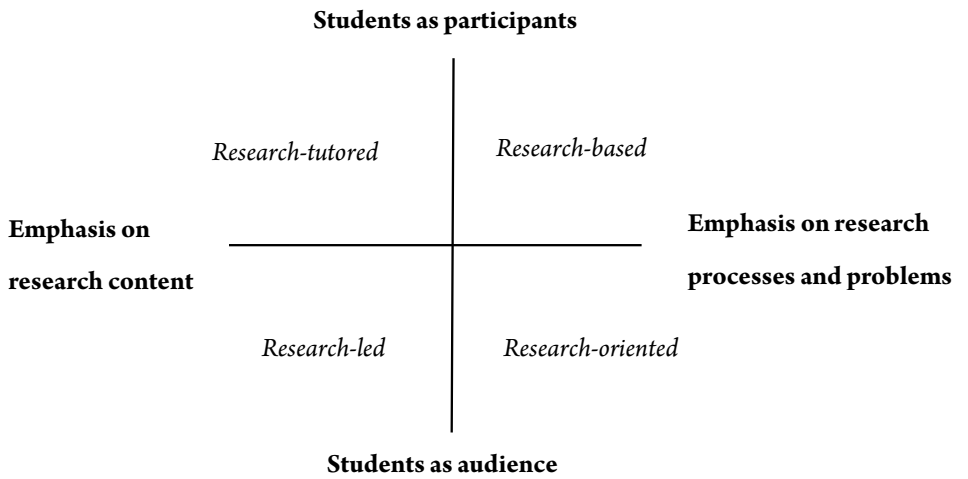

Figure 3.1. Two dimensions describing the integration of research into undergraduate courses (Healey, 2005).

3.1.1 Relationships between student learning outcomes, beliefs and perceptions

Constructivist models of student learning in higher education from the field of educational psychology show that student perceptions of the learning environment play a pivotal role in promoting their learning outcomes (Biggs, 1985; Prosser & Trigwell, 1999). Student perceptions can provide a valid and reliable image of the learning environment, since students have extensive experience of making observations during their school careers (Marsh & Roche, 1997; Spooren, Brockx, & Mortelmans, 2013). Positive perceptions on the part of students directly influence their level of achievement, including learning outcomes such as skill performance and motivation for learning (Lizzio, Wilson, & Simons, 2002). These models of student learning suggest that the relationships between learning outcomes and student perceptions of teaching are reciprocal. Thus student perceptions of the effectiveness of teaching facilitate effective learning and vice versa (Ramsden, 1991), even during the first undergraduate year (Prosser & Trigwell, 2014).

Student perceptions of the learning environment are related to student beliefs regarding learning. Such beliefs are generally referred to as a set of (partly implicit) suppositions, or as a lens through which students interpret the world, and they are considered to remain relatively stable over time and courses (Pajares, 1992). In addition to student beliefs, various elements of the learning environment itself and their prior learning experiences also influence student perceptions of the learning environment (e.g., Ashwin & Trigwell, 2012). In the present study we were primarily interested in student learning outcomes and student perceptions of research. However, student beliefs were still taken into account in order to allow our results to be interpreted sensibly. This was particular true in the case of explaining student learning outcomes and perceptions by means of changes in the learning environment.

Undergraduate medical students in their penultimate year of study might hold a belief that research is only of limited value to their learning process during clinical rotations, although their perceptions of research could change after participating in a research project (cf. Murdoch-Eaton, et al., 2010). Findings from a recent review study suggest that students, after completing a research experience, recognise the importance of research for their future career path (Chang & Ramnanan, 2015). In terms of their learning outcomes differences were found among students' interpretations of what research entails and the skills perceived to be involved in research (Bierer, Prayson, & Dannefer, 2015; Murdoch-Eaton, et al., 2010). Undergraduate medical students' interpretations of research may be focused on hypothesis testing, knowledge production, data collection and discovering new things (Burgoyne, et al., 2010). Extending the approach of previous studies, this study focusses on conceptually related variables (i.e., student learning outcomes, beliefs regarding the value of research for learning and student perceptions of research) in the context of strengthening research integration from the first-year onwards.

Two research questions are addressed in this study. First, what is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student learning outcomes, especially student products and test scores within the domain of research? Second, what is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning?

3.2 Educational context

Our study was conducted at the Leiden University Medical Center (LUMC) in the Netherlands. Staff members at the LUMC are responsible for patient care, research and teaching. Every academic year, some 330 students start studying medicine in the LUMC. The undergraduate medical programme was structured in a two-cycle model (Patrício & Harden, 2010). A weighted lottery procedure based on students' grade point average (GPA) in secondary education was used to govern first-year student admission for all cohorts included in this study. Students with a high GPA are more likely to be admitted to the programme.

A curriculum change was implemented in the first cycle from the 2012-2013 academic year onwards. A timeline of the curriculum change is presented in Figure 3.2. Prior to the 2012-2013 academic year, the first-year curriculum (i.e., the previous curriculum) was predominantly based on theoretical classes augmented by learning activities performed in small groups. The aim of the curriculum change was to strengthen the integration of research into the undergraduate programme as was described in Chapter 2. The changes made to the curriculum design were informed by the integration continuum, which features, full integration at one end and discipline-based education at the other (Harden, 2000). In this study, the previous curriculum is considered to be 'harmonised' in the sense that the teachers consulted each other and communicated about their courses. However, the changed curriculum can be classified as 'multi-disciplinary', since clearly identified subjects were brought together in a single course that featured an integrated theme, with the aim being to provide authentic learning experiences (Harden & Laidlaw, 2012; also see Chapter 2). In the changed curriculum teachers from the basic sciences and clinical disciplines were brought together

to collaboratively develop courses. The duration of the courses was between two and five weeks and the courses were developed within separate disciplines. The assessment of students took place at the end of a course mainly by means of a multiple-choice question examination. After the 2012-2013 academic year the changed curriculum (version 1.0) was evaluated by both students and teachers. As a result, minimal adaptations were made in order to improve student learning experiences, for instance, improving the spread of the study load (version 1.1). The previous and changed curricula were developed according to the Dutch Blueprint (NFU, 2009). This study was designed to allow for a comparison between student learning outcomes within a curriculum that uses strategies to foster harmonisation and a curriculum aiming to promote multi-disciplinary strategies in order to strengthen research integration.

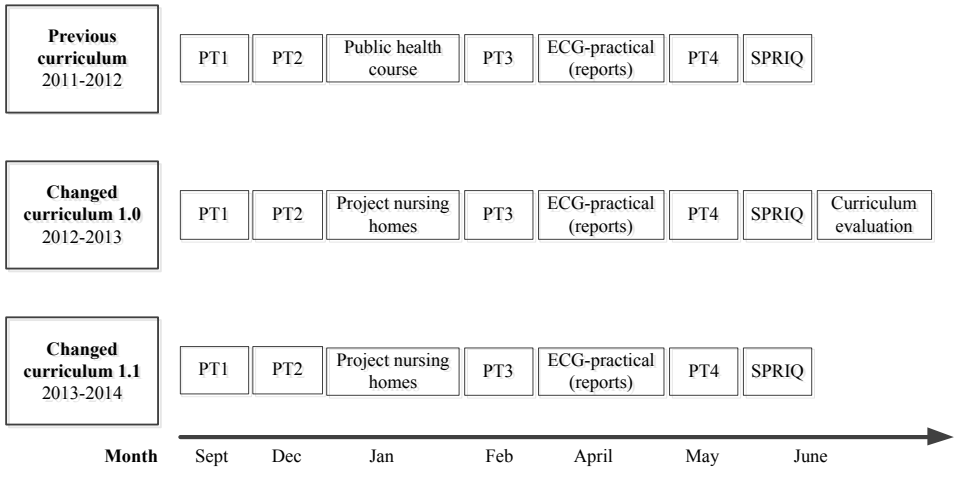

Figure 3.2. Timeline of the curriculum change including progress tests (PT), student research activities and the Student Perception of Research Integration Questionnaire (SPRIQ).

3.2.1 Fostering the integration of research into the study programme

In terms of research integration, the curriculum change aimed to promote the authenticity of student learning experiences (see Chapter 2). In particular, a classical three-week course on public health, epidemiology and biostatistics contained within the previous curriculum was replaced by a small student research project for all students in the context of an early clinical experience in nursing homes (cf. Dekker, et al., 2009) (see Figure 3.2). A more detailed description of this research project can be found in section 2.2. All the students were actively involved as participants in research, since they conducted their own research project as a learning activity (cf. Healey & Jenkins, 2009).

In both curricula, the students also participated in a practical in April in which they collected electrocardiographs (ECGs) of their peers, formulated a research question, analysed the data and present findings. The emphasis was on the promotion of student understanding of study designs, statistics as well as written and oral presentation of findings. The students also wrote a short research report during a small-group session. The ECG-project had been developed to incorporate research more explicitly, so it was maintained with only minimal adaptations. Student instruction in this course was extended by one small-group session involving peer feedback on academic writing.

In addition, all the teachers were encouraged by a curriculum committee to explicate the links between research and clinical practice within their courses where possible (e.g., Laidlaw, et al., 2012). To that end, the curriculum developers discussed the students' research projects with all the teachers. These discussions compelled teachers to explicate their ideas for strengthening research integration appropriate to their field and course.

3.3 Methods

3.3.1 Data collection and instruments

The cognitive learning goals of the medical programme were tested four times a year using a national progress test (PT) (Muijtjens, Schuwirth, Cohen-

Schotanus, Thoben, & van der Vleuten, 2008). In the Netherlands, staff members from five universities participate in writing test items that cover knowledge across all disciplines and domains relevant to the medical degree. The first PT took place in September, the second PT in December, the third PT in February and the final PT in May (see Figure 3.2). The aim of the PT is to determine the growth of individual student knowledge longitudinally, and hence the PT contributes to more reliable and valid decision making concerning future competence or the retention of knowledge (e.g., Schuwirth & van der Vleuten, 2012). The students' scores for the third (March) and fourth (May) PT during the first year of study were collected. Nine of the 200 items in total per PT reflected the students' knowledge about scientific research and methods and they were assessed in closed format ('true', 'false', 'do not know'). The 'do not know' option is scored as a neutral 0, which is preferred over negative marking in the PT, since this option allows students to avoid a penalty for guessing (McHarg, et al., 2005; Muijtjens, Mameren, Hoogenboom, Evers, & van der Vleuten, 1999). Students scored +1 point for every correct answer, -1 for every incorrect answer and 0 points when they answered 'do not know'. The scores for the PTs were converted to a scale ranging from 0 to 100 for further analysis.

In the ECG-practical, the students wrote an extended abstract as a research report. The reports were rated using a rubric developed especially for this study. The raters were trained during the rubric's development process so as to enable informed decisions to be made about the criteria and descriptors that adequately capture the key aspects of students' performance (e.g., Cook & Hatala, 2016). Two batches of 50 reports were randomly selected (previous and changed curriculum) and they were all blindly and anonymously assessed by six trained raters (an educationalist, an epidemiologist, a paediatrician, a physiologist and two third-year students) on using a grading rubric designed for this study. The rubrics contained 11 criteria and three descriptors (range 0-22) regarding (1) consistency across the introduction, method, results and discussion and (2) the structural characteristics of the text in order to assess the written presentation of the students' research findings (see Appendix 3). The intraclass correlation coefficient (ICC) for the average measure using absolute agreement with six fixed raters was .81, which suggests good interrater reliability (Streiner & Norman, 1995). The average measure was used, since (1) the raters were a random sample of all possible raters and (2) the reports were randomly selected (Shrout & Fleiss, 1979).

3.3.1.1 Student beliefs and perceptions

To measure student perceptions of research integration and student beliefs regarding research the researcher administered an adapted version of the Student Perception of Research Integration Questionnaire (SPRIQ) (see section 2.3.3). The scales include: (1) critical reflection on how research results are produced; (2) student participation as a researcher in learning activities; (3) familiarity with current research done by staff; (4) interest and motivation for research; (5) beliefs regarding the value of research for their learning; (6) beliefs regarding the value of research for clinical practice and (7) perceived quality of the learning environment. All 30 items were answered on a 5-point Likert scale. Table 3.1 presents the scales, reliability and sample items of the version of SPRIQ that was used in this study with this sample.

Table 3.1. Scales, reliability and sample items of the Student Perception of Research Integration Questionnaire for first-year students following the previous and changed curriculum

Scales	N items	Sample items during this academic year…	α*
First-year student perceptions			
Critical reflection on research	4	… attention was paid to research methods.	.63-.75
Participation in research	5	… as a student I felt involved in research.	.82-.85
Familiarity with current research	5	… I became familiar with the research carried out by my teachers.	.72-.79
Motivation for research	4	… I became enthusiastic about research in medicine.	.81-.83
Other			
Beliefs regarding the value of research for practice	6	Scientific skills are important for being a doctor.	.84-.88
Beliefs regarding the value of research for learning	3	… my learning is stimulated when education is grounded in research.	.80-.85
Quality of learning environment	3	… the teachers carried out their instruction adequately.	.69-.75

*Cronbach's alpha varied slightly per year of data collection; lowest and highest are reported indicating acceptable to strong internal consistency of scales (Cohen, 1998).

3.3.2 Participants

All first-year students who began their studies following the previous or the changed curriculum 1.0 and 1.1 were invited to participate in this cohort study. Two groups of students who followed the changed curriculum were included to be able to check for cohort effects. Data were collected during lectures from May to June of every academic year (see Figure 3.2). We distributed hardcopy questionnaires to all students who attended the lectures. They were asked to fill out the questionnaire for all courses taken up to that point. They were asked for permission for their unique student identification number to be used, so that we could send the questionnaire to the students not present at the lecture. A reminder was sent by e-mail to those students who did not respond to the initial invitation. Ethical approval was granted by the LUMC Research Ethics Committee.

3.3.3 Analysis

3.3.3.1 Progress tests

The mean score for the items about scientific research and methods on PT1 and PT2 prior to the student research projects in the nursing homes was calculated per curriculum, as well as for PT3 and PT4 after this project. We compared the mean scores for the items using independent t-tests (changed curriculum 1.0-previous curriculum; changed curriculum 1.1-previous curriculum). In addition, we used linear regression to adjust for the mean score of items about scientific research and methods in PT1 and PT2 before the student research project. In a separate linear regression analysis, we adjusted for the mean overall score on PT3 and PT4.

3.3.3.2 Research reports

The mean score per report and over all reports and raters was calculated. Thereafter, the reports were decoded, which indicated whether a particular report was written as part of the previous curriculum or the changed curriculum. Then the reports were divided based on the two curricula. After that we compared the scores per curriculum, for all the raters and reports using an independent t-test.

3.3.3.3 SPRIQ

The means for every scale of the SPRIQ were calculated for all the cohorts. After that, scale means per curriculum were compared using independent t-tests (changed curriculum 1.0-previous curriculum; changed curriculum 1.1-previous curriculum). A confidence interval of 95% was applied for all t-tests.

3.4 Results

3.4.1 Student learning outcomes

The student scores for the research-related items of PT1 and PT2 were lower for the changed curriculum in 2012 (mean difference -5.39 (95% CI [-7.20; -3.60]), while the mean scores of the students for the research related items of PT1 and PT2 were higher for the changed curriculum in 2013 (mean difference 4.26 (95% CI [2.33; 6.19])). The mean score for the research-related items of PT3 and PT4 for the changed curriculum in 2012 was significantly higher when compared to that for the previous curriculum (Table 3.2). After correcting for the corresponding mean score of research-related items of PT1 and PT2 the adjusted difference was 14.73 (95% CI [12.29, 17.17]). When controlling for the student mean scores for all the items of PT3 and PT4 the difference between the previous and changed curriculum 1.0 was 9.62 (95% CI [7.45, 11.78]). In the changed curriculum 1.1 the mean score on the research-related items of PT3 and PT4 was also significantly higher when compared to the previous curriculum (Table 3.2). This difference remained after controlling for student scores on research-related items of PT1 and PT2 (adjusted difference 15.98; 95% CI [13.48, 18.48]). After controlling for student scores for all the items of PT3 and PT4 the effects were not materially different (adjusted difference 14.55; 95% CI [12.31, 16.77]). With regards to the student research reports, a significant difference was found between the previous curriculum and the changed curriculum 1.1 in favour of the changed curriculum (difference 5.90; 95% CI [4.89, 6.91].

Table 3.2. Mean scores for student learning outcomes and scale means on the Student Perception of Research Integration Questionnaire per cohort (five-point Likert scale) before and after the curriculum change

Scales	Previous curriculum Mean (sd)	Changed curriculum 1.0 Mean (sd)	Changed curriculum 1.1 Mean (sd)
Student perceptions			
Critical reflection	2.98 (.66)	3.24 (.61)*	3.44 (.63)*
Participation in research	1.94 (.69)	2.20 (.72)*	2.44 (.71)*
Familiarity with current research	2.65 (.68)	3.02 (.72)*	3.09 (.62)*
Motivation for research	2.71 (.78)	2.97 (.81)*	3.11 (.77)*
Other			
Beliefs on value of research for practice	3.64 (.67)	3.56 (.76)	3.75 (.52)
Beliefs on value of research for learning	2.99 (.81)	2.96 (.84)	3.21 (.77)*
Quality learning environment	3.80 (.51)	3.76 (.61)	3.75 (.52)
Student learning outcomes			
Student research reports	8.93 (2.77)	No data	14.83 (2.31)*
Research related progress test (PT) items (PT1 & PT2)	14.25 (12.32)	8.85 (11.78)	18.51 (13.10)*
Research related progress test (PT) items (PT3 & PT4)	16.47 (14.26)	28.93 (16.21)*	34.41 (17.29)*

*indicates this scale mean is higher than in the previous curriculum (t-test; p≤.05).

3.4.2 Student beliefs and perceptions

In total, some 746 first-year students completed the SPRIQ (response rate 75.4%). A vast majority of the respondents had begun studying medicine as their first degree (n = 692). Table 3.3 provides an overview of the data collection periods and characteristics of the respondent group. The majority of the participating students was female, which indicates that the sample is representative of the medical student population (e.g., van der Velden, Hingstman, Heiligers, & Hansen, 2008).

Table 3.3. Characteristics of data collection and cohorts of first-year students

Curriculum	Data collection	$N_{respondents}$	Female	Response rate	Average age (yrs)
Previous	May/June 2012	261	187 (71.6%)	85.9%	19.7
Changed 1.0	May/June 2013	248	147 (59.3%)	75.2%	19.4
Changed 1.1	May/June 2014	237	149 (70.6%)	62.2%	19.5

Table 3.2 shows the scale means of the SPRIQ for the previous curriculum in comparison to those of the two groups in the changed curriculum. The abbreviations indicate the scale names. The scores on the perception scales 'critical reflection', 'participation', 'familiarity' and 'motivation' are significantly higher in the changed curriculum 1.0 and 1.1 than for the previous curriculum. Further, the scale means on the perception scales are the highest for the changed curriculum 1.1. With regards to beliefs regarding the value of research to future practice and the perceived quality of the learning environment, no differences were found between curricula. When following the changed curriculum 1.1 students held a significantly stronger belief about the value of research for their learning than in the earlier curricula. 'Critical reflection on research' was experienced the most, then 'familiarity with current research' and 'motivation for research' in all three groups. Perception scores for 'participation in research' were the lowest of four scales in both curricula, although students felt significantly more involved as participants in research through the learning activities when following the changed curriculum.

3.5 Discussion

The findings of this study suggest that strengthening research integration has a positive effect on research-related first-year student learning outcomes, especially on the research-related items of a national progress test and research reports written during a student research project. The results indicate that first-year medical students recognised a stronger emphasis on research within their courses after a curriculum change that was intended to promote student engagement in research. The first-year students tended to believe that research is important for their future careers in clinical practice. In sum, the findings suggest that the changed curriculum seemed to improve students' perceptions of research integration, although it did not seem to affect their beliefs regarding the value of research.

The curriculum change described in this study consisted of interventions with regard to assessment, collaboration between disciplines in teaching and the duration of courses in order for students to benefit from an emphasis on strengthening the integration of research and teaching. Since the study design was observational in nature, causal conclusions in relation to the curriculum change and student learning outcomes must be drawn with caution. Nevertheless, this study attempted to answer the call made in comparative curriculum studies to use the best possible comparison group (cf. Pruskil, et al., 2009). The data used in this study reflect first-year student learning outcomes and student perceptions of research integration. In higher education research in general it is argued that the quality of student learning outcomes depends on various factors related to the quality of student learning as a process, including students' prior learning experiences, student perceptions of the learning environment and their approaches to learning (e.g., Prosser & Trigwell, 2014). The different approaches to learning indicate whether students focus on, for example, transmission, reproduction or production of knowledge (Prosser & Trigwell, 2014). The present study, therefore, contributes to the quality of student learning within medical education by improving students' research knowledge through learning activities within the undergraduate programme (e.g., Laursen, 2015). The findings of this study are based on high response rates, validated questionnaires and two types of learning outcomes. Most importantly, our findings can be explained by the conceptual relationships between student learning outcomes, student beliefs regarding the value of research for learning and student perceptions of research integrated into courses (Pajares, 1992; Prosser & Trigwell, 2014).

The students performed better on the research-related items of a national progress test and on written student research reports after the curriculum change. An explanation for this is the fact that the students in the changed curriculum were actively engaged in an authentic student research project prior to writing the reports and doing the progress tests (cf. Chapter 2). In the learning process in general student learning outcomes are influenced by factors such as student perceptions of teaching, as well as student motivation and values (Biggs, 1985; Prosser and Trigwell, 1999). In that sense the learning outcomes measured in this study were closely related to the learning process whereas previous studies concerning research integration and medical student learning might be more removed from the students' actual learning process. In a recent systematic literature review, Chang and Ramnanan (2015) suggest that previous attempts made to improve student learning and research-related outcomes were mainly informed by student perceptions of research and long-term research outcomes such as presentations at conferences and peer-reviewed publications. This might raise questions about the appropriateness of the variables used in medical education research into research integration, for example, research output, for informing curriculum decision making and to improve the quality of student learning.

Teachers may feel that first-year students might not yet be open to research (Zamorski, 2002), which could be the case for undergraduate medical students in general (Burgoyne et al. 2010; Murdoch-Eaton, et al., 2010). However, our findings suggest that students do recognise research integration and, more importantly, that a curriculum change including a first-year student research project can promote student perceptions of research during the first undergraduate year of medical education. Students recognise research in courses in several ways according to the scales used in the SPRIQ. The results show that, although student perceptions of research increased on all the scales after the curriculum change, participation in research was experienced to the least extent and critical reflection on research the most. This indicates that the perceived ways in which research is actively included in student learning are complementary. Teachers should hence be encouraged to use a range of modes in order to actively include research even within the first-year of university education.

Small differences were found between student beliefs regarding research before and after the curriculum change. The relatively stable nature of beliefs can provide an explanation for this (Pajares, 1992). Students already tend to believe that research is important for physicians' practice when they begin their medical education. Despite the nature of beliefs, this indicates that the differences found in the learning outcomes and student perceptions in our study can be explained by changes in the learning environment (e.g., Ashwin & Trigwell, 2012).

Future studies are needed to provide further insight into student learning processes during courses or projects in which research is strongly integrated in order to improve the quality of student learning about research. Future studies in medical education research might benefit from careful consideration of variables and designs used to foster high-quality learning outcomes in medical education research into research integration. For example, by focusing on relations between student perceptions of research in teaching, the way students approach learning (i.e., knowledge transmission, reproduction, production) and student learning outcomes (e.g., Prosser & Trigwell, 2014; van der Rijst, 2017).

3.6 Conclusions

This study was conducted in order to improve our understanding of the relation between student learning outcomes, beliefs regarding the value of research for student learning and student perceptions of research integrated into the study programme by investigating first-year student learning in the context of a curriculum change. The first-year students who followed the changed curriculum performed better on the research-related learning outcomes in a national progress test as well as in writing research reports as part of a student research project. Students in a changed curriculum, intended to strengthen research integration, recognised a stronger emphasis on (1) critical reflection on research, (2) participation in research activities, (3) familiarity with research done by the staff and (4) being motivated for research in medical education. Students tended to exhibit a strong belief in the value of research for their future clinical

practice. The implications of this study can inform curriculum decisions about integrating research into courses using multi-disciplinary strategies in order to foster research integration (cf. Harden & Laidlaw, 2012). In sum, strengthening the integration of research into undergraduate courses is feasible in a limited amount of curriculum time, and can lead to enhanced student perceptions and associated learning outcomes. The findings of this study indicate that student beliefs regarding the value of research are less fluent when compared to student perceptions of research and learning outcomes in the domain of research. This study contributes to an emerging body of knowledge about improving students' research knowledge through student engagement in research as a pedagogy, that is, through learning activities within the undergraduate curriculum.

Chapter 4

Fostering first-year student learning through the integration of research into teaching

4. Fostering first-year student learning through the integration of research into teaching

Research should be explicated within undergraduate teaching in such a way that stimulates student learning. Previous studies in higher education have shown that student perceptions of the integration of research into teaching could promote student learning, although they have also indicated that it can prove difficult to confront first-year undergraduates with research during their courses in order to promote student learning outcomes. In this study, we describe relationships between first-year medical student perceptions of research, their learning outcomes and their beliefs regarding the value of research. The Student Perception of Research Integration Questionnaire was filled out by 261 students. The answers were related to student beliefs regarding the value of research and student achievement. The findings suggest that student motivation for research is strongly related to the merging of current research into teaching. Students rather recognised an emphasis on research methodologies than research engagement. In particular, student beliefs regarding research are related to achievement. It is suggested that to foster positive beliefs regarding research, teachers should familiarise students with current research and foster enthusiasm for research.

