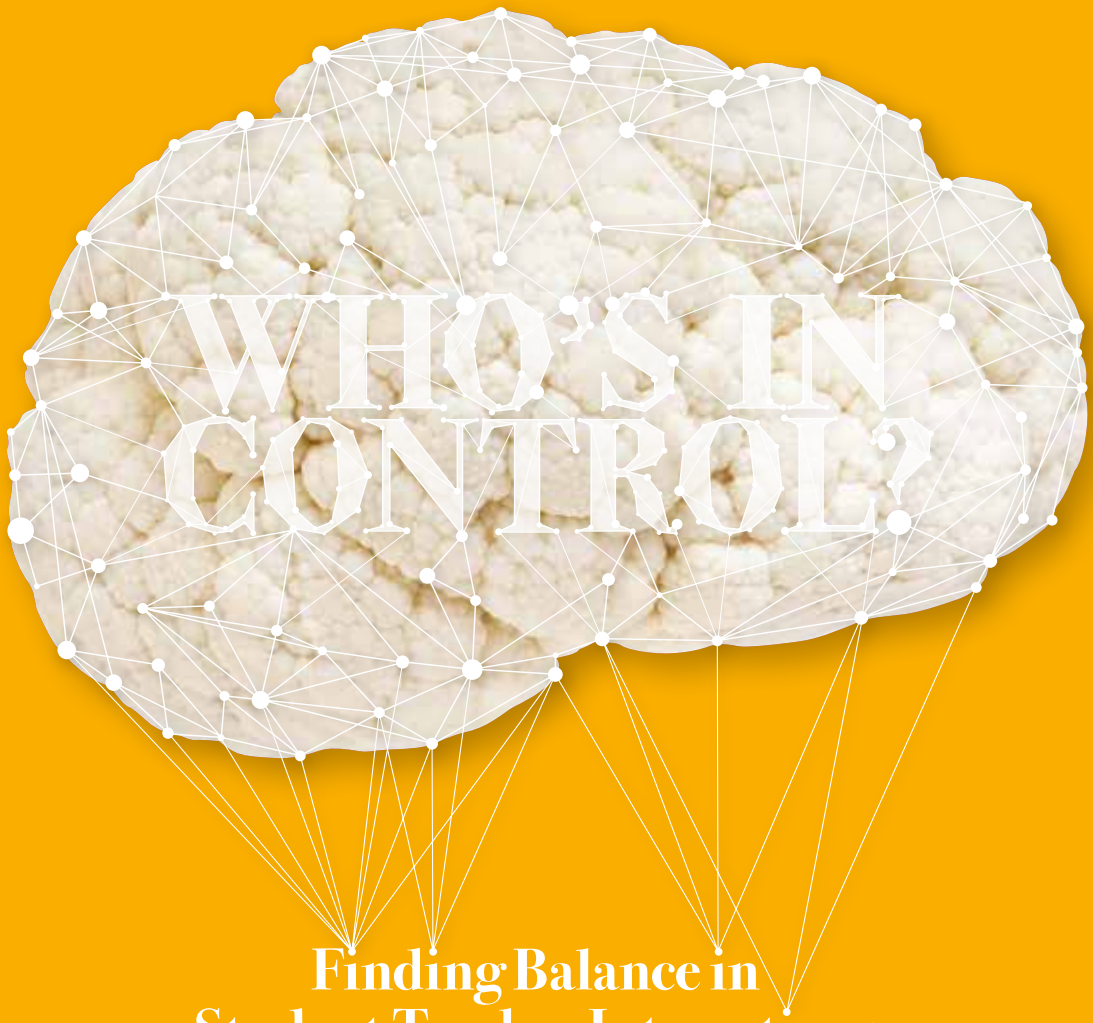
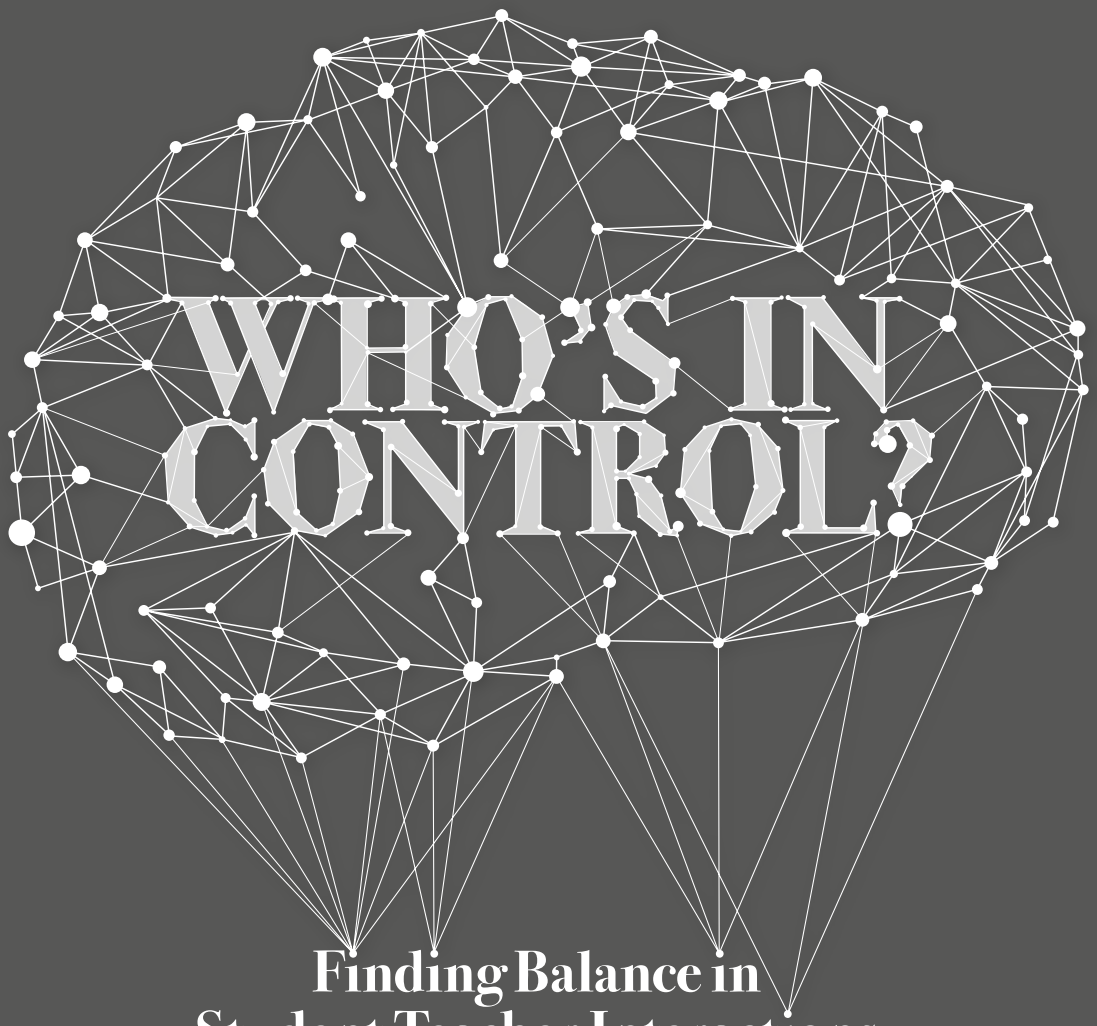


Finding Balance in Student-Teacher Interactions

Bas Agricola



Finding Balance in Student-Teacher Interactions

Bas Agricola

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Who's in control?

Finding balance in student-teacher interactions

Wie heeft de controle?

Het vinden van evenwicht in student-docent interacties

(met een samenvatting in het Nederlands)

Proefschrift

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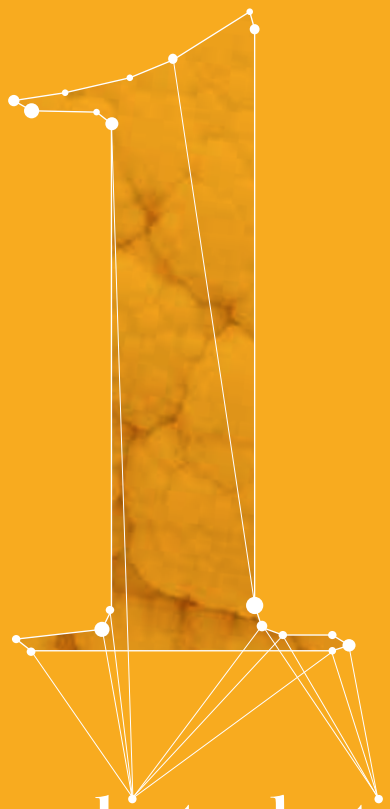
door

Bastiaan Theodorus Agricola

geboren op 2 december 1974
te IJsselstein

Promotoren	**Prof. dr. M.F. van der Schaaf**
	Prof. dr. J.W.F. van Tartwijk
Copromotor	**Dr. F.J. Prins**

Table of contents



General introduction

1.1 Introduction

> *If you can both listen to children and accept their answers not as things to just be judged right or wrong but as pieces of information which may reveal what the child is thinking you will have taken a giant step toward becoming a master teacher rather than merely a disseminator of information.* (Easley & Zwoyer, 1975, p. 25)

In higher education students have many interactions with their teacher in which teachers provide support for students' learning. We know that feedback strongly influences students' achievement (Hattie, 2009). Feedback aims to improve student's future performance, product or outcome, that is, it fills the gap between performance and what is aimed at to be performed (Sadler, 1989). Students sometimes do not understand and interpret teacher feedback accurately and rarely feel encouraged to use self-regulated thinking about the feedback (Higgins, Hartley, & Shelton, 2002; Hyatt, 2005; van der Schaaf, Baartman, Prins, Oosterbaan, & Schaap, 2011). Especially when written feedback is communicated via one-way comments students feel frustrated and experience feedback to be unhelpful (Ferguson, 2011).

Many researchers have argued to communicate feedback during conversations in which teachers and students can interact (Ajjawi & Boud, 2017; Carless, Salter, Yang, & Lam, 2011; Nicol, 2010). An advantage of these feedback conversations (compared to written feedback) is that students can adopt a more active role, that is, taking initiative, for instance by asking questions about the feedback and by verifying their interpretation of the feedback (Prins, Sluijsmans, & Kirschner, 2006). Feedback conversations in higher education are specific examples of teacher-student interactions and are the objects of this project. During feedback conversations, students discuss the process and outcome of their work individually or in a small group with their teacher. This can help students to acquire the essential skills for the task they are working on. This dissertation focuses on the complexity and development of student-teacher interactions during feedback conversations in higher education. A combined student's and teacher's perspective is key, as we apply a Vygotskian socio-cultural view on learning (Vygotsky, 1978). We argue student-teacher interactions to be a prerequisite for student learning. From this socio-cultural perspective, we will explore how student-teacher interactions during feedback conversations take place, how they develop, change and can be supported.

A teacher's perspective: diagnosing within a scaffolding framework

Feedback conversations in which teachers (as feedback providers) and students (as feedback receivers) interact, can offer opportunities for scaffolded feedback (Dekker-Groen, van der Schaaf, & Stokking, 2011). Scaffolding provides guidance within a student's zone of proximal development and bridges the distance between student's actual developmental level in a certain task and the level that will be accomplished with guidance (Vygotsky, 1978). A student receives scaffolding when performing a task that he otherwise might not be able to accomplish (D. Wood, Bruner, & Ross, 1976); teachers can scaffold learning activities of the student with feedback, hints, instructing, explaining, modeling and questioning (Van de Pol, Volman, & Beishuizen, 2010).

Within scaffolding, teacher support is adapted to student's understanding. For example, when students fail to spontaneously apply appropriate available learning strategies, teachers' prompting (i.e., hints or questioning) could be an adequate way of guidance (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001; Prins et al., 2006). When students don't have appropriate strategies available, direct instruction or training is more adequate. Adaptive teaching is accomplished when teachers gather information and diagnose student's understanding about the subject matter or task approach at hand. Van de Pol et al. (2011) proposed a scaffolding framework based on work of Ruiz-Primo and Furtak (2007), which focuses on how scaffolding takes place. In this framework, scaffolding is defined as a cycle with three teaching phases: teachers' *diagnosing*, *checking of diagnosis* and *intervening* (see Figure 1).

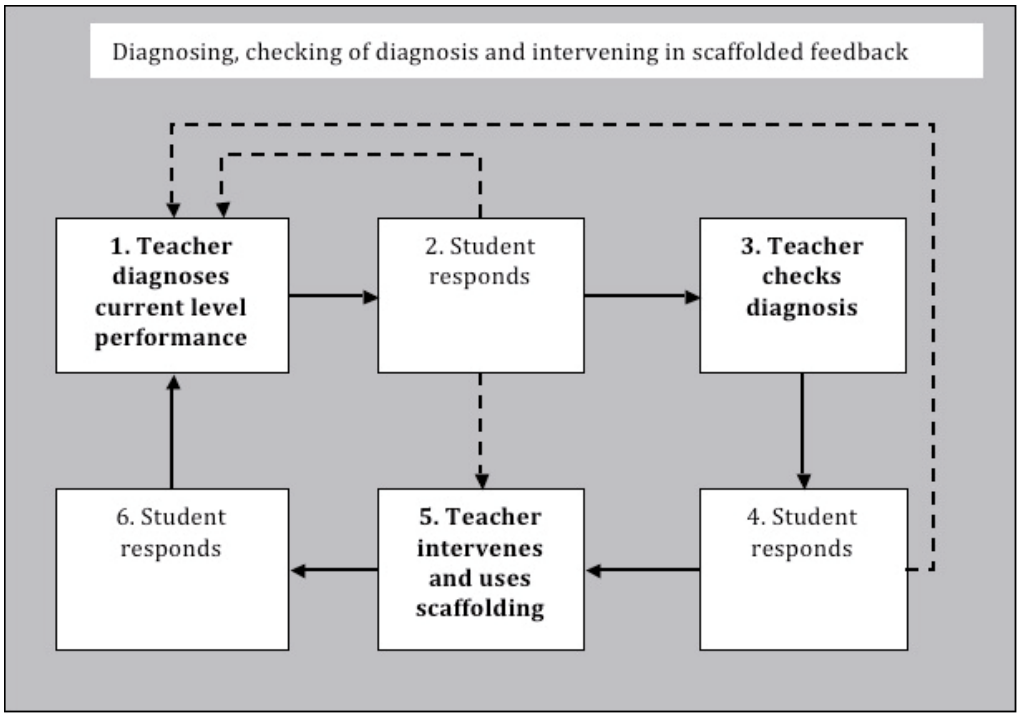


Figure 1.1. Diagnosing, checking of diagnosis and intervening in scaffolded feedback adapted from Ruiz-Primo and Furtak (2007) and Van de Pol et al. (2011)

A teacher diagnoses (1) when asking the student questions to gather information on students' current conceptions and available learning strategies. The student responds (2) and shows understanding (or not), giving the teacher a basis on which to decide whether enough is known about the students' capacities. A teacher checks the diagnosis and verifies whether s/he understood the student correctly (3). Based on students' responses and students' understanding (4) a teacher intervenes and the actual scaffolding takes place (5). Research shows teachers find diagnosing difficult; they do not diagnose (Graesser, Person, & Magliano, 1995; Putnam, 1987), their diagnoses are far from perfect (Südkamp, Kaiser, & Möller, 2012; Van de Pol & Elbers, 2013), or they are intervening immediately (Ruiz-Primo & Furtak, 2007). In this dissertation, this scaffolding framework was used as a lens to observe the diagnostic behavior of our teachers in interaction with their students.