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4.1 Introduction

Strengthening research-teaching integration in order to benefit student learning about research in universities remains a challenge that needs to be overcome in higher education (Spronken-Smith, Mirosa & Darrou, 2014; van der Rijst, Visser-Wijnveen, Verloop & van Driel, 2013). Teachers should explicitly express research within their undergraduate teaching in a way that is visible and approachable so that students learning can benefit from research integration, since student perceptions of teaching are known to play an important role in fostering student learning outcomes (e.g., Prosser & Trigwell, 2014). For first-year students in particular it can prove difficult to recognize research integrated into teaching, therefore the promotion of student perceptions of the university as a research-rich learning environment is an essential part of the transition to higher education (e.g., Brew, 2010). Our study adds to the knowledge base by describing relationships between student perceptions of research within teaching, beliefs regarding the value of research and student achievement during the first year of their undergraduate education.

4.1.1 Student beliefs, perceptions and achievement

Within teaching and learning in higher education it is argued that student perceptions of the learning environment and student characteristics influence student learning outcomes (Prosser & Trigwell, 2014; Ramsden, 1991). Findings from an empirical study by Lizzio, Wilson and Simons (2002) support the proposition that student perceptions of teaching influence their learning outcomes, indicating that positive perceptions not only directly influence student achievement but also improve the quality of their learning outcomes (e.g., generic skills). Moreover, the results from this study suggest that perceptions of the university learning environment may contribute to student achievement irrespective of the prior academic success of a particular student. A reason for this is that effective teaching, as perceived by the students, facilitates effective student learning (Ramsden, 1991), including during the first undergraduate year (Prosser & Trigwell, 2014).

In previous studies student perceptions of research were found to be related to undergraduate research experiences and institutional factors. Some such studies revealed that staff needs to be supported in order to immerse students into the research culture (e.g., Brew, 2010; Spronken-Smith, Mirosa, & Darrou, 2014) and to incorporate research into teaching (Hu, van der Rijst, van Veen, & Verloop, 2014). Yet, the integration of research into teaching within courses appears to be one of the most important factors in promoting student learning and student beliefs regarding research (Verburgh & Elen, 2011). A review study suggested that general beliefs about teaching and learning strongly influence perceptions and, further, that student beliefs are well established by the time they begin university (Pajares, 1992). At the same time beliefs and knowledge are intertwined, rendering beliefs a filter through which new information is interpreted (e.g., Abelson, 1979). Thus, previous studies emphasise the reciprocal nature of relationships between student beliefs, perceptions and knowledge that influence student outcomes in terms of their learning goals in higher education.

Few studies have focused on undergraduate student perceptions of research within teaching during the first undergraduate year and the relationship of such perceptions with student learning outcomes (cf. Levy & Petrulis, 2012; Spronken-Smith et al. 2014). Levy and Petrulis (2012) conducted a qualitative study into an undergraduate research course using inquiry-based learning pedagogies from which it can be concluded that there exists a relationship between students' understanding of inquiry, their learning and their knowledge of the topic. A survey study conducted by Spronken-Smith et al. (2014) found that first-year undergraduate students notice fewer elements of the institutional research culture than more senior students. Our study aims to describe the extent to which first-year student perceptions of research-teaching integration are related to student learning outcomes, specifically student beliefs regarding the value of research and student achievement.

4.1.2 Student perceptions of research integrated into teaching

Previous studies suggest that students vary in terms of the extent to which they experience research activities within university teaching (Brew & Ginns, 2008; van der Rijst, et al., 2013). Comparisons of teachers' intentions regarding research integration in their courses with student perceptions of research within those courses suggest that students mainly perceive participation in research and become familiar with the teachers' own research (van der Rijst, et al., 2013). Students also report that an emphasis on teachers' research within teaching can lead to narrow representations of the field (Lindsay, Breen, & Jenkins, 2002). Final-year undergraduate students mainly report the benefits of research within teaching such as research contributing to teachers' credibility, promoting undergraduates' motivation for research and facilitating an increased understanding of subjects (Healey, Jordan, Pell, & Short, 2010; Turner, Wuetherick, & Healey, 2008). These findings from the literature suggest there is no single best strategy for engaging students in research and, further, that the value of research-teaching integration lies in a considered diversity of ways of promoting student learning about research from first-year onwards.

Robertson and Blackler (2006) showed that individual differences between student perceptions of research relate to their understandings of the purpose of university education. An explanation for the variety seen in student perceptions of research within teaching can be found in differences in student motivation for and beliefs regarding academic research. Breen and Lindsay (1999) showed that students' intrinsic motivation and course competency contribute to positive beliefs regarding research, while negative beliefs or indifference to research are associated with externally motivated students. Students' prior experiences of research within teaching may also influence their perceptions of research in university (cf. Prosser & Trigwell, 2014). Thus, these results indicate that student perceptions of research depend on student characteristics and the experiences that they bring into the classroom.

Integrating research into teaching is challenging for teachers, particularly during the earlier years of undergraduate education. First, students do not always recognise research activities, they may not yet be open to them (Turner, et al., 2008) or they may lack the disciplinary framework necessary to engage in research (Robertson & Bond, 2001). Second, undergraduates may feel excluded from direct involvement in research and they may report negative

effects of the integration of research into teaching. Students also perceive staff to overcome their own challenges in terms of dealing with teaching and research responsibilities (Healey, et al., 2010; Lindsay, et al., 2002; Turner, et al., 2008). Moreover, as Brew (2010) and others (e.g., Spronken-Smith, et al., 2014) have argued, one of the critical factors in promoting student learning about research is their perception of the university as a research environment. Undergraduate students report positive impacts of a research culture within their universities on their learning (Spronken-Smith, et al., 2014). Student perceptions of teaching can provide a valid and reliable image of the learning environment and, they are hence commonly used in higher education research (Marsh & Roche, 1997; Spooren, Brockx, & Mortelmans, 2013). Since the focus of this study is on the learning environment from the perspective of student learning, student perceptions of teaching are used to provide insights into research integration (cf. Visser-Wijnveen, van der Rijst, & van Driel, 2016).

4.1.3 Disciplinary differences in student perceptions of research

Several prior studies suggest that student perceptions of research integration depend on discipline-specific characteristics, including organisational factors within departments (Durning & Jenkins, 2005), the ways in which knowledge is structured (Smeby, 2000) and shared conceptions of research and knowledge within disciplines (Brew, 2010). 'Soft' sciences (e.g., social sciences, humanities) tend to use a wide variety of research methodologies within the discipline, which leads to ample opportunities for teachers to articulate research within teaching (Biglan, 1973; Neumann, 1994). Colbeck (1998), for example, found that certain discipline-specific characteristics, such as a low consensus on paradigms within a discipline, may promote the integration of research into teaching. This in turn influences students' perceptions of research-teaching links (Robertson & Blackler, 2006). Within the 'hard' sciences (e.g., physics, medicine), attention has also been paid to enhancing research integration within teaching as well (Robertson & Bond, 2001). In addition to differences between the hard and soft sciences a distinction has been made between applied and pure domains in order to indicate the degree of applicability to practical problems. In applied

domains research questions depend heavily upon professional practice (Biglan, 1973). Medicine is an example of an applied discipline in which research skills and attitudes are important for clinical practice, especially for physicians who must stay abreast of advances in the field. In our study medicine provided a content-rich and research-rich context for improving our understanding of the relationship between student perceptions of research in teaching and student learning outcomes.

4.1.4 Research aim

This study describes student perceptions of research-teaching integration in the context of the hard-applied sciences during the first year of their undergraduate education. This exploratory study aimed to determine the extent to which student achievement, specifically grade point average, and student beliefs regarding the importance of research are related to ways in which students perceive research within the first year of their undergraduate medical education. Results of this study will be of importance to teachers and educational directors who aim to strengthen the linkages between research, teaching and student learning.

4.2 Research setting and method

Our study was conducted in the undergraduate programme of the Leiden University Medical Center (LUMC), which is related to the oldest research-intensive university in the Netherlands. Academics at LUMC are responsible for patient care, research and teaching. Further, based on written educational goals all three responsibilities should be interlinked within teaching. The medical undergraduate programme is structured into preclinical and clinical phase. During the three-year preclinical phase students attend patient interviews in addition to predominantly theoretical classes augmented by learning activities conducted in small groups. The clinical phase consists of clinical clerkships and a final-year student research project. In both phases students are taught by academic staff involved in medical scientific research and undergraduate courses. Within this programme, separate disciplines are given great importance.

In order to study first-year student perceptions of research within teaching we administered an adapted version of the SPRIQ as described in section 2.2.3 and Appendices 1 and 2. Its scales include student perceptions of teaching via (1) critical reflection on the way research results are produced; (2) research participation as a student; (3) familiarity with current research done by staff; (4) fostering interest and motivation for research; (5) propositions to measure student beliefs regarding the value of research for learning and (6) propositions to measure student beliefs regarding the value of research for practice and a scale to measure (7) propositions to measure the perceived quality of the learning environment (see Table 4.1 for sample items). All 30 items were answered on a five-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree". In addition to recording their scores for the perception and belief scales the students were asked whether they had obtained a previous degree or undertaken research experience. Table 4.1 presents the scales (see section 4.3), the reliability for this particular sample and sample items of the version of the SPRIQ that we used.

All participating first-year students were enrolled in the medical programme in the academic year 2011-2012 (n = 304). We distributed hardcopy questionnaires to all students who attended the first lecture on the cardiovascular system in April 2012. The students were asked to complete the questionnaire for all the subjects they had taken up to that point. They were asked for permission for their unique student identification number to be used, so that we could send the questionnaire to those students who were not present at the lecture. A reminder was sent by e-mail to those students who did not respond to the initial invitation. We also calculated the grade point average over all courses within the period September-April during the academic year 2011/2012, using data retrieved from the LUMC database. Ethical approval for the study was granted by the LUMC Research Ethics Committee.

The respondent group consisted of 261 first-year students, which indicated a response rate of 85.9%; 187 women (71.6%), while the average age of the respondents was 19.7 years (sd = 1.33, range 18 – 30). The vast majority of the respondents had begun studying medicine as their first degree (n = 211). Some of the students had previous or other experiences with research (n = 68), such as attending extracurricular research lectures in Honours Colleges and conducting scientific research at the university while finishing secondary education.

Descriptive analyses were performed for all the scales of the questionnaire and they are expressed as scale means. For the perception scales, we used scale means of 2.65 and higher (range 1 – 5), based on the medians of the scores, in order to indicate that the average was rather high for the perception scales. To interpret the beliefs scales we used means of 3.33 and higher, based on the medians of scores of the beliefs scales. After this, Pearson's correlation coefficients were used to determine relationships between scales and the study results retrieved from the LUMC database (i.e., grade point average; GPA). We applied a confidence interval of 95%. We used the following criteria for interpretation: $r < .30$ = weak correlation, $.30 \leq r < .50$ = moderate correlation, and $r \geq .50$ = strong correlation.

4.3 Results

The students were asked about the extent to which they had experienced research in the courses taught during their first year. In comparison to the other perception scales the students most commonly identified 'critical reflection on research' within teaching, although 'motivation for research' and perceptions of 'familiarity with current research' within the discipline both scored relatively highly as well (Table 4.1). During their first academic year, the students reported 'participation in research' the least when compared to other ways of perceiving research-teaching integration. In general, the students held relatively strong beliefs about the value of research for their professional practice when compared with their beliefs about the potential of research to enhance their learning. The mean score regarding the quality of the learning environment was relatively high (mean = 3.80). Overall, the reliability rates indicated high internal consistency between the items within the scales.

All the correlations between the variables are presented in Table 4.2. The correlation between student beliefs regarding the value of research for learning and their beliefs regarding the value of research for future practice stood out (*r*

=.68). This suggests a relatively strong relationship between the extent to which students believe the elements of research elements to stimulate their learning and the value placed by students on research for their future practice. The motivation for research scale correlated relatively highly with student beliefs regarding the value of research for future practice (i.e., $r = .54$) and their beliefs regarding the value of research for current learning ($r = .59$). Further, critical reflection and familiarity with current research correlated significantly, albeit weakly, with student beliefs regarding relevance of research for clinical practice. The data shows somewhat

Table 4.1. Scales, reliability, means and sample items of the Student Perception of Research Integration Questionnaire (Likert scale 1–5) for first-year students following the previous curriculum

Scale	N items	Cron-bach's alpha	Mean (sd)	Sample items *During this academic year…*
Student perceptions				
Critical reflection on research	4	.75	2.98 (.66)	…I learned to pay attention to the way research is carried out.
Participation in research	5	.85	1.94 (.69)	…as a student I felt involved in research.
Familiarity with current research	5	.79	2.65 (.68)	…I became familiar with the research carried out by my teachers.
Motivation for research	4	.81	2.71 (.78)	…I became enthusiastic about research in medicine.
Other				
Beliefs regarding the value of research for practice	6	.84	3.64 (.67)	Scientific skills are important for being a doctor.
Beliefs regarding the value of research for learning	3	.80	2.99 (.81)	…my learning is stimulated when education is grounded in research.
Quality of learning environment	3	.69	3.80 (.51)	…the teachers carried out their instruction adequately.

similar results for the correlations between student beliefs regarding the value of research for learning and their perceptions of research within teaching (i.e., scale 1-4), although participation also correlated significantly and weakly with their beliefs regarding learning. Of all the scales, the student beliefs regarding the value of research for clinical practice showed the highest, albeit moderate, correlation with GPA.

The perception scales correlated significantly with each other at the 0.05 level, while all the scales correlated the highest with 'familiarity with current research' (see Table 4.2). Moreover, relatively strong correlations were found between current research on the one hand and critical reflection, participation and motivation on the other (.57, .61, and .66 respectively).

Table 4.2. Correlations between the scales of the Student Perceptions of Research Integration Questionnaire and the GPA for first-year students following the previous curriculum

Scales	Partici-pation	Familiarity current research	Motiva-tion	Beliefs value for practice	Beliefs value for learning	GPA
Student perceptions						
Critical reflection on research	.36*	.57*	.49*	.18*	.20*	.06
Participation in research		.61*	.46*	.11	.23*	-.06
Familiarity with current research			.66*	.23*	.31*	.17*
Motivation for research				.54*	.59*	.22*
Other						
Beliefs regarding value of research for practice					.68*	.33*
Beliefs regarding value of research for current learning						.22*

Note: *p<.05

4.4 Discussion and conclusions

Our central aim was to determine the extent to which first-year undergraduate students' perceptions of research within teaching relate to their achievement and their beliefs. Although students recognise research throughout their courses and, find it both stimulating for their learning and important for future clinical practice, only a few correlations between perceptions, beliefs and student achievement were found. The data indicates that student beliefs regarding the value of research for future practice are more strongly related to student achievement than their perceptions of research in teaching and beliefs regarding research promoting current learning. This relationship can be explained by the reciprocal relationship between beliefs and knowledge in general as well as the relatively fixed nature of beliefs (Abelson, 1979). If that is indeed the case, and students' positive beliefs regarding the value of research for future clinical practice influence their interpretation of new knowledge regarding research within their learning environment, then students' development of knowledge about research can serve to strengthen their belief that research is highly valuable. We hence conclude that, within a hard-applied science context, student motivation for research within teaching is strongly related to their familiarity with current research and their beliefs regarding the value of research for learning as well as future practice.

In terms of student learning outcomes, we found a moderate relationship between student achievement and their motivation for research. An explanation for this is the existence of a relationship between motivation for learning and motivation for research. According to Breen and Lindsay (1999) students' intrinsic motivation for learning promotes their positive beliefs about the value of research. Student beliefs regarding the value of research for future clinical practice were most strongly related to student achievement. The motivation for learning again provides an explanation for this. Students who already hold strong beliefs regarding the value of research for their future careers are driven to obtain high grades, for example, in order to create future career opportunities rather than to enrich their current learning experiences (Breen & Lindsay, 1999).

Students clearly recognise research in several ways as well as to different degrees. Student perceptions of current research within teaching were strongly related to student motivation for research. The strong correlations between the scales might influence the reliability of the instrument, although the internal consistency is high. Furthermore, the results indicate that students recognise an emphasis on research methodologies, as well as the creation of enthusiasm for research and learning during their courses, rather than being engaged in research activities during their first year.

Our results add to those of earlier work concerning hard-pure and soft-pure sciences, which concluded that students mainly familiarise themselves with the teachers' research through their courses (van der Rijst, et al., 2013; Visser-Wijnveen, van Driel, van der Rijst, Verloop & Visser, 2010). This can be interpreted in several ways. On the one hand, the perceived emphasis on familiarity with current research indicates that, early in their undergraduate education, students mainly focus on deepening their understanding of the discipline (Neumann, 1994; Turner, et al., 2008). On the other hand, the perceived focus on current research can be explained by the teaching content, for instance, if an emphasis is placed on the evaluation of research papers during work group sessions, it can cause students to feel engaged in current advances in the discipline. In addition, our findings suggest that research can inspire first-year undergraduate students through the teaching they receive. This could also be explained by student conceptions of the discipline and the teaching content. Previous studies have found that more senior undergraduates mainly become motivated for research through teaching and research activities (Healey, et al., 2010; Turner, et al., 2008).

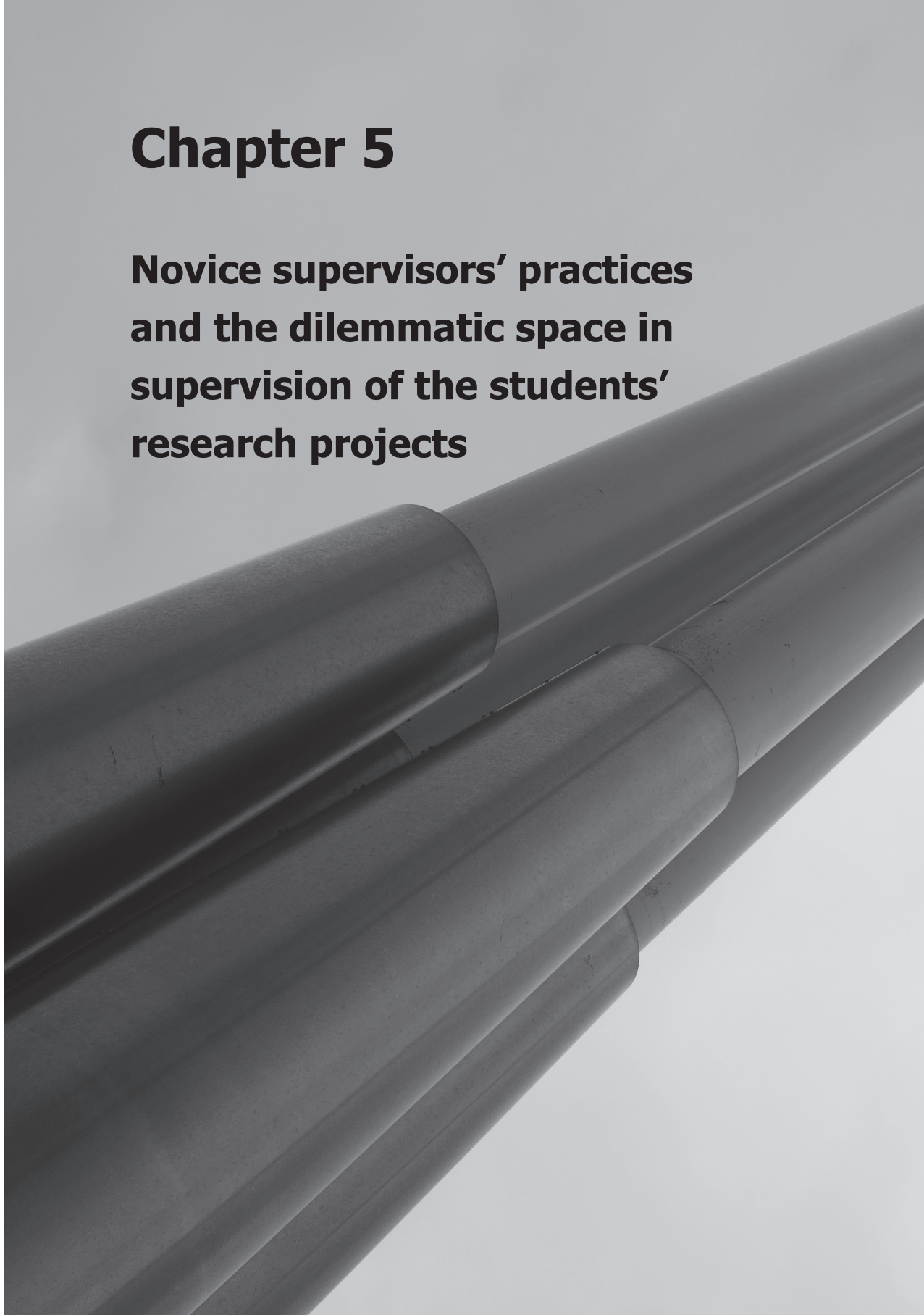
According to our data, student perceptions of the integration of research into teaching correlate most strongly with their beliefs regarding research enhancing student learning. In particular, student motivation for research is closely related to the belief that research stimulates both learning and future practice. Again this can be explained by the correlations between student beliefs about learning in general and motivation for learning. However, it must be recognized that our data collection was specifically tailored to evoke beliefs about the integration of teaching, research and learning in order to reduce the possibility that certain

beliefs regarding the value of research for learning affect perceptions of research integration (cf. Visser-Wijnveen, et al., 2016).

Although care should be taken when drawing causal conclusions about the concepts within our data, based on our theoretical framework and our data we suggest the following implications for practice. First, we suggest that teachers should explicitly increase enthusiasm for research among junior undergraduates. Students consider research to be valuable for their future practice and they believe that involvement in research promotes their achievement. Second, our findings indicate that teachers' focus on explaining current disciplinary research in the classroom can foster student motivation for research which in turn stimulates student learning. Although our study reflects student perceptions of several courses within one programme we suggest that, based on both our results and previous findings (Brew, 2010; Healey, et al., 2010), there is scope for the development of innovative students' research projects aiming to actively engage junior undergraduates in research. Future longitudinal research on the development of student perceptions of research within teaching would be helpful in determining whether research-teaching integration will increase over courses. It will also provide further insights into the nature of student characteristics and the experiences that contribute to student learning and achievement.

Chapter 5

Novice supervisors' practices and the dilemmatic space in supervision of the students' research projects



5. Novice supervisors' practices and the dilemmatic space in the supervision of students' research projects.

Growing interest in students' research projects in higher education has led to an emphasis on research supervision. In this study, we hence focus on novice supervisors' approaches to research supervision as they explore their practices and experience difficulties when supervising medical students. The concept of teacher noticing was used as a sensitising concept and relations with teacher dilemmas were explored in the research supervision context. To provide in-depth insights into supervisors' practices and pedagogical choices, twelve stimulated recall interviews with supervisors were analysed. The supervisors were all involved in individual undergraduate or master's level research projects at a research-intensive university. The analysis revealed four kinds of dilemmas that might influence research supervision practices, namely questions regarding regulation, student needs, the student-supervisor relationship and supervisors' professional identity. We explain the relationship between novice supervisors' practices and dilemmas in detail. Further, the implications of the study are discussed so as to enhance initiatives for the professional development of supervisors.

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5.1 Introduction

Growing interest in student engagement in research within university education, for example, in students' research projects, has led to an emphasis on research supervision. As a result, an increasing number of studies have investigated research supervision (e.g., Anderson, Day, & McLaughlin, 2008; Harwood & Petrić, 2017; Maxwell & Smyth, 2010; Wichmann-Hansen, Thomsen, & Nordentoft, 2015). Recent studies involving experienced supervisors have identified factors within research supervision that contribute to student learning, including responsiveness to students' needs and ways in which supervisor-student relationships are maintained (e.g., de Kleijn, Meijer, Pilot, & Brekelmans, 2014; Lee, 2008; Mainhard, van der Rijst, van Tartwijk, & Wubbels, 2009). These factors are useful for fostering supervisors' reflections on their practices as well as for the study of research supervision. Novice supervisors in particular can benefit from support in exploring their approaches to supervision, facing challenges and adapting pedagogies (e.g., Turner, 2015). Indeed, adequate support can enable novice supervisors to deliberately learn from and use their personal supervision experiences (cf. reflective practice, Schön, 1983), both as a student and a supervisor (Amundsen & McAlpine, 2009). This study aims to provide input for development initiatives for novice supervisors by focusing on what novice supervisors do to promote student learning during research projects and why they do what they do during student-supervisor interaction. Our results will inform supervisors' professional development initiatives in order to foster student learning within students' research projects in university education. This study contributes to a body of knowledge concerning research supervision by using supervisors' reflections on recordings of student-supervisor interactions rather than interview data based on their experiences. This study aims to reveal dilemmas that novice supervisors face during interactions with students and identify relations of those dilemmas with pedagogical choices in supervision practice.

5.1.1 Supervision of students' research projects in higher education

Previous studies have aimed to demystify experienced supervisors' practices and have emphasised student and supervisor characteristics or types (de Kleijn, et al., 2014; Grant, 2003; Halse, 2011). However, adapting supervision to student characteristics or traits in practice may prove difficult for novices (e.g., Kandiko, & Kinchin, 2012). In comparison to experienced doctoral supervisors, novice supervisors worry about being taken seriously by students and feel unprepared for to work in environments that lack clear guidelines for most job activities, as is usual in academic departments, which can also apply to supervising undergraduates (Amundsen & McAlpine, 2009). The term novices is used to indicate that the supervisors who participated in this study have relatively few years of supervisory experience as opposed to expert supervisors. In this study we draw on prior studies concerning doctoral research supervision pedagogy in which research supervision has been constructed as teaching (Boud & Lee, 2005; Manathunga, Lant, & Mellick, 2006). An underlying assumption when conceptualising research supervision as a teaching activity is that students are considered to be learners and it is assumed that their capabilities will develop when they receive effective feedback (Dixon & Hanks, 2010; Walker & Thompson, 2010). The findings presented in the literature suggest that, in order for students to learn from their research projects, in addition to providing them with a research-rich environment, supervisors need to apply a pedagogic approach (Boud & Lee, 2005; Manathunga, et al., 2006). This notion is in line with studies concerning master's and undergraduates thesis supervision, which emphasise supervisors' reflections on their practices during interactions with students so as to foster high-quality supervision in terms of students' research projects (Malcolm, 2011; Wichmann-Hansen, et al., 2015). In addition, interactions between academics and students that help to understand the needs of their students are considered pivotal in teaching within higher education context in general and in supervision of students' research projects at doctoral, master's and undergraduate level (Ashwin, 2012; de Kleijn, et al., 2014; Mainhard, et al., 2009; Todd, Bannister, & Smith, 2006).