A student's perspective: perceptions of feedback, self-efficacy, and motivation

During teacher-student interactions, we do not see students as passive receivers of information, but we expect them to be self-regulated learners, actively taking up feedback, asking questions and regulating their learning process (Zimmerman, 1989). When self-regulated students encounter a gap between current and desired performance they often seek feedback from teachers themselves (Butler & Winne, 1995; Nicol & Macfarlane-Dick, 2006). During feedback conversations, however, students do not automatically take an active role during interactions with their teacher. Often they are rather passive and wait for the teacher to take the lead (Prins & Mainhard, 2009, August). When students receive feedback on their work, before taking up the feedback, the first thing they do is perceive the feedback, for example on its quality and usefulness. When feedback is difficult to understand or to act

upon, students can develop low *self-efficacy* and have low expectations of being successful in a task (Wingate, 2010). When students have high self-efficacy and believe that their actions can produce the outcomes they desire, they are also motivated to act when facing difficulties (Pajares, 2012). In this project, we investigate students' feedback perception, self-efficacy, and motivation as the outcomes of teacher's feedback and student-teacher interactions during feedback conversations.

Who's in control?

From a socio-cultural perspective, we view student's self-regulation of learning as the result of a social process in which students and teachers interact (McCaslin & Hickey, 2001). Students are self-regulating, when self-regulation activities appear in their performance (Hadwin, Wozney, & Pontin, 2005). Co-regulation of learning is seen as the transitional process towards self-regulation; student's self-regulation strategies are guided and supported by a significant other (Hadwin & Oshige, 2011; Järvelä & Hadwin, 2013). Through co-regulation, students temporarily regulate their cognition, behavior, motivation, and emotions with a more capable other such as a teacher (Räisänen, Postareff, & Lindblom-Ylänne, 2016). This perspective of co-regulation is grounded in Vygotskian views of learning and occurs through interaction, activity, sharing and engagement within the zone of proximal development (McCaslin, 2009; Vygotsky, 1978). In an early stage of a new task, teachers often dominate feedback conversations with instruction, explanation and demonstration and students mainly observe. When students show more understanding, teacher regulation can decrease to a more shared regulation of learning. Student responsibility increases and co-regulation occurs (Hadwin et al., 2005). Scaffolded teacher feedback has proven to be useful to encourage students' self-regulation as an outcome of feedback conversations (Chi et al., 2001). In this dissertation, the scaffolding principles of teachers decreasing their support, when student understanding increases, and students taking up their responsibility as a result of that, were explored. Explicit reasons underneath teachers' actions during feedback conversations and how students perceived these actions were investigated as well.

Professional development of teachers' diagnosing

In general, teachers find it hard to diagnose students' understanding; they experience difficulties in asking the right questions, or do not use the diagnostic information they gathered (Ruiz-Primo & Furtak, 2007; Südkamp et al., 2012). For optimal scaffolding to occur, teachers need to get a sense of what a good diagnostic conversation looks like. Teachers need specific knowledge to develop these diagnosing skills. There are several ways in which teachers can develop in diagnosing students' understanding. A way to support teachers in this process is to provide them with prompts (hints, questions) that invite dialogue and constructive responses by the student (Chi et al., 2001; Van de Pol et al., 2010; Van de Pol et al., 2011). Providing a list of these prompts to teachers as examples of the kind of questions they can ask may support diagnosing and checking. Another way of supporting teachers in how to diagnose is to provide videotaped observations which could function as worked out examples, in which teachers show how diagnosing and checking of diagnosing takes place. In this dissertation, we have searched for a professional development program that combines teachers' active engagement and observation of teachers' lessons. Lesson study is a professional development practice in which teachers collaborate in a lesson study team; they develop, teach, and observe a lesson, and examine its impact on students (Lewis & Hurd, 2011; Stepanek, Appel, Leong, Mangan, & Mitchell, 2006).

The general *research problem* in this project is: How do teachers' *diagnoses*, *checks of diagnoses*, and their *interventions* during student-teacher feedback conversations in higher education relate to (a) the quality of students' and teachers' interactions, (b) the quality of students' self-regulation, (c) students' perceptions of teacher feedback, and (d) students' motivation?

1.2 This dissertation

This dissertation aims to contribute to the field of student-teacher interactions in several ways. First, we aim to unravel the complexity of face-to-face feedback conversations between teachers and students in higher education. More specifically, we aim to explore how these student-teacher interactions take place, why they interact the way they do, and stimulate teachers to interact differently.

Methodology

In this dissertation, we use a mixed method approach to explore feedback conversations. In five reported studies, we use multiple designs (experimental, case study, mixed method, and design based), multiple measures (questionnaires, observations, interviews, stimulated recall, and learning reports), and multiple perspectives (students and teachers). In the first study, we will use an experimental design with questionnaire data (chapter 2). Followed by two studies with an exploratory multiple case study design, that observe teacher behavior (chapter 3), and observe student-teacher behavior enriched with questionnaire student data (chapter 4). In the fourth study, we will use an explanatory multiple case study design, in which stimulated recall interviews are used to investigate teachers' decisions and students' perceptions (chapter 5). And the final study is a design-based intervention study which aims to develop teachers' pedagogical content knowledge with a lesson study approach.

Context

The studies reported in this dissertation are all carried out within the four-year bachelor program Nutrition and Dietetics at the Institute of Health Studies at HAN University of Applied Sciences. The bachelor of health program of Nutrition and Dietetics is focused on the science of nutrition in order to work out ways in which health conditions such as diabetes and cancer can be prevented or treated. Dietitians are skilled at translating scientific and medical research related to food and health into practical guidance for the general public. On the undergraduate educational program, students learn the skills necessary to become a dietitian – the only qualified health professional that can assess, diagnose and treat diet and nutrition related problems at an individual and wider public health level. Throughout the program, students gain an understanding of the conditions where nutrition plays a significant role in disease management. They develop the knowledge to provide nutrition and dietetic care for individuals, groups and populations who have or already are at risk of developing long-term health conditions. In addition to lectures and seminars, students participate in group work, role plays and practical sessions in the laboratory and the technical kitchen. In their final year, students get hands-on experience through a full-time work placement which will provide them with the opportunity to develop knowledge and skills in preparation for a qualification as a dietitian. Students will be required to complete a research project in their final year, usually specializing in a specific area of Dietetics.

This dissertation focuses on two major tasks within the educational program of Nutrition and Dietetics: 1) the role plays with simulated patients in which students train and develop their dietetic judgment based on the clinical decision making process (Chapter 2); and 2) the writing of an undergraduate thesis in which students develop the skills of critical appraisal, interpretation, analysis, defending and reflection through the design and execution of a dietetics and nutrition-focused research project (Chapters 3-6).

Outline

The research problem will be investigated in five studies. In Chapter 2 the impact of verbal feedback and feedback cover sheets on students' feedback perception and motivation is investigated. In Chapter 3 teachers' diagnosis, checks of diagnosis, and interventions are explored. In Chapter 4, co-regulation, feedback perception and motivation are investigated in time. In Chapter 5 teachers' in-the-moment decisions and students' perceptions are investigated. Finally, in Chapter 6, we determine the impact of lesson study on teachers' pedagogical content knowledge. In this dissertation, we start out in the first study by using a quasi-experimental design to verify whether verbal feedback - as main component of feedback conversations - has a positive effect on students' perceptions and motivation (chapter 2). The first study was used as a basis for the other chapters, in which we transferred the theory of feedback conversations – verbal feedback having a positive impact on student perceptions and motivation - to the task of writing an undergraduate thesis (chapters 3, 4, 5 and 6). We will explore teachers' diagnostic behavior (chapter 3), and teachers' and students' co-regulation over time (chapter 4), and explain teachers' diagnoses and students' perceptions (chapter 5), to finally develop teachers' pedagogical content knowledge with a lesson study.

In **Chapter 2** student perceptions and students' motivation will be investigated from a feedback perspective. In higher education, the main form of feedback exists of written feedback on student's work and students often misunderstand teacher feedback. A 2 x 2 factorial experiment (N = 115) is conducted to examine the effects of the use of a feedback request form (with vs. without) and feedback mode (written vs. verbal feedback) on students' feedback perception, self-efficacy, and motivation. We assume that one-on-one feedback conversations between a teacher and a student, will provide teachers and students with opportunities to engage into discussion about the feedback. During these conversations, teachers can provide their argumentation, and students can verify their interpretation, or request for more explanation. ANOVAs and ANCOVAs are applied to the questionnaire data from 115 students.

In **Chapter 3** student-teacher interactions are investigated from a teacher's perspective. These interactions are explored within the context of research supervision and the theoretical framework of scaffolding. Teachers who apply adaptive teaching, diagnose student understanding and misconceptions, which enables them to adapt their support to students' understanding. We propose an adapted model for scaffolded teaching in which four different diagnostic phases are theoretically distinguished: diagnostic questioning, diagnosing, checking of diagnosis, and intervening. In an explorative multiple case study we will investigate the diagnostic teaching behaviour of four research supervisors. Sixteen supervision meetings are videotaped and transcribed. A content and sequential analysis of these four phases as conducted on 3000 teacher turns.

In **Chapter 4** student-teacher interactions will be investigated from a teacher's and a student's perspective. Again, the interactions are explored within the context of research supervision. The theories of scaffolding and co-regulation are combined to analyse the shift in teacher support and in student responsibility. Teachers are expected to dominate research supervision meetings when students start with a new task like writing their undergraduate thesis. When time passes, student's research skills increase, more responsibility can be given to the student. We aim to test the theory of scaffolding and co-regulation in the context of research supervision. We will conduct a mixed method multiple case study, in which twenty supervision meetings are observed, videotaped and transcribed at two different moments: at the beginning of the research process and at the end. The transcripts are analysed with an automatic dialogue act coding procedure mainly used in collaborative learning studies. Students' perceptions and motivation are investigated at the same two moments with two different questionnaires. After reliability and factor analysis, we will test for differences on co-regulation, feedback perception, and motivation. Findings of the observations and questionnaire data will be discussed.

In **Chapter 5** we continue with a study into supervisors' in-the-moment decisions. As supervisors' diagnoses remained implicit and unobservable, we aim to investigate these diagnoses by gathering data about supervisors' in-the-moment decisions and students' perceptions of supervisors' actions. We will conduct a multiple case study in which seven supervision meetings are observed and videotaped with a head-mounted camera and a fixed camera. The head-mounted video is then used as stimulus during stimulated recall interviews with seven supervisors; the fixed video is used as stimulus during stimulated recall interviews with six students. All interviews are videotaped, transcribed and analysed. Supervisors' transcripts are coded with a deductive content analysis; students' transcripts are coded with an inductive content analysis. Results of supervisors' perspectives and students' perspectives are described and discussed.

In **Chapter 6** we finalize this dissertation with a lesson study project. We aim to show how this professional and educational development program contributes to changes in supervisors' pedagogical content knowledge (PCK). During this project four supervisors and a facilitator participate in a lesson study team. The lesson study approach is described in detail, several materials are provided that are developed and used by the participating supervisors. During a four-month project the supervisors are focused on enhancing student learning. We focus on supervisor learning; data are gathered on supervisors' learning activities and PCK. Nine lesson study meetings are observed, videotaped and transcribed, supervisors are asked to write learning reports, and an exit interview is held with each supervisor. All data are analysed on supervisors' PCK and learning activities during the lesson study process.

Chapter 7 encompasses an overarching discussion and the conclusions of the individual studies. Practical recommendations and suggestions for further research are presented.

Table 1.1 Dissertation overview

Chapter	Title	Research questions
1	General introduction	
2	Impact of feedback request forms and verbal feedback on students' perception, self-efficacy, and motivation.	1 What is the impact of a feedback request form on students' feedback perception, self-efficacy, and motivation? 2 What is the impact of verbal feedback on students' feedback perception, self-efficacy, and motivation?
3	Teachers' diagnosis of students' research skills during the supervision of the undergraduate thesis	1 How do supervisors apply the diagnostic phases of a diagnostic question, diagnosis, diagnostic check and intervention during supervision meetings about students' research skills?
4	Shifting patterns in co-regulation, feedback perception, and motivation during research supervision meetings.	1 How does the co-regulation between teachers and students during research supervision meetings shift in the course of a five-month research project? 2 How does students' feedback perception and motivation for their research task shift in the course of a five-month research project?
5	Teacher-student perspectives on teaching: A multiple case study about teachers' in-the-moment decisions and students' perceptions	1 Which different types of in-the-moment decisions do research supervisors report, and how are they connected to teaching actions? 2 Which of the reported in-the-moment decisions were already aimed for, and which reported teaching actions were already planned? 3 How do students perceive teachers' teaching actions?
6	The development of research supervisors' pedagogical content knowledge in a lesson study project	1 How does a lesson study approach stimulate the development of teachers' pedagogical content knowledge in students' research supervision?
7	General discussion	

Method and participants	Analysis method
Questionnaires among 115 students	ANOVAs on differences in feedback perception ANCOVAs on differences in self-efficacy and motivation
Video observations of 16 supervision meetings for 4 supervisors	Content analysis of diagnostic behaviour on 3000 teacher turns Sequential analysis of diagnostic phases
Repeated measure of • Video observations (co-regulation) of 10 triads • Questionnaires of 20 students.	Dialogue Act Coding analysis of co-regulation on 20 transcripts Wilcoxon signed rank tests of co-regulation, feedback perception and motivation.
• Video observations of 7 dyads • Stimulated recall interviews with 7 teachers • Stimulated recall interviews with 6 students	Content analysis of in-the-moment decisions and teaching actions Content analysis of student perceptions
• Video observations of 9 lesson study meetings • Learning reports of 4 supervisors • Exit interviews of 4 supervisors	Content analysis of supervisors' PCK and learning activities

Impact of feedback request forms and verbal feedback on students' perception, self-efficacy, and motivation

This chapter is based on: Agricola, B.T., Prins, F.J., Sluijsmans, D.M.A. (*submitted*). Impact of feedback request forms and verbal feedback on students' perception, self-efficacy, and motivation.

Acknowledgement of author contributions: BA, FP, and DS designed the study, BA recruited participants and collected the data, BA developed the instrument, BA analyzed the data, BA drafted the manuscript, all authors contributed to critical revision of the paper, FP and DS supervised the study.

Abstract

Students often misunderstand teachers' written feedback. This is worrisome, since written feedback is the main form of feedback in higher education. Organizing feedback conversations, in which feedback request forms and verbal feedback are used, is a promising intervention to prevent misunderstanding of written feedback. In this study a 2 x 2 factorial experiment (N = 115) was conducted to examine the effects of the use of a feedback request form (with vs. without) and feedback mode (written vs. verbal feedback) on students' feedback perception, self-efficacy, and motivation. Results showed that verbal feedback had a significantly higher impact on students' feedback perception than written feedback. Feedback request forms did not improve students' perceptions, self-efficacy, or motivation. Based on these results, we can conclude that teachers should be stimulated to communicate their feedback verbally during a feedback conversation and more research is needed to investigate the use of feedback request forms.

2.1 Introduction

In higher education, it is common practice that students receive a lot of written feedback on their work. Teachers in higher education are spending much of their time writing comments on assignments. Feedback given as one-way written comments often results in lack of effective feedback (Carless et al., 2011). Many students for example have difficulty understanding written teacher feedback and are disappointed and frustrated when the feedback is unclear, too brief, or unhelpful in terms of future learning (Ferguson, 2011; Hounsell, McCune, Hounsell, & Litjens, 2008; Hyland, 2013). In general, for feedback to be effective it is essential students have positive perceptions about teacher feedback (van der Schaaf et al., 2011). Students' perception of feedback refers to the extent to which students perceive the feedback to be supportive for their learning (Gibbs & Simpson, 2003). Students who perceive feedback positively tend to have high *self-efficacy*; they have confidence to complete similar tasks, after their efforts have been successful (Caffarella & Barnett, 2000; Pajares, 2012). Students with high self-efficacy are often also highly motivated to approach difficult tasks as challenges to be mastered (Pajares, 2012). Current feedback definitions all contain the provision of information to a student to foster students' learning (Kluger & DeNisi, 1996; Ramaprasad, 1983; Sadler, 1989; Shute, 2008). Several definitions contain the *interaction* between teachers and students, for example Carless, Salter, Yang and Lam (2011) who defined feedback as "all dialogue to support learning in both formal and informal situations" (p. 396). In this paper, we investigated feedback and considered it to be conceptualized as a *dialogue* between students and their teachers (Carless et al., 2011).

Providing effective feedback is complicated: the relation between form, timing, and effectiveness of feedback is complex and variable (Price, Handley, Millar, & O'Donovan, 2010; Sadler, 2010). The effectiveness of feedback can be improved when students have the opportunity to share their feedback preference in advance. These preferences can be expressed using *feedback request forms*, in which students are asked to identify particular aspects of their work on which they would like to receive feedback on (Bloxham & Campbell, 2010; Elbow & Sorcinelli, 2011; M. Gielen & De Wever, 2015). Furthermore, for feedback to be effective, students have to understand the feedback and communication is the key factor for that success (Higgins, Hartley, & Skelton, 2001). Van der Schaaf et al. (2011) have showed that students who have *feedback conversations* with their teacher perceive teacher feedback as more useful. We consider feedback request forms and feedback conversations with one-on-one teacher-student interactions as a possible solution for the above-mentioned students' lack of understanding of feedback. We examined the impact of feedback request forms and the impact of feedback mode (verbal vs. written feedback) on students' feedback perception, self-efficacy, and motivation.

Feedback and student perceptions of feedback

Providing teacher feedback on students' assessment tasks is regarded important and beneficial (Hattie, 2012). Many studies have found evidence of the impact of feedback on learning (Black & Wiliam, 1998; Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Shute, 2008). Still, much of this feedback is sent, but not processed (Hattie, 2012), and can have unintended effects on students (Lizzio & Wilson, 2008). Vague and ambiguous feedback tends to result in students' frustration, dissatisfaction, and a feeling of uncertainty (Price et al., 2010). Students sometimes do not understand and interpret teacher feedback accurately (Higgins et al., 2002; Hyatt, 2005), and rarely feel encouraged to think about the feedback (Duijnhouwer, 2010). When students receive feedback, the first step in the feedback process consists of perceiving the feedback, before even accepting or acting upon it (de Kleijn, Mainhard, Meijer, Brekelmans, & Pilot, 2013). As feedback is one of the most effective interventions teachers can use, fostering positive student perceptions of feedback should be a primary goal of teachers (Ekholm, Zumbrunn, & Conklin, 2015). How students interpret feedback and deal with it is critical for subsequent learning (Poulos & Mahony, 2008). In order for students to benefit from feedback, they should have positive perceptions of it. Student perceptions of feedback are significant in higher education, as students perceive feedback as a guide towards success, as a means of academic interaction, and as a sign of respect and caring (Rowe, 2011). Since students' understanding of the feedback is often not consistent with the intention of the teacher (van der Schaaf et al., 2011), insight in students' *perceptions* of feedback is important.

Feedback and students' self-efficacy

Self-efficacy refers to the beliefs of people about their capabilities to exercise control over their own level of functioning (Bandura, 1993). Students with low self-efficacy have no confidence in their own abilities; they often will not focus on opportunities to improve, or will not use the provided feedback (Wingate, 2010). When students are provided with frequent and immediate feedback self-efficacy is increased (Schunk, 1983). When feedback is difficult to understand or to act upon, students can develop low *self-efficacy* and have low expectations of being successful in a task (Wingate, 2010). Students who perceive feedback as constructive have a higher self-efficacy of their own writing skills (Caffarella & Barnett, 2000). Schunk and Zimmerman (2007) argue that students with high self-efficacy participate more readily, work harder, and persist longer when they encounter difficulties (p.9). Self-efficacy can be measured using self-assessment instruments; the Motivated Strategies for Learning Questionnaire (MSLQ) is a self-assessment instrument and has been widely used in educational research. In the MSLQ, self-efficacy is measured as part of three expectancy components (Pintrich, Smith, Garcia, & McKeachie, 1991). We know teacher feedback can influence self-efficacy (Duijnhouwer, Prins, & Stokking, 2010) and positive correlations between self-efficacy and academic achievement have been found (Pintrich & De Groot, 1990).

Feedback and students' motivation

Self-efficacy and *motivation* are strongly connected. When students have high self-efficacy and believe that their actions can produce the outcomes they desire, they are also motivated to act when facing difficulties (Pajares, 2012). As feedback can affect persistence and performance through its effect on students' self-efficacy and motivation (Butler & Winne, 1995; Duijnhouwer et al., 2010; Kluger & DeNisi, 1996), insight in the effect of feedback on students' self-efficacy and motivation is important. Students can be either extrinsically motivated to understand and act on feedback (e.g., there is a reward) or intrinsically motivated (e.g., motivated to learn) (Ryan & Deci, 2000). For a student to remain motivated, there must be alignment between students' goals and the expectations that these goals

are attainable. Students' reasons why they are engaging in a specific learning task can be measured with the concept of goal orientation (Pintrich et al., 1991). Students who apply an *intrinsic goal orientation* will participate in a task for reasons such as challenge, curiosity and mastery (Pintrich et al., 1991). They will have the desire to increase their competence by developing new skills and mastering new situations, and enhance their intrinsic motivation (Dweck, 1986; Dweck & Leggett, 1988; Shute, 2008). Students who apply an *extrinsic goal orientation* will participate in tasks for reasons as grades, awards and performance (Pintrich et al., 1991). They will focus to demonstrate competence to others and to have a positive evaluation by others (Dweck, 1986; Shute, 2008). Students with an extrinsic goal orientation will enhance their extrinsic motivation (Dweck & Leggett, 1988). Ideally, students receive feedback about whether these goals are attained (Shute, 2008).

Feedback request forms to foster feedback effectiveness

More focus on students as feedback receivers is important, as students should be active participants in the feedback process. Structured feedback request forms enhance students' role in the feedback process by expressing their preference of feedback (Prins et al., 2006). The use of feedback request forms aims at raising the quality of the feedback and student's response to it (S. Gielen, Tops, Dochy, Onghena, & Smeets, 2010). Feedback request forms can be collected together with a student's work and allow students to formulate their feedback needs. Assessors combine the assessment criteria in a rubric-scoring sheet with student's feedback request form to address these needs in the feedback (S. Gielen, Peeters, Dochy, Onghena, & Struyven, 2010). When using the feedback request forms, students perceive the feedback more personally addressed, and are more likely to use the feedback (S. Gielen et al., 2010). Gielen and De Wever (2015) used a feedback request form in their study and asked students to indicate first the criteria, and second the kind of feedback they expected. They found that students who used the feedback request form and received feedback were actively engaged in the assessment activity, and the quality of peer feedback was raised. Bloxham and Campbell (2010) also used feedback request forms, in which students posed questions the assessors could address. When using the forms students were getting more engaged in the feedback process and wanted the question and feedback process to develop more in to a dialogue with the assessor. Elbow and Sorcinelli (2011) argued that giving feedback on draft or final assignments becomes easier and more productive when students write a feedback request form with specific questions. The feedback request form should answer questions such as "Which parts feel strong and weak to you?", and "What questions do you have for me as a reader?" We consider feedback request forms to have a positive impact on students' feedback perception, self-efficacy, and motivation when assessors are able to address students' feedback preferences in their feedback comments.

Advantages of feedback conversations

Feedback is often seen as the linear transfer of information from the sender of a message (the tutor) to a recipient (the student) via usually written comments (Higgins et al., 2001). A narrow view of learning occurs when feedback is only considered as something that is *given* to a student (Ajjawi & Boud, 2017). It cannot be assumed that just providing written feedback automatically leads to students' understanding and that they can use the feedback in subsequent work (Havnes, Smith, Dysthe, & Ludvigsen, 2012). Direct comments with simple vocabulary and familiar expressions can be helpful for students to know how to improve their work (Bruno & Santos, 2010). We stress out the fact that one-way written comments are considered to be feedback as well; we argue that interaction during feedback exchange may increase the effectiveness of feedback. As written feedback is often misinterpreted and misunderstood, *verbal feedback* seems to be a solution for the problems associated with written feedback. Merry and Orsmond (2008) and Van der Schaaf et al. (2011) showed that students respond more pos-

itively to verbal feedback, seeing it as being closer to dialogue; students perceived verbal feedback to be a better natural dialogue than written feedback. With the understanding that dialogue is a two-way process, students can learn from feedback comments through interaction (Nicol, 2010). Feedback as dialogue will increase the effectiveness of feedback because students do not only receive initial feedback information, but also have the opportunity to engage the teacher in discussion about that feedback (Nicol & Macfarlane-Dick, 2006). Feedback conversations give teachers and students the opportunities for this interaction; students can adopt a more active role by asking for particular types of feedback, verifying their interpretation of the feedback, determining whether the feedback is clear to them, whether they agree, and by requesting suggestions for improvement (Prins et al., 2006).

Assessment task with a simulated patient

This study was conducted in the context of a standardized simulated patient assessment task in which dietetic students' behaviour and communication skills were assessed. Undergraduate students of educational health programs at universities, for example nutrition and dietetics, are prepared for their internship with training in communication skills. Simulated patients and role-play are frequently used in teaching communication skills (Lane & Rollnick, 2007). Simulated patients are used to provide realistic and effective training (Beshgetoor & Wade, 2007) and to help to bridge the gap between the academic and the practice (Gibson & Davidson, 2016). These simulated patients are often actors who play a patient role (Beshgetoor & Wade, 2007; Gibson & Davidson, 2016). These actors are coached to play a standardized patient, and because the patient really exists, or existed, the entire medical history can be used for fulfilling an authentic simulated patient role (Hampl, Herbold, Schneider, & Sheeley, 1999). Using simulated patients is an effective strategy for nutrition counselling curricula. No significant differences for dietetic students on their communication skills and behaviour change skills were found when they encountered a real patient or a standardized patient (Schwartz, Rothpletz-Puglia, Denmark, & Byham-Gray, 2015). Todd, McCaroll and Nucci (2016) even showed that the use of simulated patients could increase students' self-efficacy before they started with their clinical practice.