In comparison with traditional classroom practice, research supervision can be considered unique, since the research projects provide students with the relative freedom to choose a topic, while the duration of students' research projects is generally longer than that of traditional teaching units and research projects mainly involve one-to-one student-supervisor interactions (e.g., de Kleijn, et al., 2014; Todd, et al., 2006). In contrast to supervising master's and undergraduate dissertations, both students' research activities and the nature of supervisors' work as an academic play a central role in doctoral research supervision practices (e.g., Kandiko & Kinchin, 2012; Manathunga & Goozée, 2007). The supervisors of undergraduate and doctoral students' research projects draw on personal experiences gained in other supervision and teaching contexts, including previous experiences as both students and a supervisor (Amundsen & McAlpine, 2009; Todd, Smith, & Bannister, 2006; Turner, 2015). Supervisor training that focuses on eliciting development opportunities through the analysis of supervisor behaviour, can contribute to supervisors' professional knowledge and their supervision practice (e.g., Emilsson & Johnsson, 2007; Lizzio & Wilson, 2004; McCulloch & Loeser, 2016). In sum, previous findings from literature suggest that supervision of master's and undergraduate research projects can be considered a form of teaching (Malcolm, 2011; Manathunga, et al., 2006; Wichmann-Hansen, et al., 2015).

5.1.2 Pedagogical choices in supervision practice

Supervisors have to simultaneously realise multiple goals in practical teaching situations in order to foster student learning. For example, supervisors aim to develop students' sense of agency within a project whilst also maintaining an effective student-supervisor relationship that can result in indirect, albeit very potent ways of steering (Turner, 2015). For instance, supervisors shape master's students' research activities via the often implicit and unconscious diagnosis on student characteristics, including their enthusiasm for a topic, motivation and attitude towards the supervisor (de Kleijn, et al., 2015). In addition, supervisors should foster student learning during interactions with individual students and also adapt their pedagogies to student research competencies as well as the

wider context of the institute and department in which they work (de Kleijn, et al., 2015; Grant, 2003; Manathunga & Goozée, 2007; Pearson & Brew, 2002). The relations between supervisors, students and the context in which they work and learn can introduce supervisors to different, perhaps conflicting, values, responsibilities and goals. Supervisors' intentions to promote their own research development, for instance, might conflict with strategies that would foster a rich learning experience for students (Bruce & Stoodley, 2013). Thus, supervisors can have multiple goals simultaneously in supervision practice which can influence their pedagogical choices.

Findings from a previous study into research supervision pedagogy suggest that the supervisors' awareness of alternative options for practice influences their research supervision practices (Bruce & Stoodley, 2013). Indeed, the broader the supervisors' repertoire of approaches to supervision, the more they have to choose from. However, as supervisors can pursue several goals simultaneously choosing an approach may prove complex. One reason for this is that human behaviour in complex situations, for example, research supervision practice, depends on individual characteristics such as needs, drives and goals as well as structural aspects or perceptions of the environment (e.g., Shah & Kruglanski, 2008; Simon, 1957).

5.1.3 Dilemmatic space

Against the background of supervisors' goals and their perceptions of the context, teacher dilemmas can emerge that may influence their pedagogical approaches (Jonasson, et al., 2015; Leong, 2014). Supervisors might, for instance, experience a dilemma between providing a student with answers and fostering student ownership in research projects. Particular student behaviour could trigger the 'spitting out' of answers, although that approach might hamper students' independent and reflective thinking (Wichmann-Hansen, et al., 2015). Within teaching in general and higher education in particular, teacher dilemmas have been studied in relation to the concept of dilemmatic spaces which are 'social constructions resulting from structural conditions and relational aspects in everyday practices' (Fransson & Grannäs, 2013, p. 11; Leong, 2014). According to this view ever present dilemmas are inherent to teaching and specific teaching situations will bring certain considerations more to the fore while leaving others to the background (Fransson & Grannäs, 2013; Leong, 2014). All teacher's dilemmas will be evoked, for example, when a policy change requires teachers to alter their assessment practices after years of conducting assessments in a certain way (Leong, 2014) or when teachers have to balance the classroom space between the shy and talkative students (Frelin 2010, cited in Fransson & Grannäs, 2013). Practical reasoning in these situations is deeply rooted in the human desire to do the right thing in the right place at the right time in the right way (MacIntyre, 2007). What is regarded as 'right', however depends on the relationships between a supervisor and others (Fransson & Grannäs, 2013). Findings from a study into undergraduate research supervision indicate that the issue of boundaries is apparent in the role of the supervisor in the sense that supervision evokes confusion among supervisors as to what is expected of them (Todd, et al., 2006). Previous research has indicated that teaching dilemmas influence teaching practices. In higher education specifically, teaching dilemmas may depend on teachers' sense of urgency or uncertainty in relation to their teaching practice (Scager, Akkerman, Pilot, & Wubbels, 2016). Within undergraduate research supervision this uncertainty may occur when supervisors feel they have to defend the students' dissertations to a second assessor or when their expertise does not match the students' interest (Malcolm, 2011; Wiggins, Gordon-Finlayson, Becker, & Sullivan, 2016). In this study, we will explore relationships between novice supervisors' practices and their dilemmas using the idea of a dilemmatic space as an analytical framework.

5.1.4 Novice supervisors' noticing

Within teaching in general, novices tend to focus on instructional decisions and student skill performance (Talanquer, Tomanek, & Novodvorsky, 2007). It has been argued, therefore, that novices need to learn to use evidence of student learning in their student-teacher interactions in order to enable them to assess the effectiveness of their instruction (van Es & Sherin, 2008). Teacher noticing is about identifying meaningful patterns in student learning through teachers'

reflection on classroom practices (Erickson, 2011; van Es & Sherin, 2008). Teacher noticing means that (1) teachers focus on student understanding in student-teacher interaction, (2) teachers interpret student understanding based on the interaction and (3) teachers decide what pedagogy is appropriate based on the former points (e.g., Barnhart & van Es, 2015). Novices may direct their attention towards superficial characteristics of student-teacher interaction or else may generalise their own experience as a student in order to adapt their pedagogies (van den Bogert, van Bruggen, Kostons, & Jochems, 2014). In this study, we used teacher noticing to guide our attention towards important aspects and to describe novice supervisors' practices during supervision meetings (cf. sensitising concept, Bowen, 2006).

5.1.5 The role of the discipline

University teaching can depend on discipline-specific characteristics, such as a consensus on research paradigms within scientific disciplines or ways in which knowledge is structured (Colbeck, 1998; Smeby, 2000). This study was conducted within the medical discipline at a research-intensive university. It involved both applied and pure study programmes within the discipline, which served as an example of a hard discipline (e.g., Biglan, 1973). A classification of subject matter within disciplines based on a study by Biglan (1973) indicates that disciplines can be classified based on two dimensions. The hard/soft dimension involves the paradigmatic development within a field, while the applied/pure dimension involves the practical applicability of scholarly research (Biglan, 1973). Within hard disciplines knowledge construction is often characterized by a relatively high consensus on both paradigms and research content (Becher & Trowler, 2001; Biglan, 1973).

5.1.6 Research aim

The aim of this research study is to deepen our understanding of how supervisors foster student learning during students' research projects in bachelor's and master's medical education as well as to explore the relation between research supervision practices and the dilemmatic space in which novice supervisors

negotiate research supervision. The results from this study will provide input for supervisors' professional development initiatives regarding supervising research projects within university teaching. This study aims to contribute to an existing body of knowledge about research supervision by both using supervisors' direct observations of student-supervisor interactions and by focusing on novice supervisors.

5.2 Educational context

The majority of students enrolled in research-intensive Dutch universities pursue a master's degree after completing their undergraduate degree. Students conduct an individual student research project at the end of both the undergraduate and the master's phases. We use the term 'students' research projects' to indicate a context in which research, teaching and student learning are closely related. A central aim of students' research projects is to foster student understanding of research and to promote research competencies such as scientific reasoning and critical thinking. Specifically, within both graduate and undergraduate medical education, research projects are integrated into curricula worldwide so as to foster students' ability to develop knowledge by conducting research and to incorporate research into clinical care by means of the critical appraisal of research findings (GMC, 2015; NFU, 2009). This means that, in the Dutch context of the present study, all students complete a mandatory full time research project as part of their medical degree. The supervisors who participated in this study supervise students in mandatory research projects towards the end of either their undergraduate or master degree in one of the health sciences. More precisely, students' research projects are carried out within a medical, biopharmaceutical or biomedical programme. The arrangements for supervisor support and training in relation to these programmes consist of two to four voluntary training sessions held over a short period of, which focus on supervision aims, supervisors' roles and the provision of feedback, although the present study is not conducted in the context of such training. All three programmes include a three-year undergraduate

phase. After that, there is a two-year master's phase in biopharmaceutical and biomedical programmes, or a three-year master's phase in medicine. Students' research projects within the undergraduate and master's phase can differ in terms of their duration, although the students perform similar research activities (e.g., performing a literature search, formulating research questions, writing and conducting a research plan and writing a research report). Most of the research projects in this study vary in duration from 12 to 16 weeks, although some projects take 40 weeks. The students conduct their research projects individually in a setting that is similar to a fulltime internship either in a laboratory or research department within the health sciences. The projects are worth a minimum of 18 European Credit Transfer and Accumulation System (ECTS) credits. At the time of data collection, all students' research projects were about halfway towards completion.

Most supervisors are PhD-students or immediate postdoctorates. In the context of three- to four-year PhD programmes, this means that supervisors who are immediate postdoctorates or PhD students all have relatively little experience with research supervision. The student-supervisor interactions are typically one-to-one and often face-to-face. The students had either chosen or were assigned to a supervisor and chose a research topic of their interest to themselves. The supervisor provides the student with feedback regarding the research process and preliminary products. The supervisors who participated in this study are day-to-day supervisors of students' research projects. A senior researcher monitors the quality of the research projects and has less frequent contact with students. In the case of medicine, the PhD-students involved in our projects assess the students' research report, after which a second, external assessor is consulted. Within the biopharmaceutical and biomedical sciences the students' research reports are assessed by the day-to-day supervisor and an external assessor. In our study, we focus on the one-to-one supervision meetings between the student and the day-to-day supervisor.

5.3 Method

5.3.1 Participants

All the participants in this study were supervisors of students' research projects in the same research- intensive Dutch university. Eleven supervisors from two departments participated in the study. All the participants were junior researchers within the domain of the health sciences. The health sciences provided an authentic research context, wherein supervisors were likely to have more similar than different conceptions of research (e.g., Brew, 2001). Characteristics of the participating supervisors are presented in Table 5.1. The majority of the students' research projects took place either during the third year of the undergraduate degree or in the subsequent first year of the master degree. One or two students did conduct their research projects during the final year of the master degree. At the time of data collection the eleven supervisors were supervising twelve students' research projects. One supervisor was supervising two students' research projects

Table 5.1. Supervisor characteristics

Background variable		Number
Discipline[a]	Biomedical sciences	7
	Biopharmaceutical sciences	3
	Medicine	4
Gender	Female	7
	Male	4
Age (years)	Range	25-30
	Mean	27.3
Research experience (years)	0-3	9
	3-6	2
Supervising experience (years)	0-3	9
	3-6	2
Teaching experience (years)	0-3	8
	3-6	3

Note. [a]Three supervisors reported supervising students in two of the three categories

and preferred to be interviewed twice. In total, there were seven research projects being conducted as part of an undergraduate degree and five projects as part of a master's degree. The supervisors were supervising four male and eight female students. All the students had previous relevant university education within the health sciences domain prior to beginning their student research project.

5.3.2 Data collection and instrument

The participating supervisors were asked to reflect on a one-to-one supervision meeting with their student. All supervision meetings and interviews were conducted in Dutch. In order to elicit the supervisors' reflections on supervising students' research projects as well as to promote their reflective thoughts, we used a method similar to the stimulated recall method. In stimulated recall interviews, the participants select and discuss parts of student-supervisor interactions (Dempsey, 2010). In this way we were able to elicit the cognitions underlying the supervisors' supervision of their students (e.g., Verloop, 1989). Prior to the individual interviews a one-to-one research supervision meeting with a student was videotaped. Immediately after this meeting the supervisor selected meaningful fragments. The key question for selection was: 'At what times during the supervision meeting did you feel you needed to guide the student and what were your thoughts?' The supervisors were encouraged in the interviews to explain their practices during the supervision meeting with a student, based on video fragments. Data collection took place during spring 2015 and ethical approval was granted by the ethics research committee of the university's graduate school of teaching. All twelve interviews with the supervisors were audiotaped and lasted an average of 35 minutes.

5.3.3 Analysis

All the interviews were transcribed and coded based on a constant comparison analysis using teacher noticing as a sensitising concept (Bowen, 2006). As a starting point an existing coding scheme concerning teacher noticing was used (van Es & Sherin, 2008). Atlas.ti 7 software was used to iteratively analyse the data in several phases. During the first phase, the first author watched the videotape

of a supervision meeting in order to interpret the supervisors' explanations in the transcripts. After that two transcripts were coded inductively by the first and second author to obtain a sense of the information contained in the interviews. Next, the first and second authors worked independently through a set of three transcripts to identify what fragments referred to the supervisor noticing student learning. The fragments were assigned descriptive codes to the fragments based on the coding scheme of van Es and Sherin (2008). After that, the two authors discussed the descriptive codes until consensus was reached regarding the selection of fragments and descriptive codes. A total of 445 fragments were selected. In the second phase, the authors categorised the descriptive codes to establish a tentative coding scheme that fitted the supervision context of this study. The first author then applied the tentative coding scheme to an additional set of two transcripts until no new codes emerged from the data. Next, a research assistant was brought into the project who coded two transcripts together with the first author. After this round of coding and final adjustments, only a few new codes emerged. The results were compared until consensus was reached on the code descriptions. As an additional step intended to enhance the quality of the analysis, we assessed the inter-rater agreement. The first author and the research assistant both coded one-third of the transcripts independently. In two rounds of independent coding a good level of agreement between the researchers was reached for the ten codes within the coding scheme (kappa = .64; 72.6% agreement) (Fleiss, 1981).

During the third phase of the analysis the data were explored with regards to a dilemmatic space. To that end, the first author made a selection from the previously analysed fragments. The fragments that reflect the supervisors' difficulties when supervising students were selected. As a criterion for selection we used supervisors' expressions such as '…that is difficult for me' and '… that is what I'm most concerned about'. A total of 88 fragments were selected, which the first and second authors then discussed. The first author then coded the fragments into four themes that emerged from the data, after which the first and second authors interpreted the fragments for each theme. They found that formulating questions related to each theme, from the perspective of the

supervisor, demarcated a dilemmatic space. In this way a dilemmatic space in which the supervisors negotiated research supervision was established based on the data. The first author wrote a description of the themes and questions. Next, the first author and an independent researcher analysed fragments independently based on the descriptions in order to improve the analytical rigour. As a result, the themes were rephrased so as to establish four themes of the same order, all four of which relate to the supervisors' difficulties fostering student learning in supervision practice.

During the final phase of the analysis, the relationships between the dilemmatic space and the supervisors' practices were explored in a between-case data matrix (Miles & Huberman, 1994), which displayed the described dilemmatic space and practices. A summary of the between-case data matrix reflecting the illustrative fragments and references to other fragments is shown in Appendix 4. The fragments in the data matrix were discussed by the first and second authors. Examples from the data were then chosen to illustrate the relationship between the dilemmatic space and the supervisors' practices.

5.4 Results

5.4.1 Teacher noticing and dilemmatic space within the data

Five codes concerned the practices supervisors used during their undergraduate research supervision meetings. 'Fostering motivation' was concerned with encouraging the student and rendering the supervision meeting pleasant. 'Giving directions', 'promoting knowledge construction', 'thinking along' and 'creating awareness' were all directly related to the students' research process. 'Giving directions' was used to provide feedback, hints or instructions to the student, while checking students' knowledge level was a characteristic of 'promoting knowledge construction'. Through 'thinking along' the supervisor collaborated with the student, while 'creating awareness' was concerned with encouraging the student to underpin the steps taken during the research process. The full code descriptions are given in Appendix 5. Fictitious supervisor names are used and all examples taken from the data have been translated from Dutch.

Three codes emerged for the actors involved in the supervision practice, which refer to the person the supervisor was drawing attention to when watching the video, namely the 'student', the 'supervisor' or 'other'. Two codes referred to excerpts concerning (1) the supervisor's concerns regarding the planning of the project and (2) the aims of undergraduate research supervision as perceived by the supervisors.

Four codes emerged that described the dilemmatic space in which supervisors negotiated pedagogies during the supervision meetings. The codes were illustrated using questions to clarify the underlying dilemmas as elicited during the interviews. The first question was concerned with regulation in which supervisors deal with the question 'To what extent can the student regulate the research process?' An example from the data is shown below.

> '[…] On the one hand, he [the student] wants a structured project. On the other hand, he has indicated that he wants to do research independently. That was one of his learning goals for his final student research project. He wants an idea of where to start when he has a research project or research question again. For me, that's seeking a balance between those two.' (Mary).

Mary indicates that she experienced difficulties in structuring the learning process, since the student needed a structured research project and a sense of autonomy at the same time.

The second question, reflected the difficulties the supervisors experienced when determining the student needs ('What are the student needs?'). The supervisors exhibited difficulties in interpreting student behaviour or the student learning outcomes, for example, when a supervisor felt that a student did not process that supervisor's feedback in the way the feedback was intended. That led the supervisor to question her/his own actions. This is illustrated by the fragment below.

> 'And that's what I'm most concerned about. Are the tasks that I propose to her impossible to do? Yes, because she says she can't do it. Well … Is it too difficult for her? Or is she just cutting too many corners?' (Peter).

In this fragment, Peter shared his concerns about his student's actions. Fragments regarding the interpretation of students' needs reflect instances in which the supervisors might not know how to respond to their students and hence they questioned their actions.

The third question reflected the supervisors expressed concerns regarding their relationship with their students. Dilemmas regarding the student-supervisor relationship are reflected in the following question 'What should I do to maintain a good supervisor-student relationship?' which is illustrated in the following fragment.

> 'I wanted her to rephrase the text on her poster into scientific language. It was actually there, although the part about the cholesterol was missing, but I don't want to hurt her feelings. Because she tried her best and made a good sentence and she understands it.' (Vera).

Fragments involving the student-supervisor relationship illustrate the emotional aspects involved in interaction with the student. The supervisors indicated that it can be difficult for them to be clear to their students, as expressed above by Vera not wanting to hurt her student's feelings.

The fourth question was 'What is my role as a supervisor as perceived by others?' This concerns the supervisor's professional identity. It is illustrated in the following example.

> 'I have to tell him that I've noticed he's using [a translation engine] to translate and copy text. Yes, I have to tell him, otherwise he'll keep doing this. And his other supervisor at the school [university] is also going to read this'. (Anna).

In the fragment above Anna explains that she has to provide her student with instructions, since a second supervisor will also assess this research product. These fragments illustrate an emerging professional identity as the supervisors explore their roles based on their own role perceptions as well as those of others, such as a senior researcher and the student.

5.4.2 Exploring relationships between the dilemmatic space and supervisors' practices

'Promoting knowledge construction' and 'giving the student directions' as practices (see Appendix 5) were described by the supervisors across the four questions within the concept of dilemmatic space. The 'promoting knowledge construction' and 'giving directions' practices related to all the questions within the dilemmatic space. We hence chose to present examples from the data that illustrate variation regarding relationships between the dilemmatic space and supervisors' practices (see below).

5.4.2.1 The regulation question and giving directions

Within fostering regulation (Question 1) as a dilemmatic space we found that the supervisors were mainly providing the student with directions (see example below).

> 'What I've noticed is that I'm going to lecture him at a certain point. I often do that. I leave him more or less space to come up with his own things. I've noticed that during the supervision meeting, I've interrupted him once or twice. [Pointing at the video] Look, things like this. I already know he's got ideas about this, we've discussed this before. Despite that I tell him what the aim was and what we're going to do. Then I quietly wonder how that comes across to him, because I am determining the direction.' (Robert).

This example shows that the supervisors struggle with the extent to which they should promote student agency. In this case Robert is aware of that issue, although he still felt that giving the student directions was needed at that point.

5.4.2.2 Fostering motivation within the dilemmatic space

'Fostering motivation' was reflected in fragments in which the supervisors indicated that motivating the student and rendering the supervision process pleasant ('Practice/Fostering motivation') can be related to fostering student regulation (Question 1), to difficulties in interpreting student needs (Question 2) and to difficulties in maintaining the student-supervisor relationship

(Question 3) within their dilemmatic space. Dilemmatic questions regarding the supervisors' professional identity (Question 4) did not reflect 'fostering motivation' as a practice.

The following fragment from the interview conducted with Linda illustrates the relationship between 'fostering motivation' and the relationship between the supervisor and the student (Question 3; see below).

> 'She indicates that she isn't quite calm yet. I try to calm her down. She knows herself, she told me: "Every now and then I can't put my mind to rest. It [the research project] isn't easily out of my head." She keeps telling me that. And still this feeling isn't gone, she's trying to ignore it. Now, we're talking about it again.' (Linda).

In this fragment, Linda attempts to calm the student down and she provides her with clarity, without any reference to the issues resulting from the research project. A similar practice is also described by Linda in a situation where she is satisfied with the student's work, although this may relate to difficulties in interpreting students' needs (see the next fragment).

> 'Sometimes it's difficult to figure out what more you can do to make someone better. Sometimes it's already sufficient'. Interviewer: 'Did you try to figure out what you could do for her during this meeting?' 'Yes. This time I asked her, like feedback, at the end of the meeting about things that I could do. It's difficult for me to know what she thinks. […] Perhaps I'm doing too much for her?' (Linda).

Moreover, Anna describes 'fostering motivation' as a practice used in order to stimulate student regulation within the research project. This notion is reflected in the fragment below.

> 'He has to ask me if he gets stuck or when he has a question about the order of the findings in the report. He may try his best regarding his findings, although he needs to ask me when he gets stuck. From my own and others' experiences as students I know this is really difficult.' (Anna).

All three of these fragments involving fostering motivation as a practice suggest that the supervisors' assess the students' needs, including their need for supervisor support.

5.4.2.3 Supervision aims and the identity question

Finally, fragments concerning the 'supervision aims' were only reflected within the dilemmatic space of professional identity, as illustrated below.

> 'I find it difficult to provide feedback on this kind of rules of engagement [the student being late, the student sending an e-mail to the senior researcher without mentioning the supervisor]. I find it difficult, because it's only about how I like it.' (Mary).

In this fragment, Mary describes one of her supervision aims, namely to promote her students' professional behaviour. However, she feels unsure about doing this. One reason for this uncertainty could be that she understands the student to be acting in accordance with her own personal preferences ('… how I like it') rather than those of the supervisor (i.e., Mary).

5.5 Conclusions and discussion

The aim of this study was to describe novice supervisors' practices during research supervision as well as to explore relationships between supervisors' practices and the dilemmatic space which may reflect pedagogical choices in practice. This is based on the idea that research supervision practice can be seen as teaching with the aim of promoting student learning (e.g., Manathunga, et al., 2006). Supervision practice is complex, since pedagogical choices made in the real world can depend on supervisor characteristics, structural aspects of the environment and student understanding in student-supervisor interaction (Barnhart & van Es, 2015; Simon, 1957). Moreover, as novices are learning to identify patterns in students' cognitive development they may experience difficulties adapting their practices (e.g., van Es & Sherin, 2008). In this study,

the concept of teacher noticing was explored within the data. The interviews in this study elicited supervisor dilemmas which were conceptualised within the concept of dilemmatic space.

The analysis in this study revealed a dilemmatic space, that is, a decision-making space indicated by four interrelated questions about regulation, student needs, the supervisor-student relationship and supervisors' professional identity. Teacher dilemmas have previously mainly been explored separately. Amundsen and McAlpine (2009), for example, elicited novice supervisors' concerns about their professional identity. With rather similar results to our own, Wichmann-Hansen et al. (2015) found that experienced supervisors find it challenging to interpret students' questions and identify and develop their analytical skills. De Kleijn and colleagues (2014) suggested that experienced supervisors struggle with relational aspects and also with their own professional position. Although the themes were quite broadly formulated in our study concerning novices, previous findings indicate that experienced supervisors negotiate research supervision within a similar dilemmatic space (de Kleijn, et al., 2014; Wichmann-Hansen, et al., 2015).

Five practices were identified in this study encouraging student learning: 1) fostering student motivation, 2) giving directions, 3) promoting knowledge construction, 4) thinking along and 5) creating research awareness. This indicates that novice supervisors partly focused on instructional decisions in practice; for example, giving directions (cf. Talanquer, et al., 2007). Promoting knowledge construction could mean that the supervisors interpret student understanding during student-supervisor interaction, although based on the concept of teacher noticing this was expected to prove difficult for novice supervisors. These findings indicate that noticing can be a useful concept for understanding novice supervisors' practices, although longitudinal research is needed to provide insight into the adaptation of supervision practices. The supervision practices 'thinking along with the student' and 'creating research awareness' could be specific to a context in which students participate as a researcher (e.g., Healey and Jenkins, 2009). The supervision practices identified in our study may complement each other in terms of fostering student learning, although relations with student

perceptions of research within teaching still need to be explored (e.g., van der Rijst, et al., 2013). Furthermore, the results show that, in addition to supervision practices, novice supervisors reflect on the actors involved in students' research projects, the planning of the project and their personal supervision aims.