Research questions

We investigated the impact of feedback request forms (with or without) and feedback mode (written vs. verbal) on students' perceptions of teacher feedback, their self-efficacy and motivation after receiving teacher feedback during an assessment task with a simulated patient. The following research questions were addressed:

1 What is the impact of a feedback request form on students' feedback perception, self-efficacy, and motivation?

2 What is the impact of verbal feedback on students' feedback perception, self-efficacy, and motivation?

First, it was expected that students who were using feedback request forms would be more positive about the feedback, would have a higher self-efficacy, and be more motivated, because these students could receive feedback adapted to their needs. Second, it was expected that students who were receiving verbal feedback would be more positive about the feedback, would be more motivated, and have a higher self-efficacy, because students in the verbal feedback condition could interact more with their teacher. In addition to the two research questions concerning the main effects, we explored whether there was an interaction effect between the use of feedback request forms and feedback mode on students' perception, motivation, and self-efficacy.

2.2 Method

Design

An experimental study was conducted with a two (feedback request form) by two (feedback mode) factorial design. The independent variable *feedback request form* consisted of a condition in which students could not express their preference about which parts of the assessment they would like the assessor to focus the feedback on and a condition in which the feedback request form was used. The independent variable *feedback mode* consisted of written feedback and verbal feedback. Written feedback was given with an assessment form and was handed to the student without verbal comments; verbal feedback was given in a one-to-one feedback dialogue between student and assessor. This led to four conditions: (1) no form written feedback (NW), (2) request form written feedback (RW), (3) no form verbal feedback (NV), and (4) request form verbal feedback (RV).

Participants

Data were gathered from of a 4-year undergraduate nutrition and dietetics program at the University of Arnhem and Nijmegen, The Netherlands. The participants were 128 students in their second year of this bachelor of health program and two assessors (teachers) who assessed the students. Randomization was applied using a "blocked design" in which participants were randomly assigned within a block of trials while keeping sample sizes equal across conditions (Vaus, 2001). All students were ranked on student number. Thirty-two sets of the 4 unique numbers (4 conditions) per set were computed and assigned to the 128 students (see Appendix A). The participants were divided into 32 blocks of four participants each and assigned to one of the four experimental conditions; this was repeated until all participants were assigned to a condition. Eight students of the total population of 128 students did not show up for their assessment. Five students had a failed video recording of their performance. The other 115 students received feedback and their data were used for further analysis. Two independent assessors assessed the students across all four conditions; the characteristics of the participants are presented in Table 2.1.

Table 2.1 *Characteristics of Participating Students (n=115) and Assessors (n=2)*

		Condition NW (n=26)	Condition RW (n=32)	Condition NV (n=30)	Condition RV (n=27)
Age	Mean	21.00	21.09	21.10	21.44
Gender	Female	24	29	24	24
	Male	2	3	6	3
Prior education	HGCE	15	20	17	15
	PUE	5	5	5	5
	VE	5	6	4	5
	HE	0	1	4	1
	Other	1	0	0	1

Note. Age in years; NW = No Form Written Feedback; RW = Request Form Written Feedback; NV = No Form Verbal Feedback; RV = Request Form Verbal Feedback; Education: HGCE = Higher General Continued Education; PUE = Pre-University Education; VE = Vocational Education; HE = Higher Education.

Materials and procedure

Course. This study was carried out in higher education and in the context of a six-week skills course in a ten-week module called "Lifestyle Diseases". During the course, students from seven different classes received classroom instruction in the professional role of a practitioner with the responsibilities of a dietitian. After instruction the students practiced their skills in nutritional assessment, dietary diagnosis, and treatment plans with simulated patients. At the end of the skills course, students' performance was assessed via an assessment task. Providing one-way written feedback to students was the standard procedure that assessors applied with this assessment task.

Assessment task. The assessment task of the course consisted of a student's individual conversation with a simulated patient. This simulated patient was an actor who was trained to act as a real diabetes patient in order to simulate a set of symptoms or problems. The actors received a detailed description of the simulated patient case and how to react to answers and questions of the student (see for a summary of the description Appendix B). Students had twenty minutes to prepare for the assessment task and then had the counselling conversation. All students videotaped their conversation. After the performance, students sent the videotaped conversation on a secure digital memory card to the first author. He sorted the memory cards between the four conditions and divided them between the two assessors.

Rubric-scoring sheet. In all four conditions the assessors used the same rubric- scoring sheet with the ten assessment criteria (see Appendix C). The criteria were formulated in a rubric with three scales per criterion: unsatisfactory, proficient, or outstanding. Students were familiar with the scoring sheet as they practiced with the criteria during the course.

Assessor training. The first author trained both assessors with worked-out video examples to practise their feedback skills of students' performances. The assessors were experienced dietitians and did not participate in the skills course as a skills course teacher. The objectives of the assessor training were to increase a shared understanding of the assessment criteria between both assessors, and to practise their formulation of verbal and written feedback. A final objective of the training was to get acquainted with the feedback request form.

Feedback-request form. A week before the assessment task, the 59 students (verbal feedback and written feedback) filled out the feedback request form (see Appendix D). The students were asked to identify particular aspects of their performance on which they would like to receive feedback. The feedback request form consisted of three questions: (1) "In the diagnostic phase, I prefer to receive feedback on…"; (2) "In the treatment phase, I prefer to receive feedback on…"; and (3) "During the feedback conversation I prefer to receive feedback on the following aspects of my attitude/communication/structure….".

Assessment room. The assessors were both sitting in a separate assessment room. They were sitting behind a laptop, with all memory cards with the videotaped performances, the rubric scoring sheets, and feedback request forms.

Feedback. Assessors had approximately 30 minutes per student to assess each student's performance from the memory card. The first 15 minutes were used to assess student's performance by observing the videotape; as a result they scored each of the ten criteria on the rubric-scoring sheet. The other 15 minutes were used for the formulation of the feedback; in the two verbal conditions feedback was given one-to-one orally to the student; in the two written conditions feedback was written down and handed over to the student. Students who filled out the feedback request form received feedback specifically aimed at the issues mentioned in their form.

Measures

Feedback and assessment perception questionnaire. After receiving the feedback students were asked to fill out the Feedback and Assessment Perception Questionnaire (FAPQ). The FAPQ was developed based on the Assessment and Experience Questionnaire (AEQ) of Gibbs and Simpson (2004; 2003). Students' perception was measured using four scales of the AEQ (Gibbs & Simpson, 2004; Gibbs & Simpson, 2003), namely: (1) perceived quality of the feedback (six items; e.g., "The feedback helps me to understand things better"); (2) perceived use of the feedback (eight items; e.g., "I use the feedback to go back over what I have done in the assessment"); (3) perceived quantity and timing of the feedback (six items; e.g., "I received plenty of feedback"); and (4) perceived examination and learning that measured the quality of the assessment task (eight items; e.g., "I learnt new things as a result of the performance"). In addition to the 28 items of the four AEQ scales, a fifth scale was added to the final FAPQ; (5) this scale of the usefulness of feedback emphasized how useful the feedback is (16 items, e.g. "The feedback is very easy to understand"). By that, the FAPQ consisted of 44 items, scored on a five-point Likert-type scale, from 1 (strongly disagree) to 5 (strongly agree) (see Appendix E). Reliability analyses were conducted on all scales of the FAPQ (r_{ir} <.3 and a relevant increasing "Alpha if item deleted"). Nine items were deleted from the original FAPQ. The FAPQ perception scale examination and learning showed low reliability (alpha =.58). This result fitted the reliability analysis of Gibbs and Simpson (2003) when they designed the FAPQ examination and learning scale (alpha =.54). The other 4 scales were found to be reliable (Cronbach's alpha >.70).

Motivation strategies for learning questionnaire. Before students started with the preparation of the assessment task, and after receiving or reading the feedback students were asked to fill out the Motivation Strategies for Learning Questionnaire (MSLQ). The MSLQ, a self-report instrument, was used to assess students' motivational orientations (Pintrich, Smith, García, & McKeachie, 1993). The motivation section of the MSLQ consists of 31 items and six scales. With the first three scales, we measured student's motivation for the task of practicing dietetic skills with a simulated patient: 1) intrinsic goal orientation measured student's perception of participating in the task for reasons such as challenge, curiosity, and mastery (four items; e.g., "I prefer a performance that really challenges me to learn new things"); 2) extrinsic goal orientation measured student's perception of participating in the task for reasons such as grades and rewards (four items; e.g., "Getting a good grade for the performance is the most satisfying thing"); and 3) task value measured student's evaluation of how interesting and important the task is (six items; e.g., "I think the knowledge and skills assessed in this performance are useful"). With the other three scales, we measured student's expectancy of accomplishing the task successfully, including self-efficacy: 4) control of learning beliefs measured student's perception that their learning efforts resulted in positive outcomes (four items; e.g., "If I try hard enough, then I will understand the knowledge and skills required for this performance"); 5) self-efficacy measured student's expectancy for success and student's appraisal of one's own ability to master the task (eight items; e.g., "I'm confident I can do an excellent job on this performance"); and 6) test anxiety measured student's negative thoughts that disrupted performance (five items; e.g., "When I am doing a performance with a simulated patient I think about how poorly I am doing compared with other students"). The 31 MSLQ items were reformulated with regard to the skills course and simulated patient assessment task; items were scored on a seven-point Likert-type scale, from 1 (not at all true of me) to 7 (very true of me) (see Appendix F). Reliability analyses were conducted on all scales of the MSLQ (r_{ir} <.3 and a relevant increasing "Alpha if item deleted"). Three items were deleted from the 31 items of the original MSLQ (pretest and posttest). The MSLQ scales of intrinsic goal orientation (pretest; alpha =.68), extrinsic goal orientation (posttest; alpha =.69) and control of learning beliefs (pretest; alpha =.62) showed moderate reliability. These results fitted the reliability analyses of Pintrich, Smith, Garcia and McKeachie (1993) when designing the MSLQ; they argued the scales to be a reasonable representation of the data (p. 808) with Crohnbach's alphas for intrinsic goal orientation (.74), extrinsic goal orientation (.62), and control of learning beliefs (.68). The other 9 scales (pretest and posttest) were found to be reliable (Cronbach's alpha >.70). See Figure 2.1 for an overview of the study and data gathering.

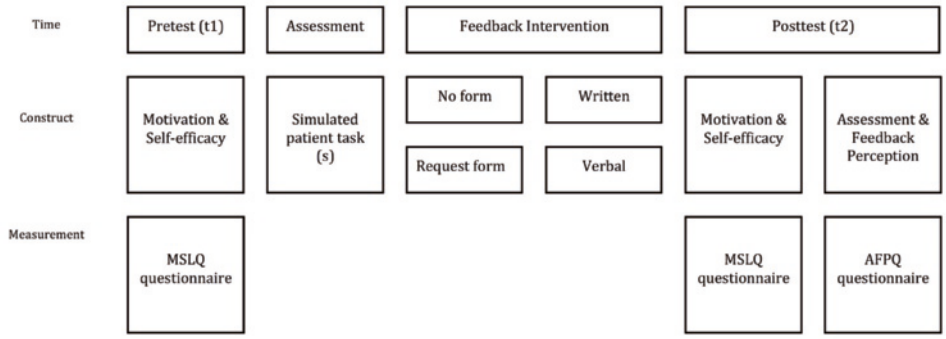


Figure 2.1. Overview of study and data gathering.

Data analysis

Feedback perception. We used two-by-two independent analysis of variance (ANOVA) to analyse the *main effects* of feedback request forms and feedback mode, and the *interaction effect* between feedback request forms and feedback mode on students' perceptions.

Motivation and self-efficacy. We used two-by-two independent analysis of covariance (ANCOVA) analyses to analyse the *main effects* of feedback request forms and feedback mode, and the *interaction effect* between feedback request forms and feedback mode on students' self-efficacy, and motivation. The pretest variables of self-efficacy and motivation were included as a covariate when they correlated significantly with the dependent variable. Following recommendations by Lakens (2013), partial eta-squared (η_p^2) was used as a measure of effect size. Effect sizes were qualified as a small (.01), medium (.06), or large effect (.14) (Cohen, 1988).

Error inflation correction. As we proposed 11 tests in our analysis (five ANOVAs and six ANCOVAs) a multiple testing correction was needed and the standard alpha level of .05 could not be applied. To correct for error inflation we have applied the False Discovery Rate (FDR) procedure of Benjamini and Hochberg (1995), as it maintains power and controls for the false positives (type I errors). The FDR procedure leads to an adjusted alpha level based on the number of tests conducted, which is called the Benjamini-Hochberg (B-H) critical value. Within the FDR procedure, the standard alpha-value (.05) was divided by each number of the 11 tests (1-11) leading to 11 FDR adjusted alpha-values from .05 (.05/1) to .0045 (.05/11). After the data were analysed, the 11 computed statistics (five ANOVA F-ratios and six ANCOVA F-ratios) with their *p*-values were ranked from high to low and tested against the 11 FDR adjusted alpha-values. The highest *p*-value that was lower than its FDR adjusted alpha level was considered the B-H critical value; all *p*-values below the B-H critical value were considered as a significant result.

2.3 Results

Main effect of feedback request form

Means and standard deviations are shown in Table 2.2, with the pre- and posttest scores of the six MSLQ scales, the posttest scores of the five FAPQ scales, and the reliability results. Contrary to our expectations, there was no significant main effect of the feedback request form on students' perceptions, self-efficacy, and motivation.

Table 2.2 Reliability Analysis of Subscales of the MSLQ (pretest), FAPQ, and MSLQ (posttest)

	Scale	N_{items}	N	Mean	SD	Min	Max	Alpha
MSLQ	Intrinsic Goal Orientation	3	115	12.74	3.30	4	21	.68
pretest	Extrinsic Goal Orientation	4	114	17.21	4.18	8	26	.72
	Task Value	6	114	32.30	3.96	22	42	.76
	Control of Learning Beliefs	2	115	8.77	2.36	3	14	.62
	Self-Efficacy	8	112	35.15	6.48	15	50	.89
	Test Anxiety	5	114	17.03	5.32	6	35	.77
FAPQ	Quality of Feedback	5	115	20.10	3.16	11	25	.76
posttest	Use of Feedback	5	113	20.20	2.73	11	25	.76
	Quantity & Timing Feedback	5	115	17.74	3.38	6	25	.72
	Examination & Learning	7	115	25.95	3.20	14	32	.58
	Usefulness of Feedback	14	114	54.80	6.63	36	68	.89
MSLQ	Intrinsic Goal Orientation	3	115	12.89	3.65	3	21	.80
posttest	Extrinsic Goal Orientation	4	114	15.38	4.27	6	27	.69
	Task Value	6	114	32.89	4.42	17	42	.82
	Control of Learning Beliefs	2	115	9.08	2.65	2	14	.73
	Self-Efficacy	8	115	37.29	7.15	9	51	.90
	Test Anxiety	5	115	18.93	6.14	5	35	.81

Main effect of feedback mode on feedback perception

The error inflation correction following the Benjamini-Hochberg procedure lead to a BH critical value of .227 (see Appendix G). Analyses showed significant results on four of the five feedback perception scales (see Table 2.3). Students who received verbal feedback during the feedback dialogue perceived the quality of feedback, the use of feedback, the quantity and timing of feedback, and the usefulness of feedback to be higher than students who received written feedback. There was a significant main effect for feedback mode (written vs. verbal) on the perceived quantity and timing of feedback, $F(1,111) = 40.49$, $p < .001$, with a large effect size of $\eta_p^2 = .27$. There was a significant main effect for feedback mode (written vs. verbal) on the perceived quality of feedback, $F(1,111) = 27.10$, $p < .001$, with a large effect size of partial $\eta_p^2 = .20$. There was a significant main effect for feedback mode (written vs. verbal) on the perceived use of feedback, $F(1,109) = 10.36$, $p = .002$, with a medium effect of $\eta_p^2 = .09$. And finally, there was a significant main effect for feedback mode (written vs. verbal) on the perceived usefulness of feedback, $F(1,110) = 8.16$, $p = .005$, with a medium effect size of $\eta_p^2 = .07$. These results indicate that students who received verbal feedback perceived all aspects of teacher feedback more positively than the students who received written feedback.

Main effect of feedback mode on self-efficacy and motivation

After controlling for the effect of pretest control of learning beliefs, students who received verbal feedback during feedback dialogue had a significantly higher control of learning beliefs than students who received written feedback (see Table 2.4). There was a significant main effect for feedback mode (written vs. verbal) on students' control of learning beliefs, $F(1,110) = 6.07$, $p = .015$. The effect size shows a small effect, $\eta_p^2 = .05$. The covariate pretest control of learning beliefs was significantly related to the posttest control of learning beliefs, $F(1,111) = 72.69$, $p < .001$. The effect size shows a large effect, $\eta_p^2 = .40$. This significant result indicates that students who receive verbal feedback have stronger beliefs that their efforts will result in positive outcomes than students who receive written feedback. No significant interaction effects were found between feedback request forms and feedback mode.

Table 2.3 Means, Standard Deviations, and Two-Way (Feedback Mode and Request Form) Analysis of Variance (ANOVA) for the Quantity and Timing of Feedback, Quality of Feedback, Use of Feedback, Usefulness of Feedback, and Examination and Learning.

	Condition NW		Condition RW		Condition NV	
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Quantity & Timing of Feedback	16.73	2.05	15.41	3.93	19.77	2.49
Quality of Feedback	19.19	3.45	18.31	3.38	21.27	2.41
Use of Feedback	19.92	2.68	18.66	3.57	20.50	2.46
Usefulness of Feedback	54.62	6.60	51.75	8.05	56.80	5.09
Examination & Learning	26.04	2.84	24.78	3.65	25.86	3.07

Note. WN = Written Feedback No Request Form; WR = Written Feedback Request Form; VN = Verbal Feedback No Request Form; VR = Verbal Feedback Request Form.
** Benjamini-Hochberg critical p-value < .0227*
*** df = 1.*

Table 2.4 Means, Standard Deviations, and Two-Way (Feedback Mode and Request Form) Analysis of Covariance (ANCOVA) for the Control of Learning Beliefs, Task Value, Test Anxiety, Self-Efficacy, Intrinsic Goal Orientation, and Extrinsic Goal Orientation.

	Condition NW		Condition RW		Condition NV	
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Control of Learning Beliefs	9.04	3.00	8.16	2.44	9.47	2.69
Task Value	33.88	4.04	31.31	5.26	33.59	4.01
Test Anxiety	18.88	5.98	19.00	5.88	19.13	7.68
Self-Efficacy	38.67	6.75	36.42	5.62	36.00	8.56
Intrinsic Goal Orientation	12.92	4.64	12.53	3.20	12.80	3.75
Extrinsic Goal Orientation	16.92	4.25	14.84	4.35	14.52	4.82

Note. WN = Written Feedback No Request Form; WR = Written Feedback Request Form; VN = Verbal Feedback No Request Form; VR = Verbal Feedback Request Form.
** Benjamini-Hochberg critical p-value < .0227*
*** df = 1.*

Condition RV		Feedback Mode**		Request form**		Feedback x Request**	
Mean	SD	*F*	*p*	*F*	*p*	*F*	*p*
19.22	2.44	40.49	<.001*	3.01	.085	.53	.470
21.78	1.72	27.10	<.001*	.12	.730	1.71	.194
21.37	2.15	10.36	.002*	.08	.781	2.76	.100
56.52	4.96	8.16	.005*	1.82	.180	1.07	.302
27.33	2.65	4.20	.043	.32	.857	5.50	.021

Condition RV		Feedback Mode**		Request form**		Feedback x Request**	
Mean	SD	*F*	*p*	*F*	*p*	*F*	*p*
9.78	2.28	6.07	.015*	.36	.548	2.29	.133
33.07	3.84	1.45	.231	1.25	.267	1.74	.191
18.33	4.67	1.37	.244	.07	.798	1.24	.267
38.11	7.31	.40	.530	.29	.592	3.08	.082
13.37	3.08	.37	.545	.25	.616	.29	.593
15.67	3.27	.03	.868	.63	.430	3.63	.059

2.4 Discussion

The present study aimed to investigate the impact of feedback request form and feedback mode, as well as the interaction between both variables on students' perception, self-efficacy, and motivation during teacher-student feedback conversations in higher education.

The first research question examined whether the use of feedback request forms had a positive impact on students' perception, self-efficacy, and motivation. With regard to perception, self-efficacy, and motivation, no significant impact was found concerning the feedback request forms. As feedback request forms have shown to engage students more in the feedback process (Bloxham & Campbell, 2010; M. Gielen & De Wever, 2015), it was expected that our feedback request form should have lead to more feedback adapted to students' needs. This would have resulted in more personal feedback, and thus students would appreciate feedback more just as Gielen et al. (2010) showed with the feedback request forms

in their study. The lack of impact by the feedback request forms on students' perception in the written conditions can be explained by the possibility that either the students did not produce high quality requests and/or assessors did not pay enough attention to this individualized part of the feedback. When students were asked to fill out the feedback request form, they received the feedback request form and explanation by email. This one-way written instruction might not have been sufficient to explain the usefulness of the feedback request form. More detailed instruction and explanation might have increased the effect of the feedback request form. The results of our study indicate that there is no significant effect of the feedback request forms on students' perception of feedback, self-efficacy, and motivation.

The second research question examined whether verbal feedback had a higher impact on students' perception, self-efficacy, and motivation than written feedback. As expected, students who received verbal feedback perceived the feedback to be better in terms of quality, use, quantity and timing, examination, and usefulness compared to students who received written feedback. These results correspond with findings that feedback is perceived in a more positive way when learner-centred methods are used (Pereira, Flores, Simão, & Barros, 2016) and with findings that students perceive high quality feedback when it does not only judge their work, but also fosters dialogue (Beaumont, O'Doherty, & Shannon, 2011).

These results can be explained by the differences in opportunities for teachers and students to interact during the feedback conversations in which assessors communicated their feedback verbally. These differences can lead to more questioning and answering by students and assessors and to better understanding and interpretation, which results in the students appreciating the feedback. Students in the written feedback condition did not have the opportunity to receive more explanation and discussion to understand the feedback properly and be able to improve their performance based on the feedback. The sometimes unclear, too brief, and/or unhelpful written feedback could lead to frustration and dissatisfaction (Ferguson, 2011; Hounsell et al., 2008; Price et al., 2010; Weaver, 2006). Furthermore, it is possible that students' perceptions concerning quality, use, quantity and timing, examination, and usefulness of feedback depend on their prior knowledge and experience with feedback. Prior to the experimental conditions of this study, students were used to receiving only written feedback on their summative performance assessments and might have had negative experiences with written feedback in the past. We conclude that the results of this study indicate a significant effect of verbal feedback on students' perception of feedback.

In contrast to what was expected, verbal feedback did not have a positive impact on the three motivation scales of intrinsic goal orientation, extrinsic goal orientation, and task value. Delayed instead of immediate effects of the intervention could have played a role. Students had a short time lapse of approximately five minutes between receiving verbal or written feedback and filling out the FAPQ for scoring their feedback perception and filling out the MSLQ for scoring their motivation and self-efficacy. It appears that the time lapse may have been too short to determine a difference of feedback mode (written/verbal) on students' motivation. Perhaps the impact of feedback could be detected a few days later, when students have interpreted the received feedback. Within the time span of this study, the results suggest no significant effect of verbal feedback on students' motivation.

As expected, students who received verbal feedback had significantly higher control of learning beliefs than students who received written feedback. If students believe that their efforts to study make a difference in their learning, they study more in appropriate ways (Pintrich et al., 1993). Verbal feedback influences these efforts more than written feedback does. Students probably will study more in appropriate ways when feedback is communicated verbally. In contrast to our expectations, verbal feedback did not have a positive impact on the MSLQ subscale of self-efficacy and test anxiety. Based on the results of this study, we conclude that verbal feedback improved the control of learning beliefs significantly more than written feedback did.

Third, we examined the interaction effect between feedback request form and feedback mode on students' perception, self-efficacy, and motivation. We found no significant interaction effects on the feedback perception variables, on the self-efficacy, and motivation variables. When teachers and students have the opportunity to communicate in a two-way manner – such as during feedback conversations – one might expect feedback request forms to have more impact. Based on the results in this study, we cannot conclude that the feedback request forms can influence students' perceived feedback, self-efficacy, and motivation more, when feedback between teacher and student is communicated verbally.

Limitations

This study is subject to some limitations. First, the feedback conversations (15 minutes per student) had a relatively short duration, and there was a relatively short time lapse between the moment of feedback reception and the moment of measurement; longer conversations and time lapse between feedback and measuring perception could have increased the effect sizes. A delayed effect on motivation and self-efficacy might have occurred when students used the feedback when preparing themselves working on a similar task. Second, the impact of the feedback request forms might have been higher when instructions for the completion of feedback request forms were more detailed and verbally explained. Elbow and Sorcinelli (2011) argued students write better feedback request forms when they are written in class and a couple of examples are discussed. This could have increased the quality of the requests, could have stimulated students filling out the feedback request forms correctly, and motivated them to use the form to strengthen their own learning. Third, the central task carried out by our students was very specific. Practicing with simulated patients is clearly connected to the domain of health studies. In our view, the results can be generalized to other studies within the domain of health studies. Although, students have difficulties reading and understanding written feedback on all kinds of tasks; e.g. writing essays, or writing undergraduate dissertations. Finally, many potential mechanisms can have caused the effect of verbal feedback. As we conducted a naturalistic experiment, comparing realistic feedback conditions, the mechanisms involved are not that clear. For example, there were many differences between the conditions such as the time spent engaging with the feedback that may also have contributed to the effects.

Practical implications and further research

This study underlines the importance of communicating assessment feedback verbally during teacher and student feedback conversations. As students understood verbal feedback better, it should be the preferred feedback mode for teachers to communicate feedback with their students. Although better understanding is found for feedback that is verbally communicated, it seems not to necessarily result in higher motivation. Feedback conversations in one-to-one settings and small classes are desirable and feasible. Implementation of individualised verbal feedback in larger classes, with full integration of feedback conversations in daily educational practice stays challenging.

Feedback request forms can be used in practice, but more research is needed to show an effect. Future research could focus on students' use of feedback request forms after training them by using worked-out examples with information of how to use the feedback request form. The quantitative findings in this study could lead to a more qualitative approach into the feedback process focusing on the taking up of the feedback. It would also be interesting to investigate the long-term impact of verbal feedback and feedback request forms on self-efficacy and motivation, and on future performance in a longitudinal design in which multiple feedback cycles are examined. In the end, feedback conversations are complex interactive processes in both students' and teachers' learning.

Teachers' diagnosis of students' research skills during supervision of the undergraduate thesis

This chapter is based on: Agricola, B.T., Prins, F.J., Van der Schaaf, M.F., & Van Tartwijk, J. (2018). Teachers' diagnosis of students' research skills during the mentoring of the undergraduate thesis. *Mentoring & Tutoring: Partnership in Learning.* doi: 10.1080/13611267.2018.1561015

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Abstract

In higher education, students often write an undergraduate thesis about a research project and receive one-to-one or small group support. During supervision meetings, teachers ideally diagnose students' research skills, to be able to adapt their support to students' needs. In this study, we aim to answer the question of how supervisors apply the diagnostic phases of a diagnostic question, a diagnosis, a diagnostic check and an intervention, during supervision meetings about students' research skills. Four supervisors participated in this multiple case study. Qualitative data were gathered and sixteen videotaped supervision meetings were coded on the four diagnostic phases. The results were compared within and between supervisors, showing that supervisors asked several diagnostic questions, seldom articulated and shared their diagnoses explicitly with the students, and mainly used interventions. We concluded that more support is needed for supervisorss who do not automatically use their diagnostic questions to formulate explicit diagnoses about students' research skills.

3.1 Introduction

In higher education (HE), it is common for students to carry out a research project and to write a thesis about it in the final part of their undergraduate programme. Undergraduate research projects often consist of several phases in which students have to carry out a literature review, prepare a research plan, collect and analyse their data, and, finally, present the findings in a thesis. Often, students are awarded between 15 and 30 European Credit Transfer and Accumulation Systems (ECTS) credits for successfully completed research projects. In the Netherlands, one year corresponds to 60 credit points and one credit point equals to 28 working hours. For most students, this is the first research project they have engaged in during their educational career and, as a result, they have to develop their research skills during the project (de Kleijn, Mainhard, Meijer, Brekelmans, & Pilot, 2012).