Relations between supervision practices and themes within a dilemmatic space were found. Dilemmas regarding fostering agency were related to student regulation and giving student directions. This could indicate that novices are aware of themselves as either hindering or fostering student ownership. Fostering student regulation might have been a prominent dilemma for the supervisors who participated in this study, since the results indicate that encouraging student regulation is related to direct means of steering students. Motivating students, as a practice intended to promote student learning, was related to fostering student regulation, the interpretation of student needs and the supervisor-student relationship. This result suggests that supervisors may encounter difficulties in making themselves clear to the student and maintaining the relationship (e.g., Turner, 2015). In addition to supervision practices, personal supervision aims seem to play a role in novice supervisors' dilemmatic space. The personal supervision aims were reflected in relation to concerns about their professional identity. This could be explained by a potential overlap between supervisors' conceptions of themselves, research and teaching, on the one hand, and supervisors' values and intentions as expressed through the dilemmatic space, on the other hand (e.g., Brew, 2003; Robertson & Bond, 2001; Visser-Wijnveen, et al., 2010).

5.5.1 Limitations and implications

When interpreting the results of this study the following points should be borne in mind. First, the participating supervisors have explicated their implicit dilemmas after the supervision meetings. In addition, the fact that the supervision meetings were videotaped might have affected both the students' and supervisors' behaviour. However, during the interviews, the supervisors were encouraged to reflect on all aspects of the supervision meeting including the potential influences of the video recording. The few times that the supervisors

mentioned being aware of the recording, they indicated that they had forgotten about it soon after the start of the meeting. Yet, this might raise questions about the validity of the explications. Nevertheless, the interviews took place immediately after a supervision meeting and the supervisors chose the moments within the meeting to reflect upon themselves. Second, the results were based on a sample of eleven supervisors employed within a single research-intensive university who voluntarily participated and were interested in improving their research supervision practices. This might affect the generalisability of our findings. Importantly, the findings of a previous study into data saturation in qualitative studies indicate that the number of supervisors in this study is close to the point at which it has been found that only limited new categories emerge from the data (Guest, et al., 2006). Furthermore, the literature concerning relations between research and teaching indicates that we need to consider potential disciplinary differences with regard to teaching (e.g., Colbeck, 1998; Smeby, 2000). This study was conducted, including multiple departments within the medical discipline as a hard discipline and this may hamper the generalizability of findings to other disciplines.

This study has three important implications for supervisor training practice within higher education institutions. First, based on the findings of this study it could prove beneficial to evoke supervisors' reflections on their own practices using video recordings in addition to more implicit ways of using supervisors' experiences to improve supervision practices. Further, the number of years of supervisory experience can serve as an indicator of quality in terms of supervision practices. For example, in the context of training, if novice supervisors could select both a positive and a challenging fragment from a meeting with a student. Subsequently, the supervisors could share their reasons for selecting the video fragments, watch the fragments together with their colleagues, discuss their supervisory behaviour and explore alternative practices (cf. Wichmann-Hansen, et al., 2015). Second, the findings of this study add to findings of earlier studies suggesting that novice supervisors approach research supervision using their previous experiences as both students and supervisors (Amundsen & McAlpine, 2009; Turner, 2015). They do so by using dilemmas that are inherent to student-

supervisor interaction as a starting point for sharing those experiences among colleagues who also supervise students. Moreover, the questions found in the dilemmatic space can be used to facilitate the sharing of ideas about research supervision practice. Third, the findings from this study suggest that fostering supervision practices that influence student learning during research projects requires an explicit focus on the part of supervisors. This is not always evident, since students' research projects are not directly seen by academics as an opportunity for promoting student learning (e.g., Brew & Mantai, 2017). Supervisor training could, therefore, focus on relations between supervisor's concrete experiences in supervising students, as well as their reflections on supervision practices and student learning.

Future studies concerning research supervision practices and the dilemmatic space of experienced supervisors could provide additional insights into the role of supervising experience in supervisor learning. For example, in comparison to novices, how do experienced supervisors reflect on their practices? Based on findings from previous studies it is expected that experienced supervisors experience similar dilemmas to novice supervisors (Amundsen & McAlpine, 2009; de Kleijn, et al., 2014; Wichmann-Hansen, et al., 2015).

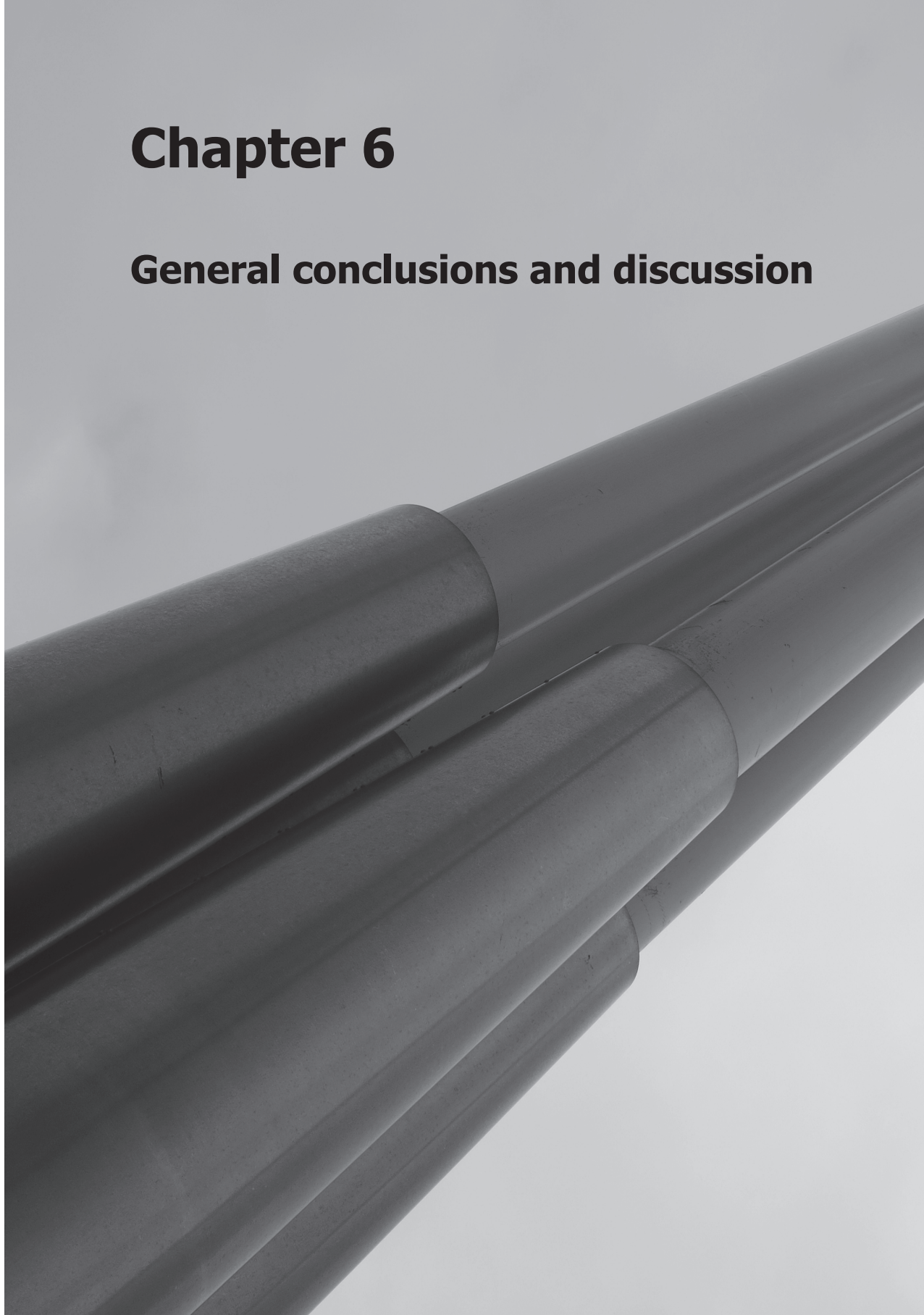
5.5.2 Conclusions

Promoting student learning in research supervision not only requires supervision experience that can be drawn upon in practice, but also the ability to interpret characteristics of student learning in interaction (e.g., van Es & Sherin, 2008). The diversity of concerns that novice supervisors' elicited in this study highlights the importance of the considerations that influence pedagogical choices. Interpreting student understanding is difficult for novices, since this is also mentioned as a theme within the dilemmatic space. This study provides in-depth insights into how novice supervisors supervise students' research projects. Our results show that, although students' research projects are common practice within higher education, stimulating student learning is not straightforward for novice supervisors. The findings further suggest that initiatives supporting supervisor development can benefit from explicit supervisor reflections on their practices

using video in contrast to more implicit ways of incorporating supervisor experiences in supervisor training. Furthermore, this study has revealed a dilemmatic space, demarcated by four dilemmas, in which research supervision takes place in practice. Based on the findings of this study it is suggested that dilemmas regarding the determination of the student needs, the extent to which the student can regulate the research process, the student-supervisor relationship and the role of the supervisor as perceived by others all influence supervision practices. Hence, they should be addressed in supervision training.

Chapter 6

General conclusions and discussion



6. General conclusions and discussion

6.1 Brief overview

The central aim of this thesis was to provide insights into student engagement within research in medical education which specifically aims to foster knowledge development through conducting research and to use of research findings to enhance patient care. Student engagement in research was purposefully chosen in order to reflect students' active involvement in a diversity of ways in which research is integrated into teaching. Student engagement in research in this dissertation is conceptualised as promoting student learning through research practices, which is facilitated by how students perceive research to be integrated into teaching, as well as student beliefs regarding the value of research for both learning and professional practice (cf. Trowler, 2010). To identify good practices and areas in need of improvement within the learning environment, student engagement in higher education in general has been considered an appropriate focus (e.g., Coates, 2010). Indeed, student perceptions of the learning environment provide a reliable picture of the integration of research into teaching (e.g., Visser-Wijnveen, van Driel, van der Rijst, Visser, & Verloop, 2016) and they play a crucial role in promoting student learning outcomes (Biggs, 1985; Prosser & Trigwell, 1999). Student perceptions of research integration are related to student beliefs regarding research and learning, in the sense that beliefs filter student perceptions of the learning environment (Pajares, 1992).

Given that the concepts of student perceptions and student beliefs are often used in close relation to each other (Pajares, 1992), both were carefully operationalised and contextualised in this study (see Chapter 1). The concept of student perceptions refers to ways in which students experience elements of research through teaching activities. Student beliefs regarding the relevance of research actually refer to two types of beliefs. First, to the belief about the extent to which research stimulates student learning, (i.e., beliefs regarding the relevance of research to learning). Second, to the belief about the extent to which students emphasise the role of research in their future professional practice (i.e., beliefs regarding the relevance of research to practice). Student perceptions and beliefs were examined in relation to teaching practices including supervision practices within students' research projects and an undergraduate programme in medicine striving to strengthen the role of research within teaching.

Four studies were conducted in order to address the central theme of the dissertation, namely: Strengthening the role of research integration in order to promote student engagement in research. The central aim of the studies presented in Chapters 2 and 3 was to improve our understanding of student research practices integrated into the study programme in the context of a curriculum change. The study presented in Chapter 4 was designed to explore student learning outcomes. The interview study presented in Chapter 5 reported on how novice supervisors stimulate student learning during students' research projects.

In this chapter, the main findings of the four studies are combined so as to draw general conclusions about student engagement in research in higher education. These general conclusions can be categorised into conclusions concerning: a) the role of the study programme in student perceptions of the integration of research into teaching and student beliefs regarding the relevance of research and learning outcomes; b) relations between perceptions, beliefs and learning outcomes; c) associations between student learning outcomes and research integration; and d) teaching practices stimulating student learning. The strengths and limitations of this thesis are considered and suggestions are offered for further studies into the integration of research into university teaching in general. This chapter concludes with recommendations for three key stakeholders in higher education, namely educational directors, academic developers and teachers.

6.2 Main findings

6.2.1 First study

What is the influence of authentic research practices, integrated into the study programme in the context of a curriculum change, on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning during the course of undergraduate medical education?

A longitudinal study was conducted in order to investigate student perceptions of research integration within the study programme and their beliefs regarding the relevance of research to both practice and learning. The context of the study was a curriculum change that aimed to strengthen research integration. Authentic research practices involved in every year of the study programme in the previous and the changed curricula were described using a framework for authentic learning (Rule, 2006). The description of the authentic elements within research practices particularly highlighted student engagement with professional practice within student research practices. In order to understand the role of such authentic aspects within student research practices three successive cohorts of undergraduates participated in this study. In total, 941 medical students completed the Student Perceptions of Research Questionnaire (adapted from Visser-Wijnveen, et al., 2016 also see Appendices 1 and 2). Over the course of the undergraduate programme, the students perceived stronger participation in research, stronger motivation for research and a more critical reflection on research findings, especially after the curriculum change. In addition, the data indicated that students' familiarity with staff research increased over their years of study. This was explained by authentic research practices that not only demonstrated tangible aspects of research integration to students (i.e., student participation), but also provided scope for modelling intangible aspects such as creating enthusiasm for research and promoting reflection on research findings (e.g., Neumann, 1994). The description of the research practices suggests that student learning could benefit from the fostering of discourse among learners and promoting student choice in terms of research practices. The findings suggest that the perceived relevance of research to practice is less strongly related to the curriculum than student perceptions of research within teaching. In the previous curriculum student beliefs regarding the relevance of research to learning decreased slightly over time, while when following the changed curriculum students found research to be more stimulating towards the end of the undergraduate programme.

6.2.2 Second study

What is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student learning outcomes, especially student products and test scores within the domain of research?

This study built upon the first study by comparing both student perceptions of research and student learning outcomes between two curricula, namely a changed curriculum that aimed to strengthen research integration and a previous curriculum. A focus on the first undergraduate year was chosen, since studying in a research environment within a university was a relatively new experience for first-year students, while it was thought that teachers may consider undergraduates to not yet be ready yet to engage in research (Brew, 2010; Zamorski, 2002). Within the changed curriculum, the first-year students participated as researchers in a student research project related to an early clinical experience in nursing homes. Within both the changed and the previous curricula, the first-year undergraduates also participated in an ECG-practical in which they collected data, conducted statistical analysis and wrote a research report. For the purpose of this study two batches of 50 reports per curriculum were rated blindly and anonymously by six trained raters using a scoring rubric. In order to understand the effect of the curriculum change on student research-related learning outcomes, the students' research reports from both curricula were compared. In addition to the reports, data were collected concerning the students' scores on the research-related items in a national progress test. The difference in the scores for the research reports as well as the research-related items on the progress test were statistically significant in favour of the changed curriculum, since the students who followed the changed curriculum wrote better research reports. The results of this study hence suggest that strengthening research integration had a positive effect on first-year students' research-related learning outcomes, particularly on their written research reports and items on a national progress test.

What is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning?

In this study, the perceptions of research integration of 261 students who followed the previous curriculum and 485 students who followed the changed curriculum were collected using a questionnaire (the SPRIQ). In line with the findings from the first study, the students who followed the changed curriculum perceived stronger participation in research, stronger motivation for research, a more critical reflection on research as well as being more familiar with staff research. No differences were found between the two curricula with regards to student beliefs regarding the value of research for future practice and the perceived quality of the learning environment. A critical reflection on research was experienced the most strongly in both curricula, followed by familiarity with current research and motivation for research. The perception scores concerning participation in research were the lowest of all the scales for both the previous and the changed curricula. The results from this study suggest that a curriculum change that aims to strengthen research integration on a large scale not only contributes to stronger perceptions of research in various ways, but also to specific, research-related learning outcomes, especially during the first year of medical education.

6.2.3 Third study

To what extent are student achievement, specifically grade point average, and student beliefs regarding the importance of research related to ways in which students perceive research in the first year of undergraduate medical education?

This study, which only involved students who followed the previous curriculum, used the SPRIQ to examine the relationship between student achievement and student perceptions of the integration of research into medical education SPRIQ. The students' grade point average (GPA) was chosen to reflect student achievement and provide an insight into the extent to which students' GPA reflects the research intensity of a study programme. The respondent group consisted of 261 first-year students. All the first-year students have participated in an ECG-practical in which they collected data, conducted statistical analyses and wrote a research report. The data suggests that student beliefs regarding the value of research for future practice are more strongly related to student achievement than perceptions of research within teaching and beliefs regarding research promoting current learning. The student perceptions of research integration were closely related to each other, indicating that the adapted version of SPRIQ used measures several aspects of perceived research integration as a concept within medical education. The students clearly recognised research throughout their courses and find it stimulating for their learning and important for professional practice. Student motivation for research within teaching was strongly related to their familiarity with current research and their beliefs regarding the value of research for both learning and future practice. A moderate correlation was found between student achievement and first-year students' motivation for research.

6.2.4 Fourth study

How do supervisors foster student learning in students' research projects in medical bachelor and master education and what is the relation between research supervision practices and the dilemmatic space in which novice supervisors negotiate research supervision?

This study focused on novice supervisors' approaches to research supervision as they explored their practices and experienced difficulties when supervising students. Twelve stimulated recall interviews were conducted with supervisors of students' research projects in the health sciences, either in the bachelor's or master's phases. The interviews took place immediately after an individual student-supervisor meeting. The analyses of the interview transcripts revealed five practices used by novice supervisors to stimulate student learning: (1) fostering motivation; (2) giving directions; (3) promoting knowledge construction; (4) thinking along; and (5) creating student awareness (see Appendix 5). In addition to supervision practices, the supervisors mentioned the actors involved in the student research project, namely themselves, the student and others. Further, the supervisors mentioned their concerns regarding the planning of the project as well as the aims of research supervision. An additional analysis was conducted, using the interview transcripts in order to explore the concept of a dilemmatic space within the data. This additional analysis revealed four kinds of dilemmas that may influence research supervision practices, namely questions regarding regulation,

student needs, the student-supervisor relationship and supervisors' professional identity (see Appendix 4). The practices that promote knowledge construction and giving the student directions were described by the supervisors across the four kinds of dilemmas. Within fostering student regulation as a dilemmatic space it was found that supervisors were mainly giving the student directions. Fostering motivation was reflected in fragments in which the supervisors indicated that they experienced dilemmas with regard to student regulation, the difficulties of interpreting student needs and the difficulties of maintaining the student-supervisor relationship. Dilemmas regarding the supervisors' professional identity were related to their aims when they are supervising students.

6.3 General conclusions

The studies presented in this dissertation were concerned with improving student engagement in research. Chapters 2 and 3 presented studies concerning student perceptions of research integration and their beliefs regarding the relevance of research in relation to the study programme. Chapters 2 and 3 both related to student engagement by providing insights into how relevant the students found the integration of research into the study programme to be (cf. Trowler, 2010). Chapter 3 also focused on improving student learning outcomes as an aim of student engagement in general (Pascarella, Seifert, & Blaich, 2010). Chapters 3 and 4 present findings regarding the learning outcomes that are directly (i.e., test items, student products) and indirectly (i.e., student achievement) related to student engagement in research. Findings from previous studies suggest that student achievement is strongly related to student engagement in learning activities in general (Kuh, Kinzie, Schuh, & Whitt, 2005; Pascarella & Terenzini, 2005). Student engagement is generally based on the assumption that learning is influenced by participation in purposeful learning activities (e.g., Coates, 2005). In line with this notion, Chapter 2 reported on research integration practices within study programmes, while Chapter 5 described novice supervisors' supervision practices. Chapters 4 and 5 focused on student engagement in research at the level of teaching and learning. As a result, partial conclusions can be drawn from each chapter. The general conclusions are categorised into conclusions in relation to the study programme, teaching practice, student beliefs and perceptions, and student learning outcomes, with a view to gaining a comprehensive understanding of the fostering of student engagement in research within university teaching at the meso and micro levels. Further, the general conclusions are presented and related to results from previous studies.

6.3.1 Study programme

A study programme that places a stronger emphasis on research integration, incorporating student research practices in professional contexts, can promote various aspects of student engagement in research: (1) critical reflection on research findings; (2) familiarity with staff research; (3) student motivation for research; (4) student participation in research; and (5) research-related student learning outcomes (Chapter 2 and 3). Student perceptions of research integration depend more on the study programme than student beliefs regarding the relevance of research do, particularly student beliefs regarding the relevance of research to professional practice (Chapters 2 and 3). When the study programmes were compared, it was found that students who followed a study programme with a stronger emphasis on research integration held stronger beliefs about the relevance of research to student learning (Chapters 2 and 3). In general, students may perceive stronger research integration towards the end of their undergraduate education, for instance, in individual undergraduate research projects (e.g., Healey, et al., 2010). Previous studies concerning research integration have identified various factors that influence student perceptions of research, emphasising the nature of disciplines, research cultures within institutes, course characteristics, ways in which teachers shape relations between research and teaching and students' abilities and motivation (Levy & Petrulis, 2012; Lindsay, Breen, & Jenkins, 2002; Neumann, 1994; van der Rijst, et al., 2013; Visser-Wijnveen, et al., 2010). Findings from previous studies indicate that the effective integration of research into the curriculum is based on factors such as students' roles in learning activities, the breadth and depth in of the promotion

of student understanding of research, current research practices within institutes and the expected learning outcomes (Healey & Jenkins, 2009; Zimbardi & Myatt, 2014). The findings discussed in Chapters 2 and 3 suggest that the study programme contributes to student engagement in research from the first year onwards. Furthermore, the findings from the studies presented in Chapters 2 and 3 indicate that student engagement in research is promoted through the connections made between research, teaching and professional practice within the study programme.

6.3.2 Teaching practices stimulating student learning

The academic staff's support of students during the conducting of research projects (Chapter 5) as well as in the learning activities related to (1) internships in nursing homes, (2) the ECG-practical, (3) the critical appraisal of drug advertisements, and (4) the critical appraisal of patient problems all shared similar characteristics a certain extent. Findings from a previous study indicate that course characteristics, such as the use of staff research, a focus on the researcher's dispositions, students conducting research projects, students following in the teacher's footsteps and student participation in the teacher's research all contribute to student knowledge about research, as well as their research skills, dispositions and awareness (Visser-Wijnveen, et al., 2012). To illustrate this point, we used a characterisation of different ways in which academic staff link research and teaching within courses as described in a recent publication by Visser-Wijnveen et al. (2012). The students' research projects and the learning activities related to professional settings both shared a focus on the teachers' research disposition, since both aimed for the students to deepen their understanding of the medical discipline by teaching them to be critical and to adopt an independent stance in a debate. For example, the supervisors of students' research projects thought along with the student and created awareness on the part of the students about what underpinned researchers' decisions (Chapter 5). Likewise, the students were taught to be critical regarding how claims are made in drug advertisements (Chapter 2). In addition, both of the students' research projects, for example, the ECG-practical, provided opportunities for the students to practise their research skills (Chapter 4 and 5). The students' research projects, unlike the other learning activities, provided the students with an environment in which they can follow in the footsteps of a researcher participate in the teacher's research (e.g., Visser-Wijnveen, et al., 2012). Despite the differences between the students' research projects and the learning activities related to professional practice, both focus on the students as learners and it is assumed that students' research capabilities will develop as they progress through the teaching they receive. The findings from the studies presented in this thesis suggest that teaching practices that make the relevance of research explicit to students mainly focused on the use of staff research, reflections on previous research findings and fostering motivation for research (Chapters 4 and 5). The findings from Chapters 4 and 5 particularly emphasise the importance of intangible aspects of research integration (in this case, critical reflection on research, student motivation for research and familiarity with staff research) rather than tangible aspects (i.e., participation in research) (e.g., Neumann, 1994) in terms of fostering student engagement in research, although the learning activities within the study programme were particularly designed to actively involve students as participants in research. On the matter of student engagement in research, the findings presented in Chapters 4 and 5 support the assumption that research integration should focus on both tangible and intangible aspects of research integration in order to benefit student learning within medical education.

6.3.3 Student perceptions and beliefs

Findings from previous studies concerning student perceptions of research suggest that students perceive both benefits and disadvantages of research integration (e.g., Healey, et al., 2010; Neumann, 1994). On the one hand, a strong focus on staff research may lead to a narrow representation of the field at the expense of the students' own interests (Healey, et al., 2010; Lindsay, Breen, & Jenkins, 2002; Neumann, 1994). On the other hand, students appreciate the staff's enthusiasm for their research, intellectually challenging research assignments and being taught up-to-date information (Healey, et al., 2010; Neumann, 1994; Robertson & Blacker, 2006). Several studies have drawn attention to student perceptions

of the benefits of research integration, including student participation in research, student motivation for research, familiarity with current research and reflection on research findings (Neumann, 1994; Robertson & Blackler, 2006; Turner, et al., 2008; Visser-Wijnveen, et al., 2016). However, previous studies have mainly focused on students in a range of disciplines from various years of study (Neumann, 1994; Robertson & Blackler, 2006; Turner, et al., 2008; van der Rijst, 2013; Visser-Wijnveen, et al., 2016), while integrating research into teaching in a way that is accessible to first-year students in particular can prove challenging (Robertson & Bond, 2001; Turner, et al., 2008). The results from the study presented in Chapter 4 suggest that first-year student perceptions of research integration within medical education mainly involve a critical reflection on research findings, motivation for research and familiarity with staff research. Student participation was less strongly perceived by first-year students. These results add to the findings of previous studies concerning hard-pure and soft-pure disciplines, indicating that students mainly familiarise themselves with the research interests of their own teachers (Biglan, 1973; van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013; Visser-Wijnveen, van Driel, van der Rijst, Verloop, & Visser, 2010). Student perceptions of research integration can be influenced by their beliefs regarding the relevance of research to both learning and practice (Robertson & Blacker, 2006). The findings of the studies in this dissertation suggest that student beliefs regarding the relevance of research to learning are more strongly related to their perceptions of research integration than their beliefs regarding the relevance of research to practice (Chapters 2, 3 and 4). This finding adds to the findings of a seminal paper on beliefs regarding teaching and learning, which indicates that general beliefs regarding teaching and learning are closely related to perceptions of teaching and learning (Pajares, 1992). Previous research findings indicate that students consider research stimulating for their learning (Healey, et al., 2010; Neumann, 1994; Robertson & Blackler, 2006; Turner, et al., 2008). In addition to student beliefs regarding the relevance of research to learning, the studies presented in Chapters 2, 3 and 4 place an emphasis on student beliefs regarding the relevance of research for practice in the context of hard-applied sciences. The findings presented in Chapters 2 to 4 indicate that students did not place more importance on research in relation to practice after participating in research practices that are closely connected to research, teaching, and professional practices, and which stressed the relevance of various approaches used to engage students in research.

6.3.4 Student learning outcomes

Student engagement in research was chosen as the focus of this thesis in order to emphasise the variety of ways used to actively involve students in disciplinary research through teaching. The concept of student engagement in general can be used to monitor good practices within institutes as well as to identify opportunities for improvement (Coates, 2010; Kuh, 2009). Student engagement in higher education research in general correlates positively with student learning outcomes as represented by their grade point average (GPA) and retention rates (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008). In this dissertation, student engagement in research was explored by investigating student perceptions of research in relation to the curriculum, student beliefs regarding the relevance of research and student learning outcomes (Chapters 3 and 4). A comparison was made between a previous curriculum and a changed curriculum using specific research-related learning outcomes (i.e., test items and student research reports; Chapter 3). The findings from the studies presented in Chapters 3 and 4 indicate that students' context- and discipline-specific student learning outcomes, including student research products and research-related test items, were a stronger indicator of student engagement in research within a study programme than generic student achievement (e.g., GPA; Chapters 3 and 4). The results reported in Chapter 4 suggest weak correlations between student perceptions of research integration and their GPA, whereas a changed curriculum intended to strengthen research integration into teaching contributed to specific research-related student learning outcomes (Chapter 3).

6.4 Strengths and limitations

6.4.1 Strengths

6.4.1.1 Various research designs and instruments

The first three studies included in this dissertation extend insights derived from previous studies into student perceptions, beliefs and learning outcomes in the particular context of a curriculum change. This combination of variables in two comparative studies (Chapters 3 and 4) provided insights into the influence of a curriculum change on both the perceived and the learned curriculum (e.g., van den Akker, 2006). Furthermore, the longitudinal design used in the study presented in Chapter 2 provided an opportunity to describe multiple research practices during the course of an undergraduate programme. Most importantly, a longitudinal study design was more likely to capture any changes in student beliefs regarding the relevance of research to learning and practice than a design focused on a one-off data collection, due to the robust, though not unchangeable, nature of beliefs (Mezirow, 1997; Pajares, 1992).

In contrast to the quantitative instruments used in the first few chapters, the study presented in Chapter 5 used interviews to provide an example of how ideas derived from research into teaching apply into the context of higher education within the medical domain. The use of several instruments serves to enhance the quality of research into higher education, since every instrument has its own biases and strengths, which complement each other and contribute to an understanding of complex phenomena such as student engagement in research and ways to foster student engagement in research (e.g., Miles & Huberman, 1994). In the study reported in Chapter 5, stimulated recall interviews were conducted in which supervisors described the practices they use in order to stimulate student learning. Using this technique, the researcher elicited the supervisors' reflections on their supervision practices in supervisor-student interactions. These interviews therefore helped novice supervisors to reflect on their supervision practices (e.g., reflective practice; Schön, 1987).

The variety of variables and instruments used in the studies presented in this dissertation originated from a desire to look beyond the boundaries of fields or disciplines when investigating student engagement in research. The findings of previous studies suggest that research into higher education could benefit from an interdisciplinary approach to investigating complex phenomena from various perspectives using a variety of instruments (Kandlbinder, 2013; Tight, 2014). The studies presented in this thesis provide examples of how ideas derived from higher education, medical education and teacher education can improve our understanding of student engagement in research.

6.4.2 Limitations

6.4.2.1 Nature of data collection

Some issues might limit the conclusions derived from the studies in this dissertation. These limitations particularly concern the nature of the data collection. The studies presented in Chapters 2, 3 and 4 relied partly on student perceptions of the learning environment and their beliefs regarding the relevance of research. The questionnaire used in this thesis explicitly asked students to report on their motivation for research, the quality of the learning environment and the extent to which they believed research to be relevant to learning and practice, which left little room for the researcher to probe or explore the student perceptions of research in specific teaching units.

In order to obtain more in-depth findings regarding student perceptions, beliefs, learning outcomes and practices, it is fruitful to triangulate the student data with information concerning teaching practices in contexts in which research is explicitly integrated. Chapter 5 reports on information obtained from stimulated recall interviews conducted with novice supervisors. Generally speaking stimulated recall techniques can prove valuable for tasks that are relatively new to teachers, since it can be expected that not much routinisation has taken place (e.g., Verloop, 1989). After the interviews, two supervisors indicated that it was difficult for them to reflect on their actions when the researcher seemed reticent, which could have hampered the verbalisation of their thoughts.

6.4.2.2 Generalisability

The studies in this dissertation were conducted within a single research-intensive

university medical centre, which may limit the generalisability of the findings. Nevertheless, the results from the questionnaire data are partly based on student perceptions of research integration in multiple teaching units taught by multiple teachers. In addition, all Dutch medical university study programmes are based on the same set of standards and learning goals (NFU, 2009). Furthermore, both medical and biomedical departments of Leiden University and the Leiden University Medical Centre participated in the interview study. The conclusions therefore primarily concern the medical discipline in research intensive universities in the Netherlands.

The sample included in the interview study was relatively small, which is typical of most qualitative studies. The results were based on a sample of eleven supervisors who voluntarily participated and who were interested in improving their research supervision practices. The number of supervisors involved in the study described in Chapter 5 is close to the point at which it can be assumed that limited new categories would emerge from the data (Guest, Bunce, & Johnson, 2006).

6.5 Implications

6.5.1 Recommendations for future research

6.5.1.1 Engagement in research in professional practice

The studies included in this thesis were based on the ultimate goal of student engagement in research in medical education, namely the integration of research into professional practice in order to improve patient care. The focus on student perceptions and learning outcomes in Chapters 3 and 4 was chosen in line with national and international frameworks for medical education which define knowledge about research and a positive research attitude as desirable learning goals (AAMC, 1998; GMC, 2015; NFU, 2009). Furthermore, both perceptions and learning outcomes can promote long-term outcomes, particularly when connections are made between prior and current learning experiences through teaching (e.g., Ashwin & Trigwell, 2012). The student perceptions and beliefs

regarding research presented in Chapter 2 were obtained at three particular moments in time, all within the undergraduate programme. Hence, the study does not provide insight into how engagement in research develops across the transition to professional practice. For example, how do novice medical doctors integrate research into their professional role? How and why do beliefs regarding the relevance of research to professional practice change during and after the transition to professional practice? An identity perspective would prove helpful in answering these questions (e.g., Kluijtmans, de Haan, Akkerman, & van Tartwijk, 2017). An example of this would be a longitudinal study following the participants of the studies included in this dissertation into clinical practice. It is important to obtain insights into relations between medical professionals' engagement in research and patient care, by means of exploring factors that could support successful integration of research into the clinical profession. Examples of these factors include academics' professional identities, their teaching activities and their beliefs regarding fostering engagement in research within professional practice (Law, Wright, & Mylopoulos, 2016; van Lankveld, et al., 2017).

6.5.1.2 Student engagement in research in other disciplines

This section summarises the most relevant suggestions for further research on student engagement in research in other disciplines. First, student engagement in research in this thesis consisted of student perceptions of the integration of research into teaching in medicine. Student perceptions of research integration in the humanities, sciences and medicine can be understood in terms of student motivation for research, their familiarity with staff research, a critical reflection on research products and their participation in research in relation to university teachers' intentions and courses (van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013; Vereijken, van der Rijst, de Beaufort, van Driel, & Dekker, 2016; Visser-Wijnveen, van der Rijst, & van Driel, 2016). To deepen our understanding of student engagement in research, a next step would be to explore relations between the actual time, effort and other resources invested by both students and teachers in research integration activities and student perceptions of research integration in various disciplines, preferably measured in terms of observations and logbooks (e.g., Trowler, 2010).

Second, the studies described in Chapters 2, 3 and 5 provide us with a sense of how research integration activities are organised within study programmes and show that research integration involves multiple disciplines within the medical domain. After all, the undergraduate research practices required the collaboration of academics from various departments. The studies in this dissertation focused on student outcomes stemming from the way in which research integration activities are organised rather than from the design and implementation processes themselves. Still, based on the notion that there are several ways for teachers to collaborate and engage in professional learning which influence the effectiveness of teaching approaches and study programmes, it could be important to focus further studies on learning processes that result from university teachers' collaborations in promoting student engagement in research (Harden, 2000; Kwakman, 2003; Steinert, et al., 2008). For example, how do university teachers learn from and with each other in the design and implementation of courses that aim to foster student engagement in research? What are relations between outcomes of professional learning, in terms of course implementation and design, and student engagement in research? It would be interesting to study these issues in the context of curriculum development within medicine and other disciplines, using instruments that facilitate teachers' critical reflection on both collaboration and professional learning (e.g., Schön, 1983).

6.5.2 Practical implications

6.5.2.1 Implications and recommendations for study programmes

A well-considered design of the study programme is needed to foster student engagement in research. Throughout undergraduate education, research integration practices can be designed in such a way that students obtain as many learning opportunities as possible and become acquainted with a broad variety of research practices during their studies. The examples described in Chapters 2, 3 and 4 of this thesis present a variety of ways of strengthening research integration within the study programme, with the aim being that students gradually develop individual competencies in conducting research. For student engagement in research to be fostered, the students need to experience a variety

of research activities, modelled and guided by the teachers. These include student participation in research, their critical reflection on research findings, the staff creating enthusiasm for research and familiarising their students with their own research. The findings of a recent study suggest that this is also the case for hard-pure and soft-pure disciplines (Visser-Wijnveen, van der Rijst, & van Driel, 2016), which indicates that educational directors and programme managers in higher education institutions, should strive to facilitate a broad variety of research within their institutions. They should aim to incorporate this research into teaching in order to provide students with ample opportunities to engage in a wide variety of research approaches within their discipline and to prevent the study programme from only showing students a narrow representation of the field.

A next step in curriculum development in order to take student engagement in research further would be to promote coherence in curriculum design. The findings from the study presented in Chapter 2 suggest the importance of focusing development initiatives on fostering student beliefs regarding the relevance of research to future practice. This requires the design of study programmes to facilitate students' integrative experiences in research in addition to the rather fragmented student research practices contained within courses. In designing a curriculum, attention should be paid to helping students relate their learning experiences gained from research practices to the use of research in professional settings. This could be achieved, for example, by fostering students' reflections on prior learning experiences at the beginning of each student research project and by using a portfolio or blogs for students to promote their reflections and strengthen connections between learning experiences in research and learning experiences in clinical settings (e.g., Howitt & Wilson, 2016).

The findings from the studies presented in Chapters 2, 3 and 4 indicate that student perceptions of research integration, context- and discipline-specific student learning outcomes can be used to provide an indication of the research-intensiveness of a study programme. For example, a tangible aspect of research such as students' perceived participation in research can be reliably measured using the SPRIQ and then sensibly interpreted in relation to a study programme. In addition to student perceptions, the findings from the studies reported in

Chapters 3 and 4 indicate that, compared to student achievement (GPA), student products and research-related test items can be a helpful source of information for decision-making. The implication of this is that dialogues within higher education institutes concerning student engagement in research in study programmes should be based on student perceptions of research in teaching in combination with specific research-related learning outcomes rather than on the GPA. Examples of specific research-related learning outcomes include student products such as reports and essays. A next step would be to adapt the learning activities towards the desired and specific learning outcomes, for example, by thinking about the student in the role of a researcher. As a starting point, the descriptions of student research practices given in Chapters 2 and 3 could be used.

6.5.2.2 Implications and recommendations for teaching

The findings from the studies presented in Chapters 2 and 3 indicate that student beliefs regarding the importance of research are rather stable but not unchangeable over time. This puts the emphasis on the idea of challenging students' beliefs regarding the relevance of research in order for student engagement in research to reach its full potential. This could be achieved by encouraging students to develop integrated ideas about the value of research for practice. Teaching could hence focus on encouraging students to reflect on their consciously and unconsciously held beliefs regarding the importance of research at the beginning of research-intensive courses. Encouraging students to make their ideas about research within the discipline explicit and compare their ideas to explanations given by researchers and professionals would be a practical way for teachers and supervisors to take students' presuppositions about the use of research in professional practice into account. Furthermore, doing so would inform teachers about how to guide their students towards the desired learning outcomes in research-intensive courses.

The findings of the studies presented in this thesis indicate that components of student engagement in research are related to the study programme (Chapters 2 and 3), to each other (Chapters 3 and 4) and to a dilemmatic space experienced by academics when attempting to stimulate student learning in research practices (Chapter 5). For this reason, it might prove profitable to gear professional development initiatives for teachers and supervisors during the process of curriculum change towards promoting student engagement in research. In order to strengthen student engagement in research through supervision, professional development initiatives should focus on both experienced and novice supervisors as well as on concrete experiences when supervising students, so as to foster reflections on teaching practices, desired learning outcomes and student perceptions and beliefs regarding research. It might be beneficial to design professional development initiatives to help supervisors make connections between specific situations and broader principles of research supervision. Such initiatives could also help supervisors to learn from student understanding by looking at supervisor-student interactions. In practice, this could be done in a series of training sessions in which supervisors reflect on their practices using video recordings of student-supervisor interactions that compel them to discuss difficulties and alternatives for action. In addition, the study programme should be involved in research supervision training. For example, by encouraging supervisors to analyse the learning goals of courses within the undergraduate curriculum that are intended to prepare students for their research projects, which should improve their understanding of students' learning paths.

6.6 Final comments

Student engagement in research in medical education aims to foster two main outcomes, namely to teach students how to conduct research aimed at developing knowledge and to teach students how to incorporate research into clinical care by means of the critical appraisal of research findings. The findings from the studies in this thesis suggest that the promotion of positive outcomes, such as student beliefs regarding the relevance of research to professional practice, mainly involves using staff research, reflections on previous research products and fostering motivation for research. The results indicate that student engagement in research in medical education is promoted through a diversity of approaches to integrating research into the medical study programme, including promoting

student participation in research, familiarity with staff research, motivation for research and critical reflection on research findings within undergraduate education. These approaches serve to improve specific, research-related student learning outcomes. It is generally assumed in higher education that strong connections between research and teaching are a valuable means of preparing students to function well as professionals as well as enabling them to appraise the role of academic research in complex, professional practices (e.g., Brew, 2003; 2010). The findings from the studies presented in this dissertation support this notion, indicating that integrating actual research into learning activities promotes student engagement in research during their undergraduate education. Particularly in medical education, it is not yet evident how connections between medical research and patient care can be strengthened (e.g., Roberts, Fischhoff, Sakowski, & Feldman, 2012). Student research practices in undergraduate medical education provide a starting point for promoting student engagement in research, although these research practices need to be continued during later phases of their medical education (i.e., specialist training). Further research is needed to investigate how beliefs regarding research and research competencies develop during both medical education and the transition to medical professional practice.

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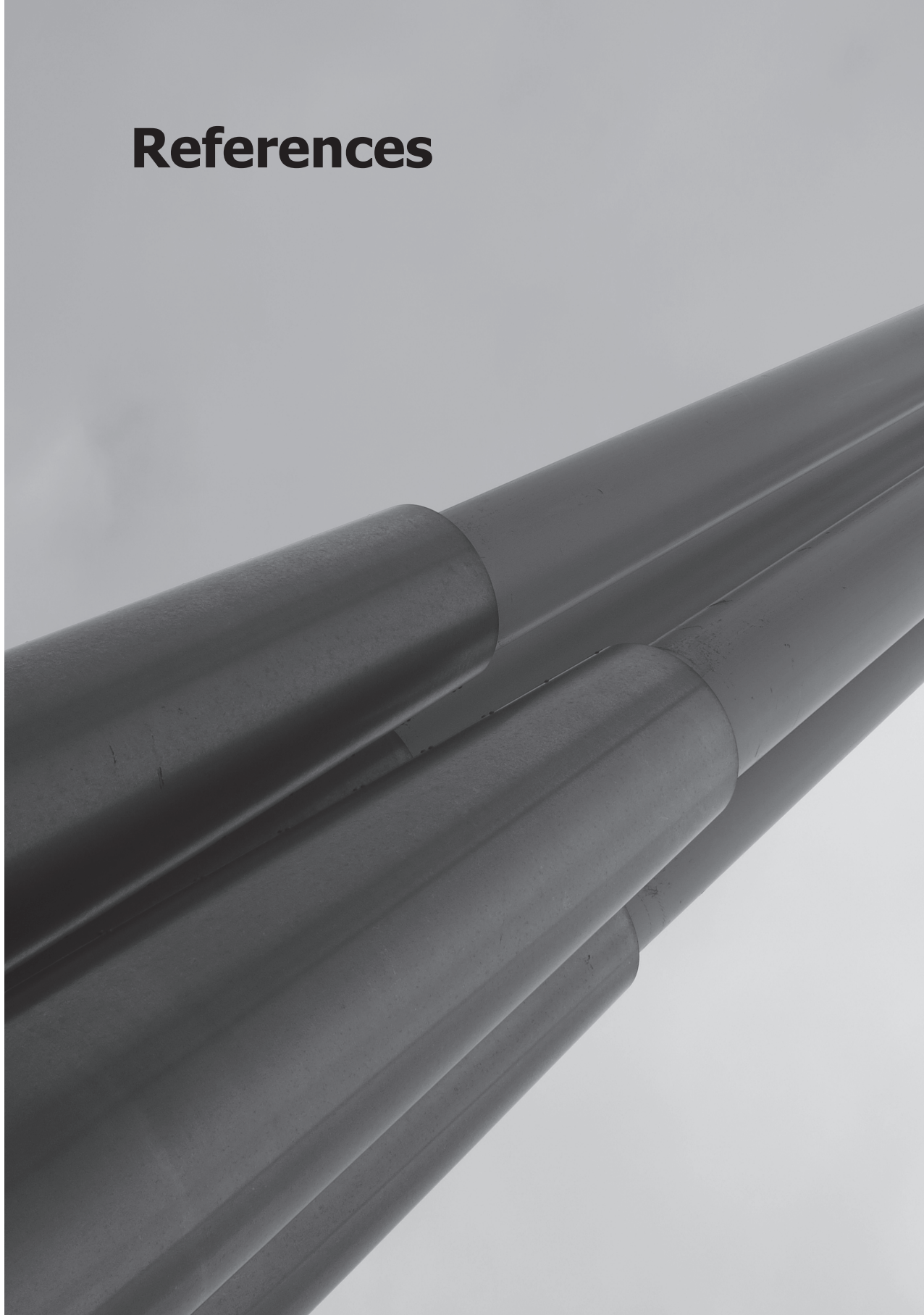

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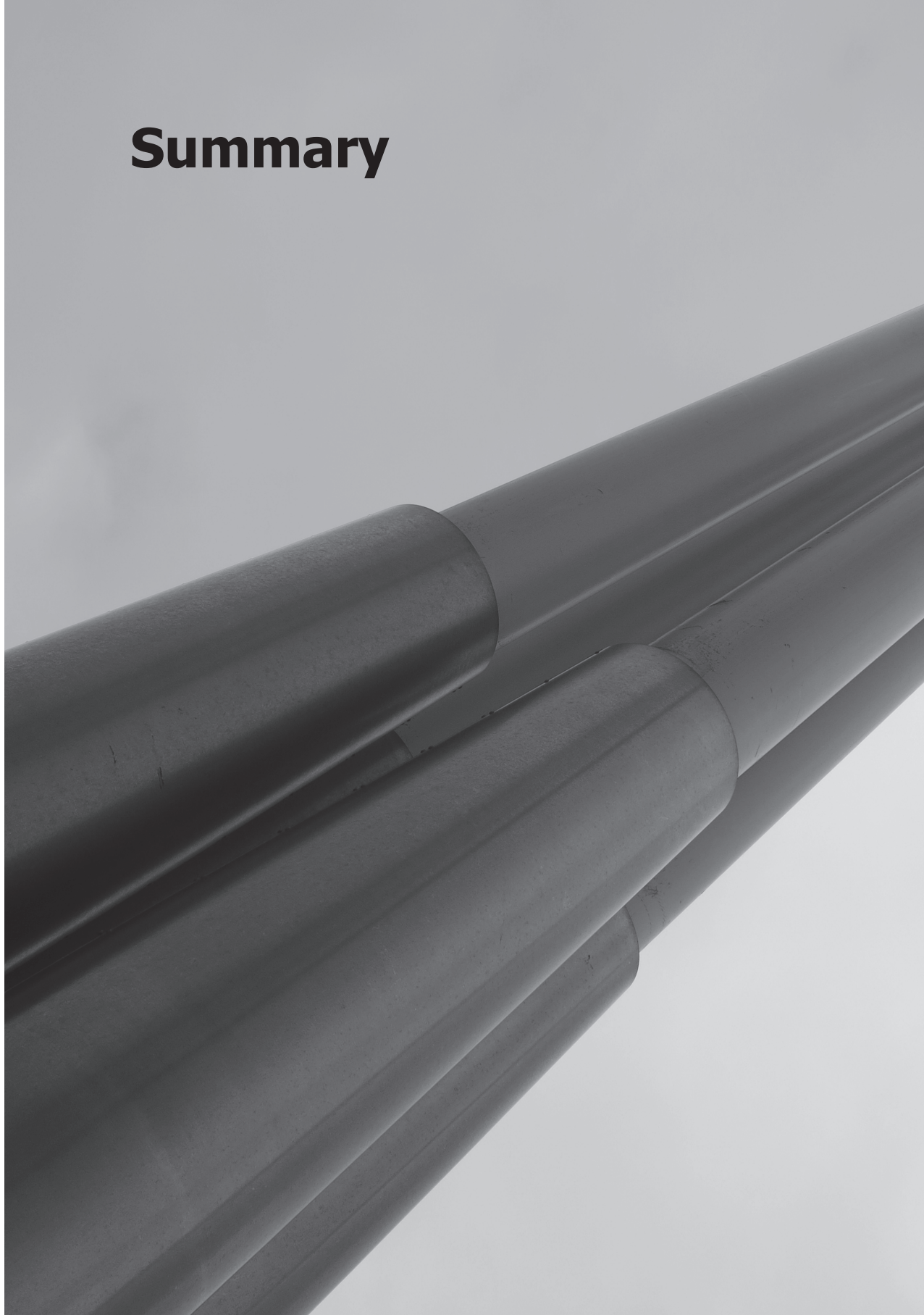
Summary



Summary

Chapter 1: General introduction

While academics, managers and academic developers generally all highly value close connections between research and teaching due to the perceived benefits for student learning, it is not always evident to students how to become engaged in research through the teaching they receive. The way in which the link between research and teaching is articulated by academics and experienced by students not only depends on the mission statement of a particular study programme, but also on the learning activities that the students participate in. The studies included in this thesis all examine various aspects of student engagement in research within the medical domain. In the medical discipline, the integration of research into teaching is deemed to be highly relevant if students are to learn how to conduct research and incorporate research into their professional, clinical decision making, all of which is intended to improve patient care. The notion of student engagement in higher education emphasises ways in which students participate in learning activities as well as how the academic staff provides opportunities for them to become involved. Student engagement in general is, therefore, considered useful in relation to monitoring both areas that need improvement and good practice within study programmes. In line with this, student engagement in research highlights the relevance of the desire to actively involve students in disciplinary research in various ways, with the aim being to promote student learning about research and from research as well as their understanding of how to conduct research. In this dissertation, student engagement in research is conceptualised as promoting student learning through research practices, which is facilitated by how students perceive research to be integrated into teaching as well as student beliefs regarding the value of research for learning and professional practice. Student perceptions of the learning environment are particularly important in terms of fostering student learning outcomes. They influence student achievement and learning outcomes, for example, skill performance, directly and indirectly via the ways in which students approach learning. More precisely, student perceptions of the learning environment influence both their achievement as reflected in their grades and their research skills as reflected in the work they produce. Student perceptions of research involve: (1) participation in research; (2) critical reflection on research findings; (3) motivation for research; and (4) familiarity with staff research. The term 'research integration' is used in this thesis to refer to all learning activities within teaching units in the medical domain in which the fostering of student engagement in research findings and research processes is an essential element.

The context of a curriculum change at the Leiden University Medical Center (LUMC) was considered particularly appropiate for studying student engagement in research. Indeed, student research practices constituted a key element of a curriculum change that aimed to strengthen research-teaching integration. The first two studies (Chapters 2 and 3) included in this thesis were designed to provide insights into the effect of the study programme (e.g., the sequence of courses) on student learning outcomes. Regarding student engagement in research, Chapters 2 and 3 provide valuable insights into the relevance of the study programme as perceived by the students as well as into the quality of student learning outcomes. Previously, strong correlations have been found between student engagement in learning activities and student achievement. The study presented in Chapter 4 aimed to explore relations between student perceptions of research, their beliefs regarding the relevance of research and student achievement. Chapter 5 reports on a study designed to provide in-depth insights into how supervisors foster student learning during students' research projects. This study relates to student engagement in research through its focus on how supervisors guide student participation in purposeful learning activities in which research is integrated. Students' research projects were chosen as a context for studying research-teaching integration, since research projects, for example, undergraduate's and master's dissertations, are common in university education and both have similar learning goals with regard to promoting research competencies such as critical and scientific thinking. Research supervision offers an example of a teaching activity based on the notion that supervision contributes

to student learning about research findings and processes. Particularly in the context of medical education, students' research projects are supervised by PhD students or immediate postdoctorates. This group may especially benefit from support in terms of exploring approaches to supervision and ways of dealing with challenges. The study presented in Chapter 5 hence aimed to provide in-depth insights into how novice supervisors can foster student engagement in practice as well as how this practice may be shaped by dilemmas they face in student-supervisor interaction.