During the research process, a student normally receives several forms of supervision support. Written comments on theses in progress are widely used to improve students' academic writing (Basturkmen, East, & Bitchener, 2014). Frequent one-on-one supervision meetings with verbal feedback lead to theses being completed and to students being satisfied with the supervision (Heath, 2002; Shanahan, Ackley-Holbrook, Hall, Stewart, & Walkington, 2015). During these meetings, supervisors use dialogue and communication with their students to obtain better understanding of students' experiences and perceptions (Greenbank & Penketh, 2009; Jaldemark & Lindberg, 2013). These dialogues are normally a two-way process, with teacher-student interaction and active student engagement (Graesser et al., 1995; Nicol, 2010), as students can check their interpretation of the feedback or ask for further explanation (Nicol & Macfarlane-Dick, 2006). For supervisors, this interaction is important because they can check whether their students understand their feedback and explanations.

The supervision process of undergraduate research is complex as it includes communication, collaboration, and conflict in addition to understanding the supervisor-student interactions (Palmer, Hunt, Neal, & Wuetherick, 2015). During supervision meetings many supervisors struggle with the balance between intervening and providing support, on the one hand, and allowing students to find their own ways, on the other(M. Todd, Bannister, & Clegg, 2004; Vehviläinen & Löfström, 2014). For example, students struggle with the production of a specific research question, which is one of the most challenging aspects during the research process for undergraduate students and supervisors (M. Todd et al., 2004). Although supervisors feel that responsibility for the thesis belongs to the students, they find it hard to determine a balance between direct instruction and the student's own decision making (M. Todd, Smith, & Bannister, 2006). A dependent relationship is created when students rely heavily on their supervisor to provide feedback and when the supervisor is willing to give it (Sambrook, Stewart, & Roberts, 2008).

Supervisors need to be sensitive to all the differences between the students and, as such, the level and amount of support needs to be adapted to students' needs and the support will differ from student to student (Engebretson et al., 2008; Shanahan et al., 2015; M. Todd et al., 2006). Supervisors have emphasized the importance of tailoring their guidance to the individual learning needs of the student; depending on the individual needs of the student they provide varying levels of guidance (Manathunga, 2005). However, supervisors are unsure about how extensive and detailed this support should be and, as a result, they have troubles tailoring their support to students' abilities and needs (Vehviläinen & Löfström, 2014).

When teachers diagnose their students' understanding accurately, they can develop and apply more effective and efficient supervising strategies, with conscious consideration of students' needs (Hedin & Gaffney, 2013; Südkamp et al., 2012). Teachers' diagnosing is crucial for the quality of research supervision (de Kleijn, Meijer, Brekelmans, & Pilot, 2015). Therefore, we examined how supervisors diagnose students' research skills by describing different characteristics of supervisors' diagnostic behaviour.

Teachers' diagnostics

Teachers' diagnosing can be operationalized as teachers' ability to judge students' achievement or task difficulties (Klug, Bruder, Kelava, Spiel, & Schmitz, 2013). In this study, we defined teachers' diagnostics as their ability to judge their students' research skills. Teachers' diagnosing has been a research topic for some time in contexts other than HE (Hoth et al., 2016; Klug et al., 2013). Research into teachers' diagnostic skills in classroom settings in primary education (PE) and secondary education (SE) has included findings that indicated diagnosing is complex (Ruiz-Primo & Furtak, 2007; Van de Pol et al., 2011). Diagnosing students' level of understanding in classrooms is rather difficult for teachers and hardly occurs during teacher-student interactions (Graesser et al., 1995; Putnam, 1987; Van de Pol et al., 2010). When teachers do diagnose, their diagnoses are often far from perfect and there is plenty of room for improvement (Südkamp et al., 2012; Van de Pol & Elbers, 2013). Instead of diagnosing, teachers either focused on objectives of their own (Nathan & Kim, 2009) and on beliefs about what they thought was difficult for the students (Van de Pol et al., 2011), or they intervened immediately (Ruiz-Primo & Furtak, 2007).

De Kleijn, Bronkhorst, Meijer, Pilot, and Brekelmans (2014) examined 12 supervisor-student dyads and found that thesis supervisors provided support that was adapted to their own goals and to students' goals. These supervisors collected information about the students and sometimes the supervisors explicitly formulated a student's characteristic that they observed. In the study of de Kleijn et al. (2015) interviews and group discussion meetings with five expert master's thesis supervisors were conducted. They concluded that these supervisors carefully diagnosed students' characteristics, such as competence level and determination. If we want to understand more about the diagnostic process of HE research supervisors, we need to know what they are doing and observe their naturalistic behaviour with their students.

We believe that diagnosing is a complex skill and that teachers should be diagnosing during interactions with their students. This paper builds on results from primary/secondary education and applies this research literature to the HE context. Given the fact that the quality of the diagnosing process is crucial for adaptive supervision and student learning (de Kleijn et al., 2014; de Kleijn et al., 2015; Hedin & Gaffney, 2013), and the knowledge that, in general, teachers' diagnostic processes need to be improved (Südkamp et al., 2012), it is worthwhile to unravel the diagnostic process involved in thesis supervision.

Identifying diagnostic phases in research supervision

In order to examine the diagnostic process of HE teachers, we used a framework that summarizes three popular models from primary/secondary education (Klug et al., 2013; Ruiz-Primo & Furtak, 2007; Van de Pol et al., 2011). Klug et al. (2013) described the diagnostic process as teachers who diagnose their student's level of understanding. Teachers make a prediction about a student's performance and possible underlying learning difficulties. Initially, the teachers interpret the information that is gathered, come to a concluding diagnosis, and finally give feedback (Klug et al., 2013). Ruiz-Primo and Furtak (2007) described the diagnosing process as an assessment conversation. Initially, the teachers elicit a question, then recognize the student's response, and finally use the collected information to support student learning. Van de Pol, Volman and Beishuizen (2011) used a model of contingent teaching in which the diagnosing process is described. Initially, the teachers apply diagnostic strategies, then check the diagnosis, and finally intervene. Although the diagnostic process in these three models sometimes lacks a specific diagnosis (Van de Pol et al., 2011)and sometimes a diagnostic check (Klug et al., 2013; Ruiz-Primo & Furtak, 2007), the three models are described quite similarly, with three cyclical phases within the teacher-student interaction. In this study, we combined the phases from these studies (Klug et al., 2013; Ruiz-Primo & Furtak, 2007; Van de Pol et al., 2011) and distinguished four diagnostic phases consisting of a diagnostic question, a diagnosis, a diagnostic check and an intervention. This model can be used to observe and determine supervisors' diagnostic behaviour as seen in Figure 3.1.

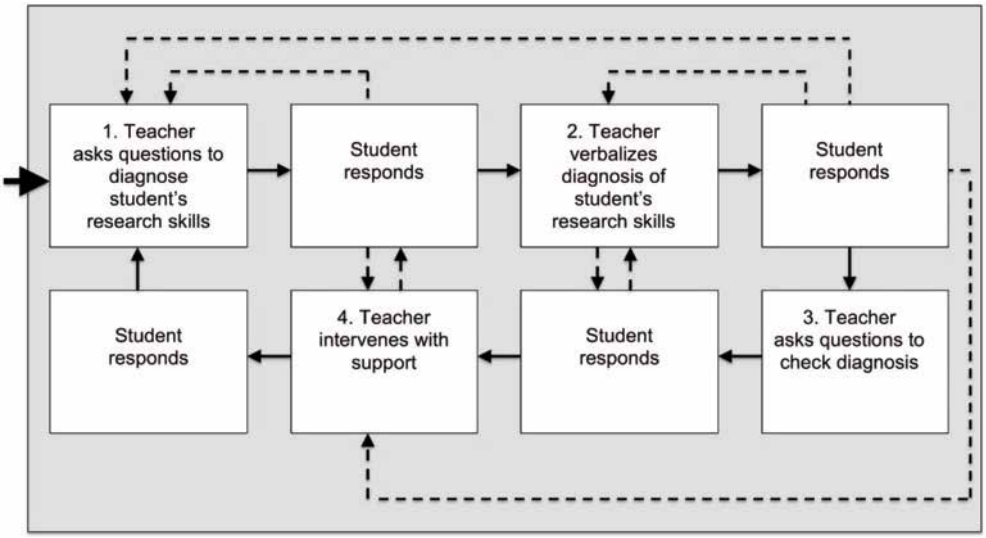


Figure 3.1. Four phases of diagnostic process during research supervision (adapted from Klug et al., 2013; Ruiz-Primo and Furtak, 2007; Van de Pol, Volman, and Beishuizen, 2011).

Diagnostic question. In the first phase of *diagnostic questions*, supervisors ask the students questions to gather information on their research skills, e.g. 'How would you make this research question more specific?'. The students respond and show (or do not show) the skills. This gives the supervisors a basis on which to decide whether they know enough about the student or more diagnostic questions can be asked before a diagnosis is reached. These questions provoke an interactive supervisor-student supervision meeting (Chi et al., 2001; Chin, 2006) and elicit further information about students' research skills. Diagnostic questions can lead to a prediction about a student's development and possible underlying difficulties (Klug et al., 2013) and to a more accurate diagnosis.

Diagnosis. In the second phase of *diagnosis,* supervisors can interpret the gathered information and come to a concluding diagnosis in which the supervisors articulate a diagnosis about student's research skills, e.g. 'You don't know yet how to compose specific research questions, because you're doing this for the first time'. By explicitly articulating a diagnosis, the supervisors are judging students' achievement, giving the student the opportunity to respond with a confirmation or rejection of the diagnosis. A diagnosis should be made explicit (Klug et al., 2013), as then it allows a shared understanding between the supervisor and the student (Van de Pol et al., 2011)and they can work on common goals(Halse & Malfroy, 2010).

Diagnostic check. In the third phase of *diagnostic check*, supervisors check the diagnosis of a student's research skills, e.g. 'If I understand you correctly, you don't know because you haven't read the book chapter about this topic yet?'. Supervisors verify whether they captured the research skills of the student correctly (Van de Pol et al., 2011). Although diagnostic checks can also provide supervisors with additional information about students' research skills, the goal of a diagnostic check is verification of the supervisor's own diagnosis.

Intervention. In the fourth phase of *interventions*, supervisors support the student, preferably in a way that is adapted to the diagnosis(Klug et al., 2013; Van de Pol et al., 2011), e.g. 'Because you have one group of children and one experiment with no comparison, the study you are conducting will probably be a prospective cohort study'. Supervisors intervene; they give feedback and explanations, and want to help the student with understanding the subject matter or with the task of approaching the thesis. In this phase, the supervisors are engaged in moment-by-moment decision-making in order to support the student in understanding the relevant issues (Hedin & Gaffney, 2013). Framing the intervention phase as an outcome of the diagnostic process is important as supervisors can only provide adaptive support, when they have asked enough diagnostic questions and gathered enough information to make a diagnosis.

Present study

In this study, we focused on supervisors who have supervisor-student dialogues, in a setting in which teacher supervisors can focus on diagnosing students' research skills without the classroom context. One might expect these teachers to be better able to diagnose their individual students' learning than PE and SE teachers. Teachers in higher education often supervise students during one-to-one and/or small group supervision meetings when students are writing a thesis about a research project (McCallin & Nayar, 2012). The supervisors and students in this study are used to having these supervision meetings and, thus, give opportunities to observe the diagnostic behavior in a naturalistic setting.

We focused our study on supervision meetings regarding students' writing of a research plan. The writing of a research plan is a crucial phase, as it involves making decisions about the direction of the project. When students write a research plan, they review the literature to develop a conceptual framework, determine the aim and focus of the study, compose the research questions, specify a research design, and choose their research instruments (Wisker, 2009). Supervisors can support students in their development of these research skills. Given the importance of arriving at an accurate diagnosis for supervisors, it is interesting to investigate what kind of diagnostic phases they apply during the supervision of an undergraduate thesis. The research question for our study was: How do supervisors apply the diagnostic phases of a diagnostic question, diagnosis, diagnostic check and intervention during supervision meetings about students' research skills?

3.2 Method

Design and participants

A multiple case study method was chosen, with a case being defined as one supervisor teacher. Ten supervisor teachers from a four-year bachelor of health undergraduate programme at a Dutch university agreed to participate. The supervised students were in their final year and worked on their research project for 20 weeks (30 ECTS; 840 hours). Supervisors had several (approximately 8–10) supervision meetings with their students.

Case sampling

As we were interested in the diagnostic behaviour of supervisors, three or four cases with quite similar characteristics were sufficient to predict similar results (Yin, 2014). We selected four supervisors with a most similar method, where cases are similar on specified variables (Seawright & Gerring, 2008). The four cases were all female supervisors; this was representative for the complete teaching staff. The characteristics that were used for case selection were age, highest degree earned, number of supervising years, and number of supervised theses. The four supervisors were between 28–34 years of age ($M = 30.50$; $SD = 2.65$) and all had a master's degree. Two of the selected supervisors were in their first year supervising and had a low number of supervised theses (Amy: 5 theses; Brooke: 8 theses). The other two selected were slightly more experienced supervisors (Claire: 3 years; Debby: 4 years), and off course had supervised more theses (Claire: 30 theses; Debby: 35 theses). All the names used are pseudonyms.

Procedure

The four supervisors were supervising students who were writing their thesis in pairs. A supervisor supervised a group of no more than five or six pairs. The supervisor offered support to the students during supervision meetings, consisting of a dialogue between one teacher and two students. The research plan was discussed in the third week of the research project. A few weeks before the start of the project, supervisors and students were informed that the study focused on the interaction between a supervisor and their students. All the participants gave informed consent before the data collection started. For each supervisor, four supervision meetings were recorded on video, without the researcher being present. The students were used to cameras, as they often videotaped their own conversations for assessment and self-reflection. The supervisors informed us that they were aware of the camera for the first few minutes but that they forgot that they were being recorded as the discussion with the students continued. The 16 videotaped supervision meetings were transcribed verbatim; the videos were transcribed literally, with punctuation, pauses, and continuers (e.g. hm, yeah) but without intonation and voice volume.