Chapter 2: Authentic research practices throughout the curriculum

The longitudinal study described in Chapter 2 aimed to assess the influence of authentic research practices on student perceptions of research and their beliefs regarding the relevance of research to both practice and learning. The research question was: *What is the influence of authentic research practices, integrated into the study programme in the context of a curriculum change, on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning during the course of undergraduate medical education?* The inclusion of authentic research practices within every year of the undergraduate study programme was implemented in the context of a curriculum change. A framework for authentic learning was used to describe authentic aspects of the research practices, including: (1) student engagement with real-world professional practice; (2) the opportunity to practice thinking skills; (3) fostering discourse among learners; and (4) elements of students' choice during learning (Rule, 2006). The description of research practices emphasised student engagement with professional practice within research practices in particular. For the data collection, an adapted version of the Student Perceptions of Research Integration Questionnaire (SPRIQ) was used with three cohorts of undergraduate medical students (n = 941). All the students in these cohorts were invited to complete the SPRIQ towards the end of each academic year, after they had completed their research practices. A comparison was made between two student cohorts

studying the changed curriculum (n = 619) and a cohort who studied the previous curriculum (n = 322). An analysis of the data suggested that the students perceived stronger participation in research, stronger motivation for research and a more critical reflection on research findings, over the years of their study, particularly within the changed curriculum. Furthermore, the data suggested that authentic research practices do not only articulate tangible research aspects to students, but also provide space for teachers to familiarise students with the research activities of staff. Students who followed the previous curriculum found research to be less relevant to their learning over time, while those who followed the changed curriculum exhibited an increased belief in the relevance of research to learning towards the end of the study programme. The findings suggest that student beliefs regarding the value of research to professional practice were less strongly related to the study programme than student perceptions of research in teaching. This implies that the active involvement of students in research through authentic research practices within the study programme does not necessarily demonstrate the practical relevance of research to students. It also suggests that learning outcomes associated with the integration of research, other than beliefs regarding research and a programmatic approach to the implementation of authentic research practices could promote student engagement in research. One way of achieving this would be to focus on learning activities that allow students to relate their perceptions of research within teaching to their beliefs regarding research in practice to promote connections between rather individual pieces of knowledge concerning the use of research in medical professions.

Chapter 3: Research integrated into the first-year curriculum

After assessing the influence of the curriculum on student perceptions of research, as well as their beliefs regarding the relevance of research to both learning and practice, in Chapter 2, the potential influence of the study programme on student learning outcomes was examined in Chapter 3. The first research question of the study presented in Chapter 3 was: *What is the influence of a curriculum change placing*

a strong emphasis on research integration into the first-year medical study programme on student learning outcomes, especially student products and test scores within the domain of research? The second research question was: *What is the influence of a curriculum change placing a strong emphasis on research integration into the first-year medical study programme on student perceptions of research in teaching and on student beliefs regarding the relevance of research for practice and learning?* The first-year study programme was chosen because studying within a research environment at the university is a relatively new experience for first-year students. This makes it challenging for teachers to incorporate research into their teaching in ways that promote student learning outcomes. This study was conducted in the context of a curriculum change that aimed to strengthen research integration. When following the changed curriculum the first-year undergraduates participated as researchers in projects related to an early clinical experience in nursing homes. For both the previous and the changed curriculum, the students also participated in an ECG-practical in which they collected data, conducted statistical analyses and wrote a research report. In order to investigate student learning outcomes, the reports per curriculum were rated blindly and anonymously using a scoring rubric. Data were also collected regarding the scores for research-related items on a national progress test. The differences in the scores for both the reports and the test items suggest that students who followed the changed curriculum wrote better reports and performed better in relation to the test items. The SPRIQ was used to compare the student perceptions of research integration and their beliefs regarding the relevance of research to learning and practice between the curricula. The findings suggest that first-year students who followed the changed curriculum (n = 485) perceived stronger participation as researchers, stronger motivation for research, more critical reflection on research and a stronger familiarity with staff research than students who followed the previous curriculum (n = 261). The findings of this study hence suggest that a curriculum change that aimed to strengthen research integration contributed to both first-year student perceptions of research integration and their learning outcomes within the domain of medical research. The findings add to the knowledge base on the integration of research into medical education by indicating that student learning can benefit from a focus on student perceptions of research in the context of teaching as well as from focusing on specific, research-related learning outcomes.

Chapter 4: Student perceptions, beliefs concerning the value of research and achievement

Chapter 2 explored relations between study programmes, student perceptions of research and student beliefs regarding the relevance of research, while in Chapter 3 this investigation was extended by including specific, research-related learning outcomes. The study presented in Chapter 4 aimed to provide insights into relations between student perceptions of research, beliefs regarding the relevance of research and a generic learning outcome, namely student achievement. This was based on the notion that student perceptions of the learning environment not only influence their research skills as reflected in the work they produce, but also their achievement. The research question addressed in Chapter 4 was: *To what extent are student achievement, specifically grade point average, and student beliefs regarding the importance of research related to ways in which students perceive research in the first year of undergraduate medical education?* The grade point average (GPA) was examined in relation to student perceptions of research in order to determine the extent to which the research intensity of the student programme was reflected in their GPA. The SPRIQ was administered to 261 first-year medical undergraduates in one study programme. The study programme mainly consisted of theoretical classes augmented by small-group work and short patient encounters. As part of the first-year study programme, the students participated in an ECG-practical in which they collected and analysed data and then reported their findings in writing. The findings suggest that student achievement was more strongly related to their beliefs regarding the relevance of research to practice than to student perceptions of research. First-year medical students clearly recognised research as being integrated into their teaching, found research motivating for their learning and considered research to be relevant to their future practice. Student motivation for research correlated strongly with familiarity with staff

research and student beliefs regarding the relevance of research for learning and practice. A moderate correlation was found between student motivation to both research and student achievement. The findings of this study suggest that, in order to promote student achievement, emphasis should be placed on learning activities that aim to foster student beliefs regarding the relevance of research to practice.

Chapter 5: Supervision practices and the dilemmatic space within research supervision

Research supervision during students' research projects, for example, undergraduate's and master's dissertations, can be considered a teaching activity, since it is assumed that students learn from conducting research under supervision, from engaging in research processes and from their supervisor's feedback. Based on the notion that supervisors learn to focus on student understanding in interaction with the students, Chapter 5 reports on a study investigating novice supervisors' practices during student-supervisor meetings. The concept of teacher noticing is explored in this study in the context of research supervision. Furthermore, research supervisors can have multiple goals simultaneously during student-supervisor interaction which may affect their pedagogical decisions and which are negotiated in a dilemmatic space. This study aimed to explore relations between novice supervisors' practices and the dilemmatic space in which they make their pedagogic decisions. The research question was: *How do supervisors foster student learning in students' research projects in medical bachelor and master education and what is the relation between research supervision practices and the dilemmatic space in which novice supervisors negotiate research supervision?* Twelve stimulated recall interviews were conducted with supervisors of students' research projects in the medical and biomedical sciences. The interviews took place immediately after an individual student-supervisor meeting. The results of the analysis of the interview transcripts suggest that novice supervisors use five practices to foster student learning (1) fostering motivation; (2) giving directions; (3) promoting knowledge construction; (4) thinking along, and (5) creating student awareness. In addition to the identified practices, the supervisors mentioned the actors who are involved in the students' research projects, namely themselves, the student and others. In addition to practices and actors supervisors mentioned the planning of the project with the goal of timely completion and the aims of research supervision. In an additional analysis the transcripts were used to explore the concept of a dilemmatic space within the data. Four kinds of dilemmas were revealed, namely supervisors' questions regarding regulation, student needs, the student-supervisor relationship and the supervisors' professional identity. Promoting knowledge construction as a practice and giving the student directions were described across the four dilemmas. It was found that the supervisors mainly provide directions within the space of fostering student regulation. Fostering student motivation was reflected in relation to dilemmas involving student regulation, difficulties in interpreting student needs and maintaining the student-supervisor relationship. The aims of supervision were mentioned in relation to supervisors' professional identity.

Chapter 6: General conclusions and discussion

In Chapter 6 the main research findings are summarised, general conclusions are offered, the strengths and limitations of the research are described, and suggestions are put forward for both future research and educational practice. The general conclusions integrate the findings of the separate studies and hence they are categorised into conclusions regarding the following themes; (1) study programme; (2) teaching practice; (3) student perceptions and beliefs; and (4) student learning.

Study programme

- The study programme contributed to five aspects of student engagement in research: (1) critical reflection on research findings; (2) familiarity with staff

research; (3) student motivation for research; (4) student participation in research; (5) research-related student learning outcomes (Chapters 2 and 3).
- The study programme was more closely related to student perceptions of research integration than to student beliefs regarding the relevance of research for professional practice (Chapters 2 and 3).

Teaching practice

- Teaching practices that render the relevance of research explicit to students were found to mainly focus on using staff research, reflections on previous research findings and fostering motivation for research (Chapters 4 and 5).
- Teaching practices within medical education emphasised both intangible aspects of research, for example, critical reflection on research findings, motivation for research and familiarity with staff research and tangible aspects of research integration, for example, student participation (Chapters 4 and 5).

Student perceptions and beliefs

- Student perceptions of research as integrated into teaching depended more strongly on their beliefs regarding the relevance of research to learning than on student beliefs regarding the relevance of research to practice (Chapters 2, 3 and 4).
- Student beliefs regarding the relevance of research were mainly fostered via the promotion of student motivation for research through teaching (Chapter 4).

Student learning outcomes

- Context- and discipline-specific student learning outcomes, for example, student research products and research-related test items, were a strong indicator of student engagement in research within a study programme, in contrast to students' generic achievement, such as their GPA (Chapters 3 and 4).

Practical and theoretical implications

Professional practice both in medicine and higher education can benefit from further studies concerning student engagement in research. First, future studies of professional practice in medicine should focus on how engagement in research develops across transitions as well as how it influences patient care. For example, how do novice medical doctors integrate research into their professional role? Second, further studies can deepen our understanding of student engagement in research by exploring relations between the actual time, effort and other resources invested by both students and teachers in research integration activities and student perceptions of research in various disciplines. Third, greater importance should be placed on professional learning in the context of the design and implementation of curriculum changes intended to promote student engagement in research. In most cases, university teachers from various departments need to collaborate and adapt their teaching practices to foster student engagement in research.

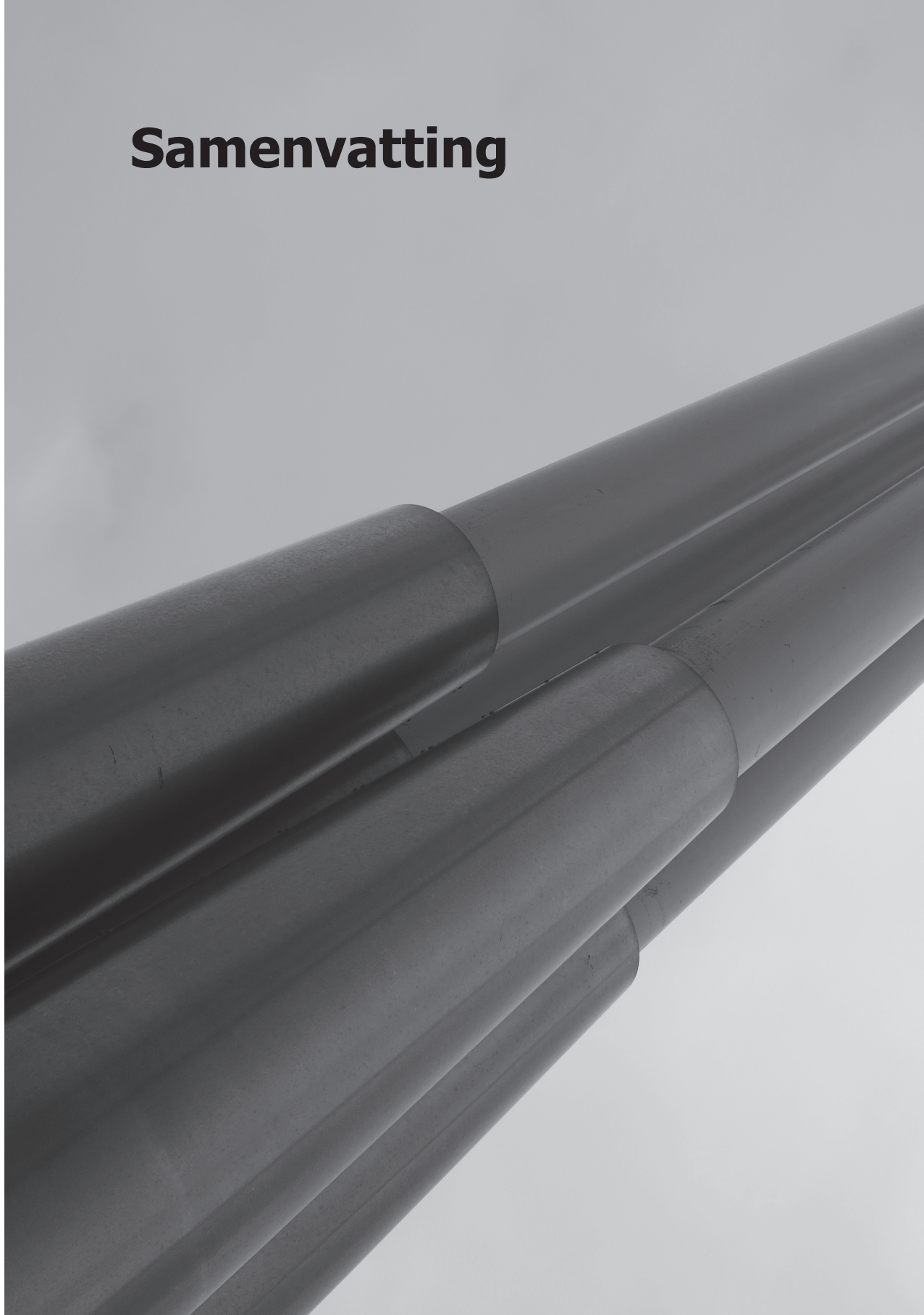
The practical implications of the studies in this dissertation are discussed in relation to study programmes and teaching. The results of the studies suggest that research integration practices should be designed to allow students to have ample opportunities to engage in a wide variety of research. This means that educational directors and programme managers should strive to incorporate a variety of research approaches into teaching so as to present a broad representation of the field to students. The next step in the curriculum design should aim to promote coherence with regard to research integration practices within the study programme, which means that study programmes should facilitate students' integrative learning experiences in research in addition to the rather fragmented research practices within courses. Furthermore, the instruments used in the studies presented in Chapters 2 to 4 can be used to gain insights into the research-intensiveness of a study programme from which adaptations to learning activities may follow.

With regards to teaching, it may be helpful to encourage students to make their beliefs regarding the relevance of research explicit. For example, by comparing

their ideas to the experiences of researchers and professionals in the field. When it comes to professional development initiatives in higher education, learning activities that enable both novice and experienced supervisors to connect principles of research supervision to their practices should be implemented. Findings from the study presented in Chapter 5 suggest that the use of video recordings of supervision meetings can be useful in terms of achieving this goal.

In conclusion, the potential of current and future studies into student engagement in research is emphasised in light of trends in both higher and medical education that will continue over the coming years. Further studies of student engagement in research in medicine could deepen our understanding of connections between research and teaching in higher education in general. In medicine in particular, further investigation of student engagement in research could provide insights into how to strengthen connections between research and patient care. Therefore, we encourage researchers who are investigating student engagement in medical education to look beyond disciplinary boundaries.

Samenvatting



Samenvatting

Hoofdstuk 1: Introductie

Een van de doelstellingen in de onderwijsvisie van de Universiteit Leiden is het versterken van de rol van onderzoek in het onderwijs. Betrokkenheid van studenten in onderzoek in het onderwijs wordt als waardevolle voorbereiding gezien op functioneren in een toekomstige baan. Toch is het voor studenten niet altijd evident op welke manier zij betrokken worden in onderzoek in hun onderwijs. De studies in dit proefschrift gaan over aspecten van studentbetrokkenheid in onderzoek in het medisch onderwijs. Studenten geneeskunde leren tijdens de opleiding bevindingen uit medisch-wetenschappelijk onderzoek te gebruiken en leren onderzoek doen ter bevordering van de patiëntenzorg. De studies hebben tot doel inzicht te krijgen in hoe studenten onderzoek in hun opleiding ervaren, in gerelateerde leeruitkomsten en de manier waarop onderzoek begeleid wordt in de context van een curriculumverandering bedoeld om onderzoek sterker in het onderwijs te integreren. Een curriculumverandering in het Leids Universitair Medisch Centrum bood een passende context om het onderzoek uit te voeren. De curriculumverandering had tot doel onderzoek sterker te integreren in leeractiviteiten en daartoe werden onderzoekspraktijken in het studieprogramma geïmplementeerd. In dit proefschrift is studentbetrokkenheid in onderzoek gedefinieerd als het bevorderen van leren door onderzoekspraktijken, ingegeven door studentpercepties van onderzoek in het onderwijs en opvattingen over de relevantie van onderzoek. Bevindingen uit eerdere studies naar studentbetrokkenheid in het hoger onderwijs suggereren dat zowel de manier waarop docenten studenten in leeractiviteiten betrekken als de wijze waarop studenten de leeromgeving percipiëren het leren beïnvloeden (Bryson & Hand, 2008; Coates, 2005). Eerdere studies naar verwevenheid van onderzoek in universitair onderwijs laten zien dat percepties ervaringen van studenten weergeven die direct gerelateerd zijn aan hun vakken en samenhangen met opvattingen van studenten over leren (Robertson & Blackler, 2006; Visser-Wijnveen, van der Rijst, & van Driel, 2016). Verder zouden studentpercepties van de leeromgeving in universitair onderwijs bijdragen aan leeruitkomsten zoals studiecijfers en studentproducten (Lizzio, Wilson, & Simons, 2002; Prosser & Trigwell, 2014).

Hoofdstuk 2: Authentieke onderzoekspraktijken in het studieprogramma

Aan het belang dat studenten toekennen aan specifieke onderdelen uit het studieprogramma, in dit geval onderwijsonderdelen waarin onderzoekspraktijken in leeractiviteiten geïntegreerd zijn, valt studentbetrokkenheid in onderzoek af te leiden. In dit hoofdstuk wordt een longitudinale studie beschreven met als doel de invloed te bepalen van authentieke onderzoekspraktijken in het studieprogramma op studentpercepties van onderzoek en opvattingen over de relevantie van onderzoek. In het hoger onderwijs in het algemeen kan studentbetrokkenheid afgeleid worden uit de mate waarin studenten studieonderdelen relevant vinden voor hun leerproces en later beroep (e.g., Trowler, 2010). De onderzoeksvragen waren: *Wat is de invloed van een curriculumverandering, bedoeld om onderzoek sterker te integreren in de bachelor geneeskunde, op studentpercepties van onderzoek en op opvattingen over de relevantie van onderzoek voor het leren en de beroepspraktijk? Hoe verandert deze invloed gedurende de bachelor geneeskunde?* Authentieke onderzoekspraktijken waren tijdens de curriculumherziening in elk jaar van het bachelorprogramma geïmplementeerd. Eerdere bevindingen uit studies naar leren in authentieke praktijken werden gebruikt om authentieke elementen van de praktijken te beschrijven. Authentieke elementen van onderzoekspraktijken in deze studie zijn: (1) studenten voeren leeractiviteiten uit in een professionele setting; (2) studenten oefenen denkvaardigheden die relevant zijn voor de onderzoekspraktijk; (3) het bevorderen van een onderzoeksdiscussie onder studenten tijdens leeractiviteiten; (4) studenten worden aangemoedigd hun eigen interesses te volgen in het leerproces (Rule, 2006). In het herziene curriculum nemen eerstejaars studenten deel aan een onderzoeksproject in het kader van een zorgstage in verpleeghuizen. In dit project verzamelen

studenten data en formuleren en beantwoorden ze een onderzoeksvraag. In beide curricula beoordelen tweedejaars studenten de wetenschappelijke basis van geneesmiddeladvertenties in vakbladen voor huisartsen. In het derde jaar van het herziene curriculum is de onderzoekspraktijk direct gerelateerd aan de klinische praktijk. Studenten doen een literatuurstudie ter bevordering van behandeling of diagnose van een specifiek patiëntprobleem onder supervisie van een arts in opleiding tot specialist. Voor de dataverzameling in deze studie is een aangepaste versie van de Student Perception of Research Integration Questionnaire (SPRIQ) gebruikt, in drie cohorten geneeskunde studenten (n = 941). Alle studenten werd aan het einde van het academisch jaar gevraagd SPRIQ in te vullen. Dit was nadat zij de onderzoekspraktijken hadden afgerond. De cohorten die het herziene curriculum volgden (n = 619) werden vergeleken met die in het vorige curriculum (n = 322). Uit de resultaten volgt dat studenten een sterkere eigen bijdrage aan onderzoek in de geneeskunde ervoeren naarmate ze verder kwamen in het studieprogramma evenals een sterkere motivatie voor onderzoek en sterkere kritische reflectie op onderzoeksresultaten in het onderwijs. Dit was met name het geval in het herziene curriculum. Studenten die het vorige curriculum volgden, vonden onderzoek minder relevant voor het leren naarmate de studie vorderde, terwijl in het herziene curriculum studenten onderzoek relevanter vonden aan het einde van het studieprogramma. Over het algemeen werden studentpercepties van onderzoek in onderwijs sterker door het studieprogramma beïnvloed dan opvattingen over de door studenten ervaren relevantie van onderzoek voor de professionele praktijk. Dit betekent dat authentieke onderzoekspraktijken niet per definitie de door studenten ervaren relevantie van onderzoek voor de klinische praktijk vergroot, maar wel de relevantie van onderzoek voor het leerproces. De bevindingen van deze studie suggereren dat leeruitkomsten anders dan studentopvattingen over de relevantie van onderzoek voor de praktijk bijdragen aan studentbetrokkenheid in onderzoek. Voor de onderwijspraktijk zou dat betekenen dat, om opvattingen van studenten over de relevantie van onderzoek voor de beroepspraktijk te veranderen, studenten ondersteund moeten worden de kennis over onderzoek uit relatief afzonderlijke projecten en de klinische praktijk te verbinden.

Hoofdstuk 3: Onderzoek geïntegreerd in het eerstejaars curriculum

Eerdere studies naar studentbetrokkenheid in universitair onderwijs waren erop gericht leeruitkomsten van studenten te bevorderen. De resultaten beschreven in hoofdstuk 2 laten zien dat het studieprogramma in beperkte mate bijdraagt aan de door studenten ervaren relevantie van onderzoek. In lijn met deze bevindingen wordt in dit hoofdstuk een mogelijke invloed van onderzoek in het studieprogramma op specifieke leeruitkomsten van onderzoekspraktijken van studenten bestudeerd. Het eerste jaar geneeskunde bood een interessante context om leeruitkomsten te bestuderen, omdat voor eerstejaars het studeren in een onderzoeksomgeving op de universiteit nieuw is. Dit kan het voor docenten uitdagend maken onderzoek in onderwijs zodanig te integreren dat het leeruitkomsten bevordert. De onderzoeksvraag die leidend was voor deze studie luidde: *Wat is de invloed van een curriculumverandering, bedoeld om onderzoek sterker te integreren in het eerste jaar geneeskunde, op leeruitkomsten, in het bijzonder studentproducten en toetsscores in het onderzoeksdomein?* In het herziene curriculum deden alle eerstejaars een onderzoeksproject gerelateerd aan een vroege klinische stage in een verzorgingstehuis. In het vorige en herziene curriculum voerden studenten een ECG-practicum uit waarbij ze data verzamelden, analyseerden en beschreven in een onderzoeksverslag. De onderzoeksverslagen uit beide curricula werden blind en anoniem beoordeeld om leeruitkomsten per curriculum te bestuderen. Verder werden studentscores verzameld op toetsvragen over medisch-wetenschappelijk onderzoek in nationale voortgangstoetsen. Zowel de verschillen in scores van onderzoeksverslagen als de toetsvragen suggereren dat studenten die het herziene curriculum volgden betere verslagen schreven en beter presteerden in de voortgangstoetsen. De SPRIQ werd gebruikt om studentpercepties van onderzoek en opvattingen over de relevantie van onderzoek tussen curricula te vergelijken. Eerstejaars studenten in het herziene curriculum (n = 485) percipieerden een sterkere participatie in onderzoek, een sterkere motivatie voor onderzoek, een sterkere kritische reflectie op onderzoeksproducten en gaven aan meer bekend te zijn met het onderzoek van hun docenten dan studenten die het vorige curriculum volgden (n = 261). De

resultaten suggereren dat de onderzochte curriculumverandering, bedoeld om onderzoek sterker in het onderwijs te integreren, bijdraagt aan leeruitkomsten in het onderzoeksdomein en een positieve invloed heeft op studentpercepties van onderzoek in het eerste jaar geneeskunde.

Hoofdstuk 4: Studentpercepties, opvattingen over de waarde van onderzoek en studieprestatie

Studentbetrokkenheid in leeractiviteiten op de universiteit beïnvloedt studieprestaties van studenten (e.g., Trowler, 2010). De studie in dit vierde hoofdstuk had tot doel inzicht te krijgen in relaties tussen studieprestaties enerzijds en studentpercepties van onderzoek en opvattingen over de relevantie van onderzoek anderzijds. Studentpercepties van de leeromgeving dragen direct en indirect, via studieaanpak, bij aan studieprestaties. In aanvulling op de onderzoeksgerelateerde leeruitkomsten onderzocht in hoofdstuk 3, wordt in dit hoofdstuk dan ook de relatie tussen studentpercepties en studieprestaties zoals studiecijfers verkend. De onderzoeksvraag in dit hoofdstuk was: *In welke mate hangen studieprestatie, in het bijzonder studiecijfers, en studentopvattingen over het belang van onderzoek samen met manieren waarop studenten onderzoek in het onderwijs percipiëren in het eerste jaar geneeskunde?* Aan de hand van deze vraag werd nagegaan in hoeverre studiecijfers samenhangen met onderzoek geïntegreerd in de leeromgeving. De SPRIQ was afgenomen onder 261 eerstejaars geneeskundestudenten in het studieprogramma voor de curriculumverandering. Het studieprogramma bestond voornamelijk uit hoorcolleges, aangevuld met werkgroepen en korte patiëntcontacten. Het onderwijsonderdeel dat bijdroeg aan onderzoeksintegratie in de leeromgeving was een ECG-practicum voor eerstejaars, waarin zij data verzamelden, analyseerden en hun bevindingen rapporteerden in een verslag.

Eerstejaars geneeskunde herkenden onderzoek geïntegreerd in het onderwijs. Studenten vonden onderzoek motiverend voor hun leren en relevant voor de beroepspraktijk. Motivatie voor onderzoek hing sterk samen met de mate waarin studenten het onderzoek van hun docenten kennen en met opvattingen over de relevantie van onderzoek voor leren en de praktijk. Een matige correlatie werd gevonden tussen motivatie voor onderzoek en studieprestatie. De bevindingen suggereren dat leeractiviteiten die aanzetten tot verdere ontwikkeling van opvattingen over relevantie van onderzoek voor de praktijk studieprestatie kunnen bevorderen.

Hoofdstuk 5: Begeleidingspraktijken en de dilemma's in onderzoeksbegeleiding

Studentbetrokkenheid in onderzoek kan bevorderd worden door de manier waarop begeleiders studentparticipatie in onderzoek vormgeven. In dit hoofdstuk wordt een studie beschreven over begeleidingspraktijken van beginnende begeleiders in interactie met studenten. In de context van deze begeleidingsgesprekken werd het inschattingsvermogen van begeleiders over wat nodig is in onderzoeksbegeleiding van studenten verkend. Bij het maken van deze inschattingen in interactie met de student spelen verschillende doelen van begeleiders een rol. Bijvoorbeeld het willen bevorderen van eigenaarschap van het afstudeeronderzoek en tegelijkertijd het onderhouden van een goede relatie met de student. Tegen de achtergrond van deze doelen kunnen dilemma's ontstaan die begeleidingspraktijken beïnvloeden. De onderzoeksvraag was: *Hoe bevorderen begeleiders het studentleren over onderzoek in afstudeeronderzoek in de bachelor en master in het medisch onderwijs en wat is de relatie tussen begeleidingspraktijken en de dilemma's ervaren door beginnende begeleiders in onderzoeksbegeleiding?* Twaalf individuele stimulated recall interviews met begeleiders zijn gehouden direct na een individueel begeleidingsgesprek tussen student en begeleider. In stimulated recall interviews selecteerden begeleiders delen uit de begeleidingsgesprekken en lichtten hun handelen toe. Uit analyse van de transcripten volgt dat begeleiders het leren van studenten op vijf kwalitatief verschillende manieren kunnen bevorderen: (1) verhogen van motivatie; (2) instructies geven; (3) kennisconstructie bevorderen; (4) meedenken met de student; (5) studenten bewust maken van

het onderzoeksproces. Naast praktijken noemden begeleiders actoren die van invloed zijn op begeleidingspraktijken: de begeleider, de student en anderen. In aanvulling op begeleidingspraktijken en actoren werden de doelen van begeleiding en de planning van het project genoemd. In een aanvullende analyse werden de transcripten gebruikt om het concept van dilemma's te verkennen in de data. Vier dilemma's werden onderscheiden, namelijk overwegingen van begeleiders met betrekking tot (1) regulatie van het leerproces; (2) behoeften van de student; (3) de student-begeleider relatie en (4) de professionele identiteit van de begeleider zelf. Het bevorderen van kennisconstructie en het geven van instructie werden overwogen in relatie tot alle vier dilemma's. Dilemma's met betrekking tot regulatie en de bedoeling de student eigenaarschap te geven over het project, hingen samen met het geven van instructie. Begeleiders vinden het lastig te bepalen in welke mate de student eigenaarschap te geven over het project en reageren dan door het geven van directe instructies. Het stimuleren van studentmotivatie werd afgewogen in relatie tot dilemma's over regulatie, behoeften van de student en het in stand houden van de relatie. Dit betekent dat op de momenten dat begeleiders de relatie met de student goed willen houden of verantwoordelijkheden en behoefte van studenten lastig kunnen inschatten, zij in de praktijk de begeleiding zo prettig mogelijk maken om de student te motiveren. Doelen met betrekking tot de professionele identiteit hingen samen met overwegingen over de onderzoeksbegeleiding. De bevindingen suggereren dat beginnende begeleiders, om het leerproces van studenten te bevorderen in afstudeeronderzoek, niet alleen varen op hun ervaringen als begeleider en student. Het vermogen om kenmerken van studentleren te interpreteren speelt een rol in onderzoeksbegeleiding, al laten de resultaten zien dat het lastig is de begeleidingspraktijk daarop af te stemmen in student-begeleider interacties. Op basis van de resultaten wordt gesuggereerd om aandacht te geven aan de dilemma's van begeleiders tijdens professionele ontwikkelingsactiviteiten, bijvoorbeeld door het stimuleren van reflecties op videobeelden van supervisiegesprekken met als doel begeleidingspraktijken af te stemmen op de student.

Hoofdstuk 6: Conclusies en discussie

In het laatste hoofdstuk worden de conclusies uit de hoofdstukken geïntegreerd, de sterke punten en beperkingen van de studies beschreven en aanbevelingen gedaan voor onderzoek en onderwijs. De conclusies van de afzonderlijke studies zijn onderverdeeld in thema's om tot algemene conclusies te komen. De geïntegreerde conclusies hebben betrekking op het studieprogramma, de onderwijspraktijk, studentpercepties en opvattingen en leeruitkomsten.

Studieprogramma

De onderzochte studieprogramma's waarin de nadruk ligt op onderzoek in onderwijs bevorderden vijf aspecten van studentbetrokkenheid in onderzoek in het medisch onderwijs: (1) kritische reflectie op onderzoeksbevindingen; (2) kennisnemen van onderzoek van docenten; (3) studentmotivatie voor onderzoek; (4) studentparticipatie in onderzoek en (5) onderzoeksgerelateerde leeruitkomsten zoals studentproducten en scores op nationale voortgangstoetsen in het domein van onderzoek. Het studieprogramma heeft een sterkere invloed op studentpercepties van onderzoek in het medisch onderwijs dan op de studentopvattingen over de relevantie van onderzoek voor de professionele praktijk en de door studenten ervaren relevantie van onderzoek voor het leren.

Onderwijspraktijk

De bevindingen uit de afzonderlijke hoofdstukken duiden op overeenkomsten tussen onderwijspraktijken die de studentbetrokkenheid in onderzoek stimuleren in verschillende contexten, namelijk het studieprogramma zoals gepercipieerd door studenten en de onderzoeksbegeleiding zoals gepercipieerd door begeleiders. In beide contexten richt de onderwijspraktijk in het medische domein zich op het onderzoek dat gedaan wordt door docenten, op kritische reflectie op eerdere onderzoeksresultaten en op het motiveren van studenten voor onderzoek. Dit betekent dat praktijken in het medisch onderwijs die studentbetrokkenheid in onderzoek bevorderen, zich richten zich zowel op direct zichtbare aspecten van onderzoek, zoals participatie in onderzoek en kennisnemen van onderzoek van

de staf als op aspecten die niet direct zichtbaar zijn, namelijk kritische reflectie op onderzoeksresultaten en motivatie voor onderzoek.

Studentpercepties en opvattingen

Op basis van de bevindingen uit de studies kan geconcludeerd worden dat studentpercepties van onderzoek in het medisch onderwijs sterker zullen samenhangen met studentopvattingen over de relevantie van onderzoek voor het leren dan met studentopvattingen over het belang van onderzoek voor de medische beroepspraktijk. De resultaten suggereren verder dat de studentmotivatie voor onderzoek in onderwijs sterk samenhangt met opvattingen over de relevantie van onderzoek voor leren en de medische beroepspraktijk.

Leeruitkomsten

Met betrekking tot aan studentbetrokkenheid in onderzoek gerelateerde leeruitkomsten suggereren de bevindingen dat context- en discipline-specifieke leeruitkomsten, zoals die af te leiden zijn uit onderzoeksproducten van studenten en scores op onderzoeksgerelateerde toetsvragen een sterkere indicator zijn van studentbetrokkenheid in onderzoek binnen het studieprogramma dan algemene studieprestaties zoals gemiddelde studentcijfers.

Implicaties voor onderzoek en praktijk

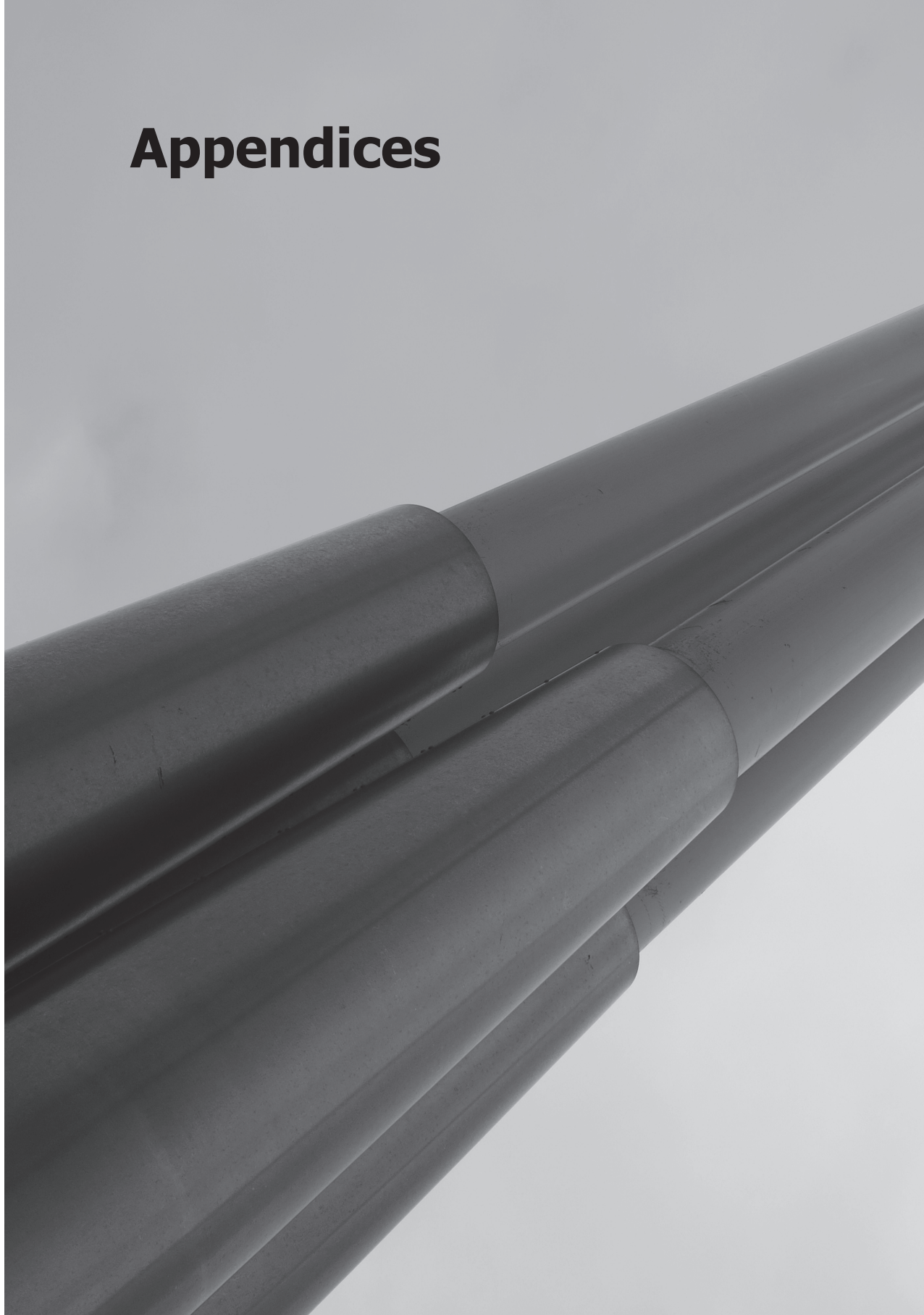
Er worden verschillende suggesties gedaan voor verder onderzoek naar het bevorderen van studentbetrokkenheid in onderzoek in zowel het medisch als het universitair onderwijs. Ten eerste werden de studentpercepties van onderzoek in onderwijs en studentopvattingen over de relevantie van onderzoek, bijvoorbeeld in hoofdstuk 2, alleen bestudeerd in de context van de bachelor geneeskunde. Daarom zouden toekomstige studies zich kunnen richten op de ontwikkeling van betrokkenheid in onderzoek in de transitie naar de medische beroepspraktijk. Bijvoorbeeld: Hoe integreren beginnend artsen onderzoek in hun professionele rol? Ten tweede kan dieper inzicht verkregen worden studentbetrokkenheid in onderzoek door verkenning van relaties tussen onderwijspraktijken, studentpercepties van onderzoek in onderwijs, leeruitkomsten en studieaanpak van studenten.

De resultaten uit de studies suggereren dat onderzoekspraktijken in onderwijs studenten gelegenheid bieden betrokken te worden bij een variëteit aan onderzoeksbenaderingen, gerelateerd aan verschillende professionele settings waarin onderzoek uitgevoerd wordt. Dit betekent dat onderwijsdirecteuren en managers zouden moeten streven naar implementatie van een verscheidenheid aan onderzoek in hun studieprogramma's. Dit geeft studenten een breed perspectief op het beroepsveld. Vervolgens zal een goed curriculumontwerp samenhang ondersteunen in het studieprogramma tussen afzonderlijke onderzoekspraktijken. Bijvoorbeeld door implementatie van leeractiviteiten waarin studenten hun ervaringen met betrekking tot onderzoek en hun opvattingen over de relevantie van onderzoek integreren. De SPRIQ, gebruikt in de studies in hoofdstukken 2, 3 en 4 kan deels toegepast worden om inzicht te krijgen in aspecten van de onderzoeksintensiviteit van de leeromgeving. SPRIQ geeft bijvoorbeeld inzicht in de mate waarin studenten zich betrokken voelen in onderzoek in het onderwijs dat zij volgen. Hieruit kunnen aanpassingen van leeractiviteiten volgen gericht op het vergroten van studentbetrokkenheid in onderzoek. In de dagelijkse onderwijspraktijk zouden docenten studenten kunnen aanmoedigen hun opvattingen over de relevantie van onderzoek te expliciteren om de ideeën van studenten over onderzoek verder te ontwikkelen. Bijvoorbeeld door studenten hun beelden over onderzoek te laten vergelijken met de ervaringen van onderzoekers en professionals in het veld. Met betrekking tot professionele ontwikkelingsactiviteiten voor docenten in het universitair onderwijs wordt gesuggereerd activiteiten te ontplooien die het mogelijk maken dilemma's in onderzoeksbegeleiding te identificeren en te koppelen aan begeleider-student interacties. De bevindingen uit hoofdstuk 5 suggereren dat het gebruik van video-opnames van gesprekken tussen begeleiders en studenten een effectief middel is om dit doel te bereiken.

Tot slot wordt aangegeven dat studies naar studentbetrokkenheid in onderzoek in medisch onderwijs dieper inzicht geven in relaties tussen onderzoek en onderwijs in het algemeen. In het medische domein kan studentbetrokkenheid in onderzoek kennis opleveren over hoe relaties tussen onderzoek en patiëntenzorg versterkt kunnen worden. Onderzoekers met een

interesse in studentbetrokkenheid in onderzoek worden daarom aangemoedigd verder te kijken dan de grenzen van een discipline.

Appendices



Appendix 1. The adapted version of the Student Perception of Research Integration Questionnaire for medical education (in Dutch)

Deel 1 Studentpercepties van onderzoek

Item	Tijdens dit studiejaar…	Schaal
1.	leerde ik het onderzoek van mijn docenten kennen.	Actueel onderzoek
2.	was het wetenschappelijke onderzoeksproces een essentieel onderdeel van de leerstof.	Kritische reflectie
3.	voelde ik me aangespoord om me verder te verdiepen in wetenschappelijk onderzoek.	Motivatie voor onderzoek
4.	werd aandacht besteed aan onderzoeksmethodologie.	Kritische reflectie
5.	leerde ik te letten op de manier waarop een onderzoek uitgevoerd wordt.	Kritische reflectie
6.	nam ik kennis over onderzoeksuitkomsten tot mij.	Kritische reflectie
7.	werd mijn bijdrage aan wetenschappelijk onderzoek op prijs gesteld.	Participatie in onderzoek
8.	kwam ik in aanraking met het onderzoek van mijn docenten.	Actueel onderzoek
9.	was mijn aandeel in het onderzoek van belang.	Participatie in onderzoek
10.	werd mijn besef van de vraagstellingen waar wetenschappelijke onderzoekers op dit moment aan werken vergroot.	Actueel onderzoek
11.	leerde ik wat voor onderzoek er gedaan wordt in de geneeskunde.	Actueel onderzoek
12.	werd mijn interesse in onderzoek in de geneeskunde vergroot.	Motivatie voor onderzoek
13.	leverde ik een bijdrage aan de wetenschappelijke ontwikkeling in de geneeskunde.	Participatie in onderzoek
14.	voelde ik me als student betrokken bij wetenschappelijk onderzoek.	Participatie in onderzoek
15.	werden de verbanden met de actuele onderzoekspraktijk gelegd.	Actueel onderzoek
16.	raakte ik betrokken bij het onderzoek van mijn docenten.	Participatie in onderzoek
17.	stimuleerden de docenten mijn interesse en enthousiasme voor onderzoek.	Motivatie voor onderzoek
18.	raakte ik enthousiast over onderzoek in de geneeskunde.	Motivatie voor onderzoek
19.	verzorgden de docenten hun onderwijs op een voor mij adequate manier.	Kwaliteit
20.	konden de docenten de leerstof goed aan mij uitleggen.	Kwaliteit
21.	heb ik een juist beeld ontwikkeld van wat er van mij verwacht werd.	Kwaliteit

Deel 2 Opvattingen over onderzoek

Item		Schaal
22.	Wetenschappelijke vaardigheden zijn belangrijk voor het artsenberoep.	Praktische relevantie
23.	Mijn leren wordt gestimuleerd als het onderwijs doordrongen is van onderzoek.	Relevantie voor leren
24.	De onderzoekscultuur in het LUMC stimuleert mijn leerproces.	Relevantie voor leren
25.	Een wetenschappelijke opleiding is belangrijk voor mij.	Praktische relevantie
26.	Ik vind aandacht voor wetenschap in de opleiding leuk.	Praktische relevantie
27.	Onderwijs waarin veel aandacht is voor wetenschappelijk onderzoek stimuleert mijn leren.	Relevantie voor leren
28.	Ik heb interesse in onderzoek doen.	Praktische relevantie
29.	De opleiding geneeskunde hoort wetenschappelijk te zijn.	Praktische relevantie
30.	Een arts zou zelfstandig onderzoek moeten kunnen doen.	Praktische relevantie

Note. Each item is rated on an agreement scale, a five-point Likert scale ranging from 1 = '--' to 5 = '++'. The questionnaire was administered in Dutch and is based on the item wording as reflected in a study by van der Rijst, Visser-Wijnveen, Verstelle and van Driel (2009).

Appendix 2. The adapted version of the Student Perception of Research Integration Questionnaire for medical education (in English)

Section 1 Student perceptions of research

Item	During this year of study…	Scale
1.	I came in contact with my teachers' research.	Current research
2.	the scientific research process was an essential part of the curriculum.	Critical reflection
3.	I was inspired to learn more about research in medicine.	Motivation for research
4.	attention was paid to research methodology.	Critical reflection
5.	I learned to pay attention to the way research is carried out	Critical reflection
6.	I assimilated knowledge about research findings.	Critical reflection
7.	my contribution to the research was valued.	Participation in research
8.	I became familiar with the research carried out by my teachers.	Current research
9.	my participation in the research was important.	Participation in research
10.	my awareness of the research issues that scientific researchers are currently contributing to was increased.	Current research
11.	I learned what kind of studies have been carried out in medicine.	Current research
12.	I became enthusiastic about research in medicine.	Motivation for research
13.	I made a contribution to development in medicine.	Participation in research
14.	as a student I felt involved with the research.	Participation in research
15.	links to current research practices were made.	Current research
16.	I became involved in my teachers' research.	Participation in research
17.	my teachers encouraged personal interest and enthusiasm for research in this field.	Motivation for research
18.	I became enthusiastic about research in medicine.	Motivation for research
19.	the teachers carried out their instruction adequately.	Quality
20.	my teachers were able to explain the subject matter effectively.	Quality
21.	I developed an accurate picture of what was expected of me.	Quality

Section 2 Beliefs regarding research

Item		Scale
22.	Research skills are important for the medical profession.	Practical relevance
23.	My learning is stimulated when education is grounded in research.	Relevance for learning
24.	The research culture at the LUMC stimulates my learning.	Relevance for learning
25.	I find research intensive education important.	Practical relevance
26.	I like a focus on research in the study programme.	Practical relevance
27.	Education in which scientific research is central stimulates my learning.	Relevance for learning
28.	I'm interested in conducting research.	Practical relevance
29.	Medical education should be research intensive.	Practical relevance
30.	A medical doctor should be able to conduct research independently.	Practical relevance

Note. Each item is rated on an agreement scale, a five-point Likert scale ranging from 1 = '--' to 5 = '++'. The questionnaire was administered in Dutch and the translation is based on the item wording as reflected in a recent study by Visser-Wijnveen, van der Rijst and van Driel (2016).

Appendix 3. Grading rubric first-year student research reports (translated from Dutch).

Score per criterion	0	1	2
Consistency			
Introduction	Research question (RQ) is missing; no indication of relevance, no rationale.	Lack of argument(s) underpinning the RQ.	Introduction provides clear arguments underpinning RQ, aim or hypothesis.
Method	Unbalanced in terms of size; either overlong or lacks key information about participants and analysis.	Analysis suits the RQ; mainly replicable, lacks detail.	Clear to the reader; enables replicability appropriate to a short report.
Results	Contains redundant information, students' interpretations or opinions.	Factual display of results; either too limited or too detailed.	Comprehensive and factual display of results.
Discussion	No indication of a limitation; conclusion does not fit RQ and results.	Appropriate conclusion and a limitation; either overgeneralised implications or lacks explanation of results (previous studies).	Results are related to previous or future research; contains limitations, implications, main conclusion & answer to the RQ.
Structural characteristics			
Title	Does not reflect the message, raises different expectations.	Partly reflects the main message.	Covers the main message.
Structure of the text	No order (introduction – method – results – discussion).	In logical order, at times repetition or overlap.	Coherent, to the point, reads easily.
Language (terminology)	Style and spelling errors, inconsistent use of scientific language.	Nearly flawless and consistent use of scientific language.	No errors, consistent use of scientific language.
Comprehensiveness	Text is not confined to key issues. (Abbreviations like MET and QRS are common language).	Key issues are clear; missing are details needed to answer the RQ.	Key issues are clear; contains relevant information in order to answer the RQ.
References	No references.	Some information is missing or not in Vancouver-style.	Full reference list in Vancouver-style.
Tables and figures	Messy, too large or too small on the page; overlaps text.	Make an orderly impression; lay-out does not fully support the text.	Numbered tables, support the message in the text.
Attractiveness abstract	Does not encourage further reading.	Raises the reader's interest.	Report fosters further reading; cannot wait to read more.
Total score report			

Appendix 4. Between-case data matrix of fragments reflecting relationships between dilemmatic space and supervision practices

Code ($N_{fragments}$)	Regulation question (N = 34)	Student needs question (N = 21)	Relational question (N = 16)	Identity question (N = 17)
Practice/ Fostering motivation	'He has to ask me if he gets stuck or when he has a question about the order of the findings in the report. He may try his best regarding his findings, although he needs to ask me when he gets stuck. From my own and others experiences as students I know this is really difficult.' (Anna).	'Sometimes it's difficult to figure out what more you can do to make someone better. Sometimes it's already sufficient'. Interviewer: 'Did you try to figure out what you could do for her during this meeting?' 'Yes. This time I asked her, like feedback, at the end of the meeting about things that I could do. It's difficult for me to know what she thinks. […] Perhaps I'm doing too much for her?' (Linda).	'She indicates that she isn't quite calm yet. I try to calm her down. She knows herself, she told me: "Every now and then I can't put my mind to rest. It [the research project] isn't easily out of my head". She keeps telling me that. And still this feeling isn't gone, she's trying to ignore it. Now, we're talking about it again.' (Linda). + 2 fragments; Peter, Anna.	
Practice/ Giving directions	'What I've noticed is that I'm going to lecture him at a certain point. I often do that. I leave him more or less space to come up with his own things. I've noticed that during the supervision meeting, I've interrupted him once or twice. [Pointing at the video] Look, things like this. I already know he's got ideas about this, we've discussed this before. Despite that I tell him what the aim was and what we're going to do. Then I quietly wonder how that comes across to him, because I am determining the direction.' (Robert). + 13 fragments; Peter, Vera, Mary, Paul, Jacky, Ricky.	'This project is completely different from what was planned previously. The outcome is just not what we expected. That is always difficult, but the most important thing, which is crucial for atherosclerosis is that blood cholesterol level goes down. And that wasn't the case here. She didn't discuss that on the poster. She talks about [concept], but that was something I thought: Isn't that on the poster? That's a bit strange, because that's key. Apparently, I've not explained it well, or she still missed something.' (Vera). + 2 fragments; Jacky.	'Here we talk about the report. She isn't quite at the level that I expect her to be. I won't beat about the bush this time. Normally, ehh, I always try to be polite. There's still a lot to be done, there really should be … You're [the student] often unclear. You leave the reader with a whole lot more questions than answers. It still isn't clear what you mean.' (Peter). + 1 fragment; Vera.	'Because she doesn't respond with "oh yeah" right away on my instruction I thought I apparently needed something else. Perhaps it's better for her to come up with another example. I prefer to, I reckon. I prefer to give hints that she can fill in, over explaining exactly what she has to do. Although I seem to do that every now and then.' (Ricky). + 1 fragment; Paul.