Data analysis

The coding of the 16 transcribed supervision meetings was conducted in four steps: coding on topic, segmentation in units of meaning, coding on the diagnostic phases, and a sequential analysis. To get insight on the variety of diagnosing phases among supervisors, we examined how supervisors differed in how they conducted their supervision. First, we identified which codes were used most. A within-case analysis was conducted between the four supervision meetings of each supervisor and a

between-case analysis was conducted between all four supervisors. The relative scores of the diagnostic phases and the significant results from the sequential analysis were used to determine similar and/or different patterns (Miles & Huberman, 1994). Several excerpts from the supervision meetings were selected to show the application or absence of diagnostic phases and to illustrate sequences of diagnostic phases. In the next subsections, more details are provided about the four coding steps.

Coding on topic. As three different actors attended every supervision meeting, the transcripts contained three different turns: teacher turns, student1 turns and student2 turns. Speech turn taking was used as the first segmentation criterion because it fits with the natural course of the conversation (Chi, 1997). The analysis focused on the teacher turns only. Since we were interested in supervisor behaviour that concerned the supervision of an undergraduate research project, all supervisors' turns were first coded for being "on topic" or "off topic". An on topic turn is a turn in which elements of the undergraduate thesis were discussed, such as "the definition of the research problem", "the research questions", and "the theoretical framework". The unit of analysis consisted of each supervisor's turn. The first author coded all supervisors' turns (n = 2989) to determine if they were on topic. The interrater reliability was determined by coding 10% of all supervisors' turns (2/16 supervision meetings; 304/2989 supervisor turns) independently with the second (1/16 meeting; 215/2989 turns) and third author (1/16 meeting; 89/2989 turns). Interrater reliability between the first and the second author (Krippendorff's alpha = .79) and between the first and the third author (Krippendorff's alpha = .76) was satisfactory (Krippendorff, 2004).

Segmentation in units of meaning. In the second step, we segmented all on topic supervisor turns in units of meaning, based on semantic features and, specifically, on ideas or topics of discussion (Chi, 1997). Every on topic supervisor's turn was characterized as either (a) a single unit of meaning or (b) segmented into several units of meaning. For example, when a supervisor was addressing two different topics within one turn (e.g. "research questions" and "data gathering"), this turn was segmented into two units of meaning. The first author segmented all supervisors' on topic turns (n = 1881) into units of meaning. The reliability of the segmentation was computed as the proportion agreement because there was only one category involved with two values (agree = 1, disagree = 0)(Strijbos, Martens, Prins, & Jochems, 2006). The proportion agreement was determined by segmenting 10% of all supervisors' on topic turns (2/16 supervision meetings; 188/1881 on topic turns) independently with the second (1/16 meeting; 117/1881 turns) and third author (1/16 meeting; 71/1881 turns). With an agreement percentage of 94% (with the second author) and 92% (with the third author), the reliability of the segmentation appeared to be good (Riffe, Lacy, & Fico, 2005).

Coding diagnostic phases. The third step of coding was conducted on all units of meaning. The first author coded all units of meaning (n = 1963) on one of the four diagnostic phases: (a) diagnostic question, (b) diagnosis, (c) diagnostic check, and (d) intervention. The interrater reliability was determined by coding 10% of all supervisors' turns (2/16 supervision meetings; 204/1963 supervisor turns) independently with the second (1/16 meeting; 132/1963 turns) and third author (1/16 meeting; 72/1963 turns). The interrater reliability between the first and second author (Krippendorff's alpha = .73) and between the first and third author (Krippendorff's alpha = .75) was satisfactory (Krippendorff, 2004).

Sequential analysis. Finally, a sequential analysis was conducted on all coded units of meaning to analyse the sequential links between the four phases (diagnostic question (DQ), diagnosis (D), diagnostic check (DC), and intervention (I)) and to identify patterns within the sequences of these phases(-Jeong, Clark, Sampson, & Menekse, 2011). A simple evaluation of the independence of these phases was done in order to identify whether a particular sequence of behaviour occurred more or less often than might be expected by chance alone(Wampold & Margolin, 1982). The program Multi Episode Protocol Analysis (MEPA) was used and three different scores of possible sequences were computed: a frequency score, an expected score, and a Z-score (Erkens, 2005). Each sequence consisted of exactly two diagnostic phases, starting with one phase (e.g. diagnostic question) and followed by another (e.g.

intervention). Thus, the four different diagnostic phases led to 16 different sequences, which were tested. Chi square tests can be performed when the expected value is more than five (Gravetter & Wallnau, 2013). Therefore, a threshold with a minimum expected frequency of five was used for further analysis and reporting of the results. All sequences that involved a diagnostic check occurred very infrequently because only one diagnostic check was coded and, thus, they were not used for further analysis.

Credibility of the study

Several basic key elements to the study design were integrated to enhance the overall study quality and credibility. Clearly written research questions were posed that fitted the case study design (Baxter & Jack, 2008; Yin, 2014). A purposeful case sampling procedure was conducted based on the most similar method described by Seawright and Gerring(2008). The videotaped data were collected and transcribed systematically. The supervision meetings were videotaped and coded from the beginning to the end. The goal of selecting excerpts from the different supervision meetings was to present thick and rich descriptions of the diagnostic phases, and to bring the supervisor-student interactions alive(Creswell & Miller, 2000). Triangulation of researchers was applied to explore the diagnosing process of supervisors from different perspectives (Baxter & Jack, 2008; Creswell & Miller, 2000). The first author coded all transcripts; the second and third author made coding checks (Guba, 1981; Miles & Huberman, 1994). Interrater reliability and agreement were determined for the first three coding steps (Krippendorff, 2004; Riffe et al., 2005).

Table 3.1 Percentage of Diagnostic Phases per Supervisor for Each Meeting and Total Frequency

	Amy						Brooke					
	A1	A2	A3	A4	M	SD	B1	B2	B3	B4	M	SD
Question	21	26	37	27	27.77	6.65	57	41	42	43	45.84	7.19
Diagnosis	2	4	5	3	3.39	1.29	4	5	4	3	3.97	1.04
Check	0	0	0	0	0.00	0.00	0	1	0	0	0.22	0.44
Intervention	77	70	58	70	68.84	7.77	39	53	54	54	49.97	7.11
Total (n)	114	147	149	165	143.75	21.41	122	114	132	183	137.75	31.05

Note. Four supervision meetings (1-4) were coded for each supervisor, A= Amy, B = Brooke, C = Claire, D = Debby

3.3 Results

First, the descriptive results from coding the four diagnostic phases will be presented. Then, an excerpt is presented from each supervisor and each diagnostic phase to provide better insight into the application of the four diagnostic phases, and finally we present the sequential analysis results.

Supervisors' diagnostic phases

Regarding our research question about how supervisors apply the diagnostic phases of a diagnostic question, diagnosis, diagnostic check, and intervention, the descriptive results show that supervisors mainly used *interventions* and applied *diagnostic questions* less frequently (see Table 3.1). Amy, Claire, and Debby showed similar diagnostic behaviour and applied many interventions. Brooke showed different diagnostic behaviour than the other three supervisors, she asked substantially more diagnostic questions and by that Brooke had better opportunities to gather enough information to diagnose students' research skills. All four supervisors barely formulated a *diagnosis* in which they articulated the level of the students' research skills, and, consequently, a *diagnostic check* was scarcely observed. Even Brooke who asked a lot of diagnostic questions did not formulate her diagnoses explicitly with her students As a consequence, these supervisors did not share a lot of understanding about the diagnosed research skills with their students.

Claire						Debby					
C1	C2	C3	C4	M	SD	D1	D2	D3	D4	M	SD
28	19	20	29	23.93	5.08	17	28	21	25	22.98	4.58
7	7	1	0	3.76	3.75	5	0	0	0	1.34	2.68
0	0	0	0	0.00	0.00	1	0	0	0	0.17	0.34
65	74	78	71	72.31	5.55	77	72	79	75	75.51	2.80
72	128	93	73	91.50	26.19	149	111	108	103	117.75	21.09

Sequences of diagnostic phases

The sequential analysis results show that supervisors applied the sequences of a diagnostic question and a diagnostic question (DQ-DQ) and the sequence of an intervention and an intervention (I-I) significantly more frequently than might be expected by chance. These sequences were quite similar for all four supervisors. It seems these supervisors used a lot turns with diagnostic questions to diagnose students' research skills and also used a lot of turns with interventions to support students' skills (see Table 3.2).

Table 3.2 Summary of Sequential Analysis for the Diagnostic Phases of Diagnostic Question, Diagnosis and Intervention

		Diagnostic question			
		A	B	C	D
Diagnostic question	Fr	81.00	129.00	26.00	37.00
	E	44.24	69.85	10.48	23.91
	Z	7.59*	10.80*	5.64*	3.47*
Diagnosis	Fr	9.00	2.00	2.00	.00
	E	5.53	5.16	2.29#	1.58#
	Z	-	-	-	-
Intervention	Fr	69.00	72.00	37.00	69.00
	E	109.23	127.99	52.23	80.29
	Z	-8.22*	-10.00*	-5.13*	-2.85*

Note 1: Supervisor A= Amy; B = Brooke; C = Claire; D = Debby.
*Note 2: Fr = Frequency; E = Expected score; Z = Z-score; * p < .05; # E < 5.00 .*

Diagnosis				Intervention			
A	B	C	D	A	B	C	D
9.00	5.00	5.00	1.00	70.00	69.00	33.00	68.00
5.57	5.16	2.26#	1.58#	110.19	127.99	51.26	80.29
-	-	1.99	-	-8.02	-10.53	-6.48	-3.11
3.00	5.00	4.00	.00	8.00	8.00	8.00	6.00
.70#	.38#	.49#	.10#	13.77	9.46	11.21	5.30
2.86	7.67	5.17	-	-2.82*	-	-2.19*	-
8.00	5.00	5.00	6.00	318.00	295.00	277.00	281.00
13.74	9.46	11.25	5.30	272.03	234.55	255.52	356.00
-2.82*	-2.40*	-4.24*	-	8.87*	10.72*	6.71*	2.97*

Diagnostic question. The excerpt of Brooke shows the repetition of diagnostic questions (DQ-DQ) without a diagnosis. This excerpt was typical for Brooke as a supervisor, as she applied many diagnostic questions throughout her four supervision meetings. She applied the largest quantity of diagnostic questions of the four selected supervisors. Table 3.3 presents a description of this excerpt.

Table 3.3 Transcript Excerpt from Brooke (Dialogue1 Lines 292-310)

Turn	Speaker	Utterance	Code
1	Brooke	Uhum, how would you make this research question more specific? Have you thought about that?	Diagnostic question
2	Student2	No.	
3	Brooke	And what is the point of this...well to make this more specific?	Diagnostic question
4	Student1	Yes well, I do not know if this is specific enough or that you think it should be even more specific?	
5	Brooke	Hmhm. What do you think? Do you think that, if this is your question, you can develop a brochure, you can do some literature research and find out what is possible and what is not?	Diagnostic question
6	Student1	Uhm ... yeah, I think it is specific enough.	
7	Student2	Yes.	
8	Student1	I do not really know how you can make it more specific.	
9	Brooke	No uhm, well, you want to make the word 'nutrition' more specific.	Intervention

In this excerpt, Brooke asked several diagnostic questions (turns 1, 3 and 5), in order to diagnose the students' research skills concerning both the formulation of a research question and how to make this question more specific. By asking several diagnostic questions, Brooke seemed to imply that the formulation of the students' research questions was not specific enough. After three diagnostic questions, when the students still could not give the right answer, Brooke intervened by saying "the word "nutrition" has to be more specific". This excerpt shows a supervisor who skipped the explicit articulation of a diagnosis after her diagnostic questions and provided an intervention immediately.

Diagnosis. The excerpt of Amy shows one of the few instances where the actual diagnosis was articulated. This excerpt illustrates the diagnostic behaviour of Amy, with a few diagnostic questions and many interventions. Table 3.4 presents a description of this excerpt.

Table 3.4 Transcript Excerpt from Amy (Dialogue3 Lines 636-665)

Turn	Speaker	Utterance	Code
1	Amy	And will this group of children be compared to another group?	Diagnostic question
2	Student2	No	
3	Amy	Nope. That gives a lot of information. It will probably be a prospective cohort study	Intervention
4	Student2	Ooh… okay	
5	Amy	Because you have one group of children and one experiment will be applied, there is no comparison, thus it is not controlled for and it is not ehm back in time so it is forward in time.	
6	Student2	Hmhm	Intervention
7	Amy	And finally here you got your outcomes, and what is very important is that you get very descriptive data and that you can probably already think of okay what statistical tests can we do.	Intervention
8	Amy	Well what kind of test can you do?	Diagnostic question
9	Student1	Yes I thought eh descriptive statistics, so one sample t tests And I have been describing the t test here, but I also had a question about it haha because i did not quite get it…	
10	Amy	No?	
11	Student1	This is what we have got so far.	
12	Amy	Well quite good though, you are already very far. So you guys have really thought this through, and now you see how far you can get, even when you haven't started with the analysis	Diagnosis

Amy tried to figure out what kind of research design the students were actually dealing with and what kind of data the students were collecting. Amy started with a diagnostic question about the design, offering students an opportunity to answer it. Instead of asking more diagnostic questions and waiting for an answer of the students, she answered the question herself and even explained why she thought it was a prospective cohort study. She continued with this intervention approach, by stating that this design offered descriptive data. Then, Amy asked another diagnostic question about statistical testing. However, this time, the students offered the correct answers and Amy ended this section with a diagnosis about how well the students did. This diagnosis was not followed by new interventions and was more of a conclusive diagnosis.

Diagnostic check. The excerpt of Debby shows another of the few instances with an explicit diagnosis (turn 3), but without a diagnostic check, followed by the repetition of interventions (turns 4, 6, 8, 10 and 12). This excerpt is typical for Debby as a supervisor, as she applied many interventions throughout her four supervision meetings, with little diagnostic questioning. Table 3.5 presents a description of this excerpt.