Code ($N_{fragments}$)	Regulation question (N = 34)	Student needs question (N = 21)	Relational question (N = 16)	Identity question (N = 17)
Practice/ Promoting knowledge construction	'That's an example that she figures out herself. That's why we meet often in order for her to check whether she's doing it right. Because when she has to do that many samples and she makes a mistake with the first one, she can go on, but she's to do it again.' (Linda). + 1 fragment; Vera.	'I've asked her "Did you forget?" Because I expected her to forget this. After that, I explained to her that it's very difficult for me to figure out whether she forgets, she doesn't agree or she can't do it and needs help.' (Vera). + 6 fragments; Brenda, Jacky, Ryan.	'Every now and then you [the student] have a question and you want to hear the right answer. I don't want to ask questions all the time, but confirm his thoughts as well. He's on the right line of reasoning here. He understands.' (Brenda). + 1 fragment; Brenda.	'I doubt whether it came out pretty quickly that I've asked how he's doing. Usually he answers me with specific questions. [video fragment]. Now, I should have let him explain more himself.' (Mary). +1 fragment; Linda.
Practice/ Thinking along	'Here we are discussing vitamin D and [concept], which we didn't find in the data. Do we've to include this? No, we mustn't do that. So, we have discussions about this.' (Peter).			
Practice/ Creating awareness			'Actually, I want to tell him, because he's to be aware of that. He has to try to think about the Dutch words to choose when he reads a piece of English text that he wants to use in his report. That's what I try to tell him.' (Anna).	'I have to tell him that I've noticed he's using [a translation engine] to translate and copy text. Yes, I have to tell him, otherwise he'll keep doing this. And his other supervisor at the school [university] is also going to read this.' (Anna).

Code ($N_{fragments}$)	Regulation question (N = 34)	Student needs question (N = 21)	Relational question (N = 16)	Identity question (N = 17)
Actor/supervisor	'From my experience with him [not finishing his project before the next course] … I didn't pose a deadline back then. Like when you don't submit your research proposal by the end of December, you aren't allowed to start your research project. He didn't submit it in time, but there were no consequences for him. I've learned from that.'(Vera). + 7 fragments; Brenda, Mary, Robert.	'The other student I supervise… I just don't know what to do to make it better. It's really annoying when [the student] doesn't respond. If I were the student, I'd go and ask, while I leave the samples in the nitrogen. Now everything is defrosted and ruined. I quietly wonder whether that's my fault, or his, or our interaction? I don't understand. I just don't know… There are so many examples of this.' (Vera). + 3 fragments; Vera, Brenda, Mary.	'I try to keep it friendly and a little directive, but I notice that's difficult for me. I don't ask myself how that comes across to the student, so I fin d that hard.' (Robert) + 4 fragments; Robert, Anna, Linda, Mary.	'What's difficult is that I'm not an expert in this literature. So, ehh … Basically, he's helping a colleague with his research (Robert). + 5 fragments; Brenda, Vera, Linda.
Actor/student	'[…] On the one hand, he [the student] wants a structured project. On the other hand, he has indicated that he wants to do research independently. That was one of his learning goals for his final student research project. He wants an idea of where to start when he has a research project or research question again. For me, that's seeking a balance between those two.' (Mary) + 1 fragment; Anna.	'And that's what I'm most concerned about. Are the tasks that I propose to her impossible to do? Yes, because she says she can't do it. Well… Is it too difficult for her? Or is she just cutting too many corners?' (Peter) + 5 fragments; Anna, Peter, Vera, Mary, Ricky.	'The previous meeting was with his other supervisor. She simply neglected half of his tables and told him to focus on this. I know that he's interested in that stuff and started from there. I wanted to know if he's OK now.' (Brenda). + 1 fragment; (Linda)	'Eventually he had just few specific questions about this. I really expected him to have questions, such as "How is this and that done?". Then I found out he'd already e-mailed his other supervisor without notifying me.' (Mary).

Code ($N_{fragments}$)	Regulation question (N = 34)	Student needs question (N = 21)	Relational question (N = 16)	Identity question (N = 17)
Actor/other				'My supervisor told me that I have to be stricter for students. I don't know. I find that difficult in this case.' (Mary).
Rest/planning	'At the end of the conversation, we discuss whether this planning is realistic. She raises the bar for herself. Too high, I think. But, hey, it's her internship. I keep the option open that this work isn't finished by Friday. And I wouldn't mind. Her assessment is on Monday. So if it's finished before then it's ok. But she raises the bar herself, wanting to finish this on Friday.' (Peter). + 5 fragments; Vera, Paul, Linda.		'I see her everyday anyway. I think it's important, I think, that you see people and talk to other colleagues. You know what everyone is doing and you know what their day is really like. I'm not going around talking nonstop for an hour with my cup of coffee, but I'll walk around every morning at nine o'clock. "How's it going? Today you did this and this and do this." That's OK, I think.' (Linda).	'I've said to her, lets cancel that, because there is enough to do for those other two things. Things have to be completed, because we have to show something to the board of examiners and we need something to publish.' (Peter).
Rest/supervision aim				'I find it difficult to provide feedback on this kind of rules of engagement [the student being late, the student sending an e-mail to the senior research without mentioning the supervisor]. I find it difficult, because it's only about how I like it.' (Mary). + 2 fragments; Anna.

Appendix 5. Coding scheme and examples of practices, actors and context factors using noticing as sensitizing concept

Code ($N_{fragmetns}$)	Description	Example
Practice/Fostering motivation (N = 26)	The supervisor acts at the level of the relationship with the student without reference to the research project. These fragments are about motivating the student and making supervision pleasant.	[About the senior researcher rejecting parts of the student's work]. I'd planned in advance to reflect with him on his experience. That sounds like a big issue, although he'd told me it didn't keep him awake at night. […] I completely understand. The first time that happens it's really disappointing. That's why I got back to him about it. (Brenda).
Practice/Giving directions (N = 133)	The supervisor gives the student directions on how to make progress with the research process or product. Examples are providing the student with feedback, using hints and explaining how a task should be done.	Let's just say, here, I impose my vision upon him. Like I would have done it this way. Like giving examples, and explaining that I would do it in a certain way. (Robert).
Practice/Promoting knowledge construction (N = 119)	The supervisors checks the student's knowledge construction or interpretations in order to assess the knowledge level, check knowledge reproduction, make student's reasoning explicit, and structure or confirm student's findings.	I try again to check her knowledge about the introduction, whether she knows the rules. Well, rules … I told her before and now I'm checking whether she remembers. (Ryan).
Practice/Thinking along (N = 6)	The supervisor thinks along with the student. There is ongoing discussion between the student and the supervisor. This is a collaboration between two researchers.	At this point I'm in doubt about whether I can believe her explanation [about her findings]. It's a nice explanation, which could be true, we can expect this [valid explanation]. (Paul).
Practice/Creating awareness (N = 13)	The supervisor makes the student aware that the choices made during the research process need to be underpinned by the researcher. While doing this the supervisor can refer to earlier discussions and choices made in the research project.	She doesn't have a very clear idea yet. I mean, she wrote an introduction, she thought it was a nice story. But I've had to make her aware that writing an introduction is very hard, that there are certain rules for that, and so on. (Ryan).
Actor/supervisor (N = 50)	The supervisor mentions him- or herself, without reference to pedagogy. The fragments are about supervisor characteristics, knowledge and experiences.	Because I'm a very positive person. I don't quickly feel that things aren't good enough, we've to leave this part out [of the research report]. I always see the big picture. (Linda).

Code ($N_{fragmetns}$)	Description	Example
Actor/student (N = 40)	The supervisor mentions a student, without reference to pedagogy. The supervisor describes personal student characteristics or 'type'.	Yes, she's very shy. That might be inherent in her cultural background […]. (Vera).
Actor/other (N = 6)	The supervisor mentions someone other than her/himself or a student. For example the supervisors' supervisor. No practices are mentioned in these fragments.	I don't want her to present this text on the poster at the conference. […] I'm sure, our boss is going to assess the poster. I already know he wouldn't agree with this. I'll try to change this before it's sent to him. (Vera).
Rest/planning (N = 42)	The supervisor is worried that the research project may take too long. Because of this, (s)he makes decisions for the student or asks the student to plan the next activities carefully.	Especially since I'm not here next week, so they really need to work independently. That's what I wanted to discuss. What are you going to do next week? (Jacky).
Rest/supervision aim (N = 10)	The supervisor explains his/her ideas about good research supervision and undergraduate education. These fragments may also include curriculum goals, content of the educational programme and perceived benefits of undergraduate research.	I had an idea about what he could do in his research project. However, my supervisor didn't feel that had to be done. She says the evidence is convincing, there's no need for another validation. However, I was thinking it would be good for him, because he's learned about this in his undergraduate programme. (Anna).

Publications and presentations

Scientific publications

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Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H., & Dekker, F.W. (2017, June). *Student engagement in research in health science education.* Paper presented at the annual conference of the Higher Education Research and Development Society for Australasia, Sydney, NSW, Australia.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H., & Dekker, F.W. (2016, December). *Novice supervisors' research supervision pedagogies and dilemmatic space in students' research projects.* Paper presented at the annual conference of the Society for Research into Higher Education, Newport, Wales, United Kingdom.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H., & Dekker, F.W. (2016, December). *Novice supervisors' research supervision pedagogies and dilemmatic space in students' research projects.* Paper presented at the Newer Researcher Conference of the Society for Research into Higher Education, Newport, Wales, United Kingdom.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H. & Dekker, F.W. (2016, November). *Vroeg op weg naar succes? Het effect van een sterkere onderzoek integratie in de bachelor op studieprestaties in het eerste jaar geneeskunde* [In Dutch: The influence of strengthening research integrated into undergraduate teaching on learning outcomes in the first year of medical education]. Paper presented at the annual conference of the Netherlands Association for Medical Education, Egmond aan Zee, the Netherlands.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H., & Dekker, F.W. (2016, July). *Improving first-year student learning outcomes by strengthening research integration into teaching.* Paper presented at the Higher Education Conference, Amsterdam, the Netherlands.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H. & Dekker, F.W. (2016, June). *Leerproces bevorderen door verwevenheid van onderzoek en onderwijs. Een vergelijkende cohortstudie* [In Dutch: Stimulating student learning through research integrated into teaching. A comparative cohort study]. Paper presented at the Onderwijs Research Dagen, Rotterdam, the Netherlands.

Vereijken, M.W.C., Buis, D.T.P., Dijkerman, M., Adelmeijer, E.G.M., le Cessie, S., Swenne, C.A., de Beaufort, A.J., & Dekker, F.W. (2015, November). *Onderzoekscompetenties vroeg in de bachelor: ontwikkeling en relatieve betrouwbaarheid van een rubric voor beoordeling van onderzoeksverslagen* [In Dutch: Research competencies in undergraduate education: Development and reliability of an assessment rubric for student research reports]. Paper presented at the annual research conference of the Netherlands Association for Medical Education, Rotterdam, the Netherlands.

Vereijken, M.W.C., van der Rijst, R.M., van Driel, J.H. & Dekker, F.W. (2014, November). *Wetenschappelijke vorming in de bachelor* [In Dutch: Scientific training in undergraduate education]. Paper presented at the annual research conference of the Netherlands Association for Medical Education, Egmond aan Zee, the Netherlands.

Vereijken, M.W.C., van der Rijst, R.M., de Beaufort, A.J., van Driel, J.H. & Dekker, F.W. (2014, September). Research-based learning in undergraduate medical education. Paper presented in D. Griffioen (chair), *Critically examining the relationships between research, teaching and students' learning in higher education.* Symposium conducted at the annual conference of the European Educational Research Association, Porto, Portugal.

Vereijken, M.W.C., van der Rijst, R.M., de Beaufort, A.J., van Driel, J.H. & Dekker, F.W. (2014, April). First-year student perceptions of research in an educational reform. Paper presented in M. Mulder (chair), *Barriers and facilitators of integrating research in higher education.* Symposium conducted at the annual conference of the American Educational Research Association, Philadelphia, PA, USA.

Posters/round tables

Vereijken, M.W.C., van der Rijst., R.M., van Driel, J.H., & Dekker, F.W. (2015, August). *Towards a research pedagogy: Supervisors' knowledge of interventions in student research supervision*. Round table presented at the Junior Research Pre-Conference of the European Association for Research on Learning and Instruction, Limassol, Cyprus.

Vereijken, M.W.C., van der Rijst., R.M., van Driel, J.H., & Dekker, F.W. (2015, June). *Strategieën en overwegingen van begeleiders van onderzoeksstages* [In Dutch: Supervisors' strategies and considerations in students' research projects]. Poster presented at Onderwijs Research Dagen, Leiden, the Netherlands.

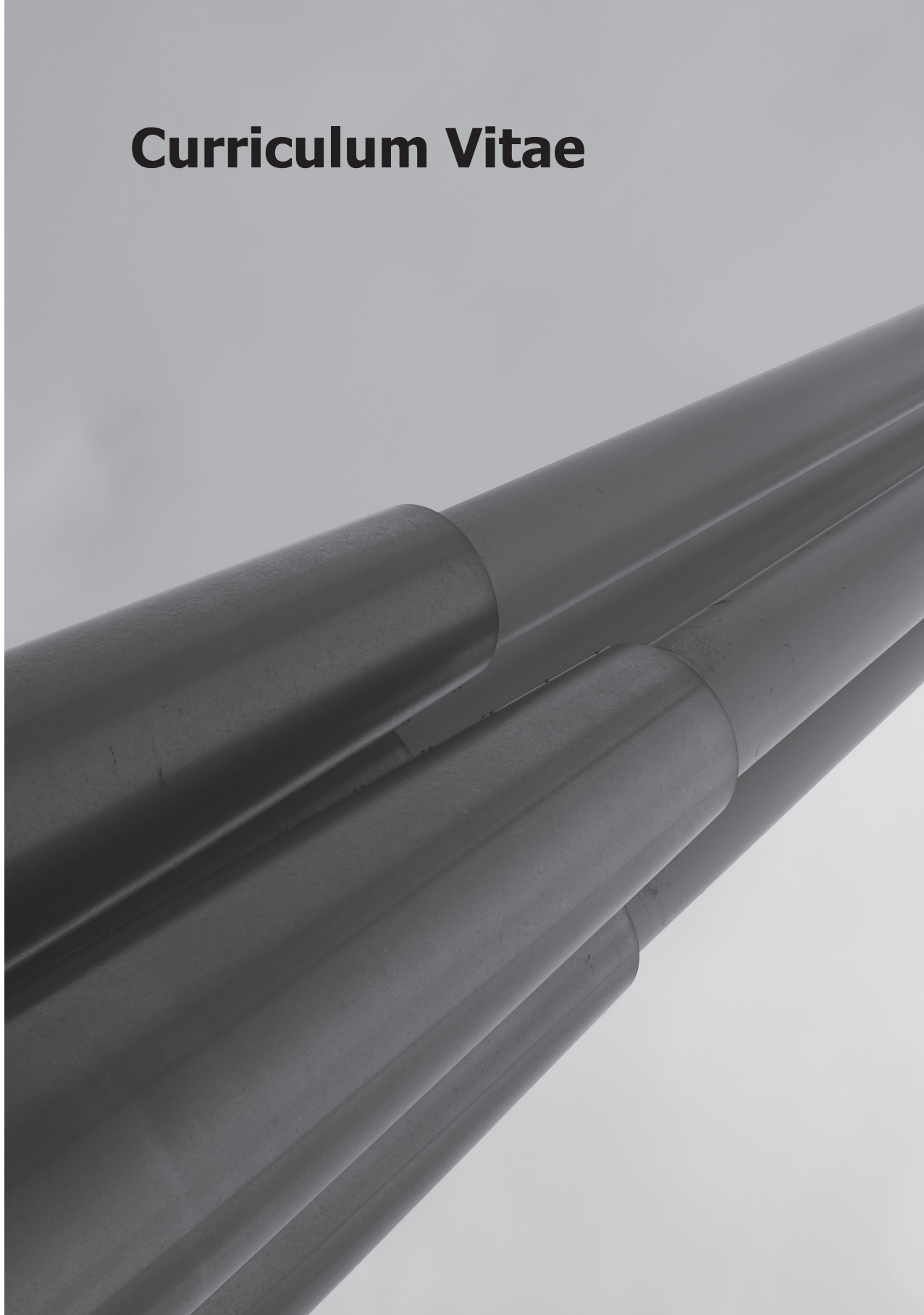
Vereijken, M.W.C., van der Rijst., R.M., van Driel, J.H., & Dekker, F.W. (2014, November). *Scaffolding undergraduate research.* Round table presented at the International Fall School of the Dutch Interuniversity Centre for Educational Research, Blankenberge, Belgium.

Vereijken, M.W.C., van der Rijst., R.M., van Driel, J.H., & Dekker, F.W. (2014, June). *Studiesucces: Research-based learning in de bachelor* [In Dutch: Study success: Research-based learning in undergraduate education]. Poster presented at Onderwijs Research Dagen, Groningen, the Netherlands.

Vereijken, M.W.C., van der Rijst., R.M., van Driel, J.H., & Dekker, F.W. (2015, August). *Strategies in undergraduate research supervision.* Poster presented at the annual conference of the European Association for Research on Learning and Instruction, Limassol, Cyprus.

Vereijken, M.W.C. & Dekker, F.W. (2013, November). *Onderzoek doen: een eigen relevante leerervaring voor alle eerstejaars* [In Dutch: Doing research: An individual and meaningful learning experience for first year students]. Poster presented at the annual conference of the Netherlands Association for Medical Education, Egmond aan Zee, the Netherlands.

Curriculum Vitae



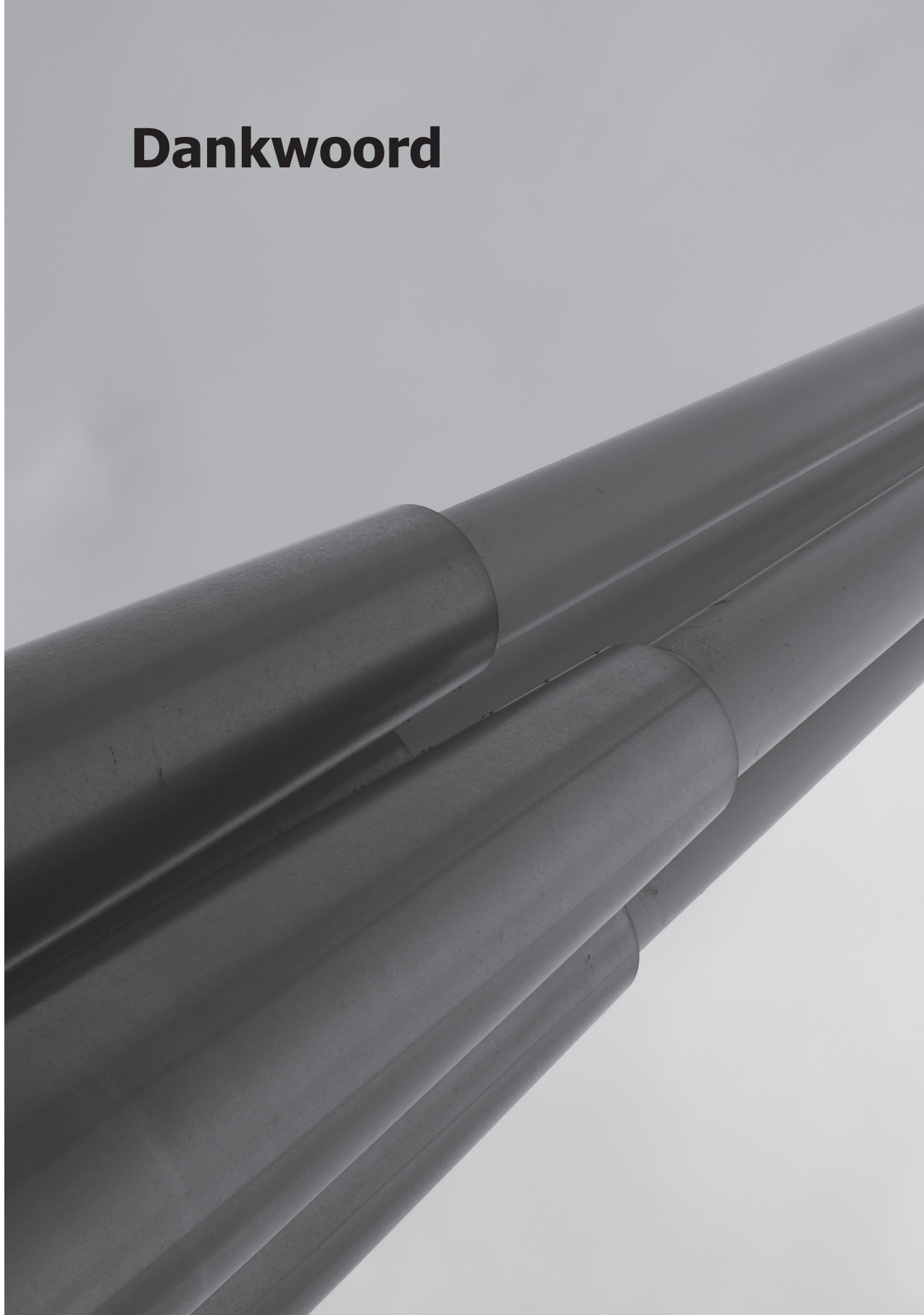
Curriculum Vitae

Mayke Vereijken was born in Bergeijk, the Netherlands on 1st September, 1986. She completed her secondary education at the Were Di College in Valkenswaard, graduating in 2004. Afterwards she began her studies at the Radboud University in Nijmegen. She first obtained a bachelor's degree in pedagogical sciences in 2010, before going on to complete a master's degree in educational sciences. During her master's study she specialised in medical education. Her master's thesis covered the affect and coping behaviour of undergraduate medical students during early clinical experiences. After graduating in 2011, she worked as an educational consultant at the Leiden University Medical Center. She also became a member of the special interest group on research integrated into teaching of the Netherlands Association for Medical Education (NVMO).

In 2013, Mayke enrolled as a PhD candidate at ICLON, Leiden University Graduate School of Teaching. Her research project focused on promoting student engagement in research in medical education. Her research was part of a project funded by the Leiden University board that aimed to foster study success. Mayke attended courses and master-classes related to her research topic provided by ICO, the Dutch Interuniversity Center for Educational Research. Since 2014, she has been a co-coordinator of the ICO 'Higher Education' themegroup. In 2017, she participated in organising the annual NVMO PhD student day. Furthermore, she received a visiting student scholarship to Melbourne University, the Australian National University and Macquarie University from the Leiden University Fund. She has presented her research at national (NVMO and ORD) as well as international conferences (AERA, EARLI, HERDSA and SRHE). Additionally, in 2017 she was given the award for the best student paper presentation at the Annual Conference of the Higher Education Research and Development Society of Australasia.

Currently, Mayke is employed as a postdoctoral researcher at the ICLON. She is working on a research project investigating professional development in inquiry-based teaching at international schools with a particular focus on relations between teacher beliefs and inquiry-based teaching practices. Furthermore, she is employed at the ICLON as a consultant in higher education, focusing on instructional development initiatives for university teachers.

Dankwoord



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Mayke Vereijken

ICLON PhD dissertation series

Hoeflaak, A. (1994). *Decoderen en interpreteren: een onderzoek naar het gebruik van strategieën bij het beluisteren van Franse nieuwsteksten.*

Verhoeven, P. (1997). *Tekstbegrip in het onderwijs klassieke talen.*

Meijer, P. C. (1999). *Teachers' practical knowledge: Teaching reading comprehension in secondary education.*

Zanting, A. (2001). *Mining the mentor's mind: The elicitation of mentor teachers' practical knowledge by prospective teachers.*

Uhlenbeck, A. M. (2002). *The development of an assessment procedure for beginning teachers of English as a foreign language.*

Oolbekkink-Marchand, H.W. (2006). *Teachers' perspectives on self-regulated learning: An exploratory study in secondary and university education.*

Henze-Rietveld, F. A. (2006). *Science teachers' knowledge development in the context of educational innovation.*

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Van der Rijst, R.M. (2009). *The research-teaching nexus in the sciences: Scientific research dispositions and teaching practice.*

Platteel, T.L. (2010). *Knowledge development of secondary school L1 teachers on concept-context rich education in an action-research setting.*

Kessels, C.C. (2010). *The influence of induction programmes on beginning teachers' well-being and professional development.*

Min-Leliveld, M.J. (2011). *Supporting medical teachers' learning: Redesigning a programme using characteristics of effective instructional development.*

Dobber, M. (2011). *Collaboration in groups during teacher education.*

Wongsopawiro, D. (2012). *Examining science teachers pedagogical content knowledge in the context of a professional development programme.*

Belo, N.A.H. (2013). *Engaging students in the study of physics: An investigation of physics teachers' belief systems about teaching and learning physics.*

De Jong, R.J. (2013). *Student teachers' practical knowledge, discipline strategies, and the teacher-class relationship.*

Verberg, C.P.M. (2013). *The characteristics of a negotiated assessment procedure to promote teacher learning.*

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