Table 3.5 Transcript Excerpt from Debby (Dialogue1 Lines 224-244).

Turn	Speaker	Utterance	Code
1	Debby	Do you mean an action plan?	Diagnostic question
2	Student2	Yes	
3	Debby	Uhm …yeah yeah I know…but it is quite logical you don't know though, because you're doing this for the first time…	Diagnosis
4	Debby	And uhum, I can well imagine that you do not know exactly what part belongs in and what part of it comes later, but the more you already know how to approach your research right now the better…because you actually…	Intervention
5	Student2	Yes	
6	Debby	…uhm you just want to limit your search uh, and not be searching too long too broadly, because it takes too much time actually.	Intervention
7	Student2	Yes	
8	Debby	So if the two of you go and brainstorm about how we are going to tackle the report of health promotion	Intervention
9	Student1	Uhum (nods yes)	
10	Debby	Uhm it's okay if you then write down all of it in great detail, okay…we will recruit patients that way. We will approach them in that way or we are going to do interviews or a survey, that you have to actually decide yet, how are you going to conduct the survey or to actually decide yet, how are you going to conduct the survey or interview. uhm uhm where do you start your literature search, what kind of literature you could possibly need.	Intervention
11	Student1	Yes	
12	Debby	and where do you search for existing interventions	Intervention

Debby first stated that the students do not know the answer (*diagnosis*), obviously, because they are doing research for the first time (*intervention*). After the diagnosis has been articulated, Debby provided support through several interventions, aimed at showing how the students could proceed. This excerpt shows that Debby provided support without a *diagnostic check*. A check would have given Debby the opportunity to verify with her students whether she was right about her diagnosis. In this excerpt, Debby's support seems to be taking over the thought processes of the students, as they are only affirming what the supervisor is saying.

Intervention. The excerpt of Claire shows quite a similar pattern to those of Amy and Brooke. Claire asked one or two diagnostic questions (turns 1, 3 and 9) and applied interventions (turns 6, 11 and 13) with explanation and instruction. Table 3.6 presents a description.

Table 3.6 Transcript Excerpt from Claire (Dialogue1 Lines 162-207).

Turn	Speaker	Dialogue	Code
1	Claire	Yes. Did you just do a literature research?	Diagnostic question
2	Student1	Yes we did a bit	
3	Claire	What was the result?	Diagnostic question
4	Student2	We particularly looked at how much dental caries exists and if there	
		were studies done in that area	
5	Student1	We found one study of 1992 … we can use it, but we are not sure if	
		it is up to date	
6	Claire	Heh no, but it could also mean that there is no other research done	Intervention
7	Student1	Yes, we found two …	
8	Student2	I found one of 2007	
9	Claire	Did you do some literature research into the relationship between nutrition and dental caries?	Diagnostic question
10	Student1	We have particularly searched for that relationship, on PubMed, you can find a lot of hits	
11	Claire	Okay, because it is also important to determine what exactly the question is that you want to address. Maybe you do not want to research the correlation, but there may be another question …	Intervention
12	Student1	Yes	
13	Claire	Because you already know that there is a relationship, so you do not need to re-examine that …	Intervention

First, Claire asked about the literature research the students had done (*diagnostic question*) and, after they gave their responses, proposed an explanation for their failure to find many studies (*intervention*). Subsequently, she asked a more specific diagnostic question about the relationship. Again, this question was immediately followed by two interventions that explained why the students should rephrase their research question.

3.4 Discussion

The aim of this study was to examine how supervisors diagnose students' research skills, by describing different characteristics of supervisors' diagnostic behaviour. In order to answer the research question, we analysed supervisor utterances that could be coded in one of the four diagnostic phases of the model. The excerpts and sequential analysis of the four supervisors showed that supervisors followed several phases of the cyclical model with the four diagnostic phases.

Diagnostic question

It seems very natural to ask several diagnostic questions about one topic in sequence to gather enough information about the students, just as our supervisors did. Amy, Claire and Debby did not ask as many diagnostic questions as Brooke did and, as a result, would find it more difficult to tailor their support to the student's needs(Nicol & Macfarlane-Dick, 2006; Vehviläinen & Löfström, 2014). Overall, our supervisors asked an adequate amount of diagnostic questions, which could potentially present them with enough information to formulate a diagnosis about their students' research skills.

Diagnosis

However, our supervisors formulated only a few diagnoses in their supervision meetings. According to the model, the phases of a diagnosis (and a diagnostic check) are ideally placed between a phase of diagnostic question(s) and a phase of intervention(s). The absence of an explicit diagnosis can cause a lack of shared understanding between the supervisor and the student about the students' research skills and, consequently, they cannot work on common goals, students do not understand supervisor feedback properly, and supervisors do not understand why their feedback is not used. These findings within the area of higher education and thesis supervision fit the findings of Van de Pol, Volman and Beishuizen (2010) and Graesser et al. (1995), who argued that teachers find it hard to diagnose their students' skills.

Diagnostic check

As our supervisors were seldom articulating a diagnosis explicitly to their students, diagnostic checks were scarcely uttered (only twice). We propose three explanations of why supervisors do ask enough diagnostic questions, but do not explicitly share their diagnoses with their students and check their diagnoses. Firstly, supervisors do not *have* the appropriate diagnostic skills available. Secondly, supervisors fail to *enact* the appropriate available diagnostic skills. It seems supervisors do have the appropriate skills available, as supervisors showed they applied diagnostic questions and even formulated some diagnoses explicitly, but they are not always capable of enacting these skills. A final explanation could be that the many diagnoses, including the actual process of determining the students' understanding (i.e. arriving at a diagnosis), were made implicitly.

Intervention

Our supervisors, especially Amy, Claire and Debby, seemed to struggle with the balance between providing support (interventions) and allowing students to find their own way (asking questions). This fits the results of Todd et al.(2006), who found their supervisors to be struggling with this balance as well. These three supervisors mainly applied interventions and applied several interventions in sequence. The result of supervisors, who provided support immediately without an explicit diagnosis, is similar

to the findings of Ruiz-Primo and Furtak (2007). We propose two explanations as to why supervisors apply so many interventions. Firstly, it could be that supervisors are following their own objectives and own agenda (Nathan & Kim, 2009). Secondly, it could be that supervisors are focusing on the difficulties they believe students are dealing with.

Limitations and future research

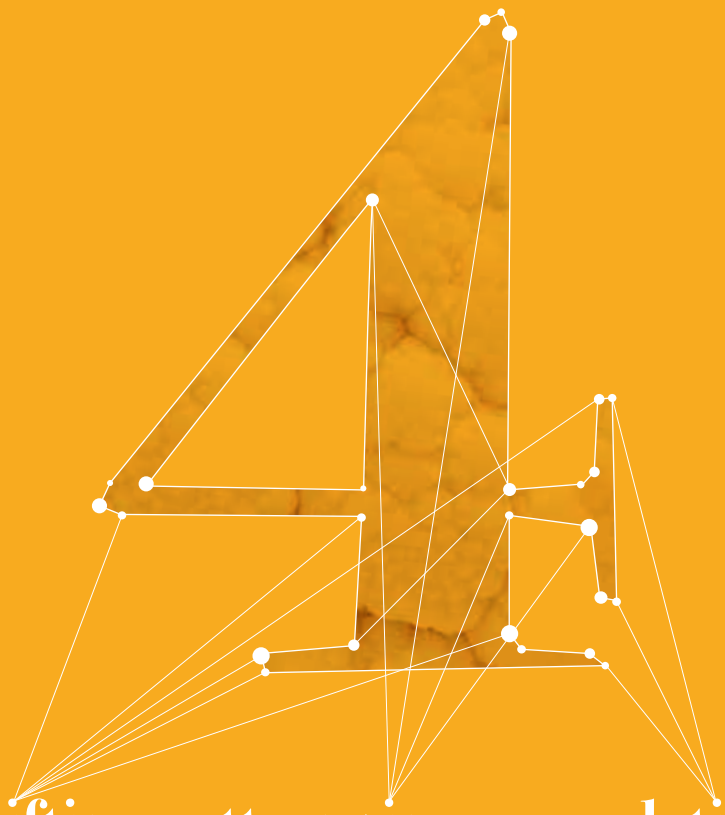
The four cases have provided insight into the diagnostic phases that are applied by supervisors. However, there are some limitations to this multiple case study. This small-scale exploratory multiple case study was performed in one undergraduate program, which might limit the transferability of the findings. Another limitation arises from gathering data in the third week of the research project. These starting weeks of the research project might have led the study to focus on supervisors who were very involved in the process and, as a result, might have shown many more interventions than a supervisor who is less directly involved and who might provide less instruction and explanation in the finalizing phase of the thesis. We acknowledge the need for more empirical studies to investigate the diagnostic skills of supervisors. This study focused on how teachers were diagnosing their students. Future research could be focused on the implicit diagnosis. Furthermore, studies on supervisors who have more supervision experience could be a topic of research. For example, one could investigate whether they would apply more explicit diagnoses. Further interesting avenues for research include investigating the possible differences between research supervision of the development of a research plan and the writing of a final research report.

Practical implications

It is necessary that supervisors get a sense of what good diagnostic skills are, in order to be better at judging their students' research skills(Südkamp et al., 2012). Supervisors should be offered formal supervisor training to be kept updated on the demands of the research agenda (McCallin & Nayar, 2012). When supervisors do not have the appropriate diagnostic skills available, a good strategy could be instruction through video(Van Es & Sherin, 2010) and guided reflection(McCullagh, 2012). When supervisors fail to *enact* the appropriate available diagnostic skills, supervisors could be provided with a list of prompts, as examples of the kind of questions supervisors can ask(Chi et al., 2001), and this may improve diagnostic questioning, diagnosis articulating, and diagnostic checking. Supervision meetings can become more interactive when supervisors are trained to suppress their explanations and feedback and, instead, are trained to prompt students with questions.

Conclusion

The context of the supervision meeting with a one-to-one (or one-to-two) interaction did not enable our supervisors to use diagnostic questions automatically to articulate their diagnosis of their students' research skills explicitly. Instead, they mainly use interventions. Since diagnostic questions and the articulation of the diagnosis are conducive to supervision that is adapted to students' needs, supervisors need to be skilled diagnosticians. From this point of view, a goal should be to make teacher supervisors more aware of their lack of diagnostic skills and to stimulate the development of strategies for effectively supporting their students' research skills.



Shifting patterns in co-regulation, feedback perception, and motivation during research supervision meetings

This chapter is based on: Agricola, B.T., Van der Schaaf, M.F., Prins, F.J., Tartwijk, van, J. (*Submitted*). Shifting patterns in co-regulation, feedback perception, and motivation during research supervision meetings.

Acknowledgement of author contributions: BA, FP, MS, and JT designed the study, BA recruited participants, constructed the instruments, collected the data, constructed the coding scheme, and analyzed the data; BA and MS drafted the manuscript; FP and JT contributed to critical revision of the paper; FP, MS, and JT supervised the study.

Abstract

Supervision meetings give teachers and students opportunities to interact with each other and to co-regulate students' learning processes. Co-regulation refers to the transitional process of a student who is becoming a self-regulated learner by interacting with a more capable other such as a teacher. During a task, teachers are expected to pull back their support and give opportunities to students to take responsibility. This study aims to explore the shifting patterns of co-regulation, feedback perception, and motivation during a 5-month research project. Participants were 20 students conducting research in pairs and six teachers who supervised these students. Two videotaped supervision meetings at the beginning and end of the research process and questionnaires on feedback perception and motivation were analysed. Results on co-regulation showed a constant and comparable level of regulation at the start and at the end of students' research projects. Feedback perception did not change, but motivation decreased significantly.

4.1 Introduction

Supervision meetings in which teachers and students interact give teachers an opportunity to scaffold their students' learning (Allal, 2016; Ruiz-Primo, 2011). The concept of scaffolding can be defined as teachers who adapt their support to students' level of understanding and is based on two rules: 1) when the student fails, the teacher increases control; 2) when the students succeeds, the teacher decreases control (Van de Pol, Volman, Oort, & Beishuizen, 2014; D. Wood, Wood, & Middleton, 1978). Scaffolding can be seen as support that is adapted, is slowly decreased over time, and is aimed at transferring the responsibility of the task to the student (Van de Pol & Elbers, 2013). Within scaffolding, teachers adapt their support to students' level of independence in order to support them to be active participants during meetings (Rasku-Puttonen, Eteläpelto, Arvaja, & Häkkinen, 2003).

Co-regulation relies on scaffolding and refers to the transitional process of a student who is becoming a self-regulated learner by interacting with a more capable other such as a teacher (Hadwin & Oshige, 2011). Co-regulation of learning refers to social regulation of learning in which students temporarily regulate their cognition, behaviour, motivation, and emotions with their teacher (Räisänen et al., 2016). Supervision meetings give teachers and students opportunities to interact with each other and to co-regulate students' learning processes. Teachers apply regulation that is more direct and use instruction and explanation when the student's level of independent functioning is low; they apply regulation that is more indirect and use questions and prompts when the student's level of independent learning increases (Salonen, Vauras, & Efklides, 2005). Co-regulation occurs with teacher's indirect regulation; students can take on their responsibility because of teachers who are decreasing their support (Hadwin & Oshige, 2011; Järvelä & Hadwin, 2013).

In higher education, students are supported in their research projects during supervision meetings with their teacher. The goal of these research projects is that students develop research skills by applying their knowledge about research in practice (Wisker, 2009). During these meetings, students discuss the process and outcome of their research individually or in a small group. Although students can adopt a more active role and take initiative when they interact with their teacher, they often show passive behaviour (Prins & Mainhard, 2009, August) and still misunderstand and misinterpret teacher feedback (Higgins et al., 2002; Hyatt, 2005). The meetings give teachers the opportunity to evaluate students' research skills and to adapt their support to the students' needs (de Kleijn et al., 2015). However, teachers tend to intervene and provide feedback without diagnosing students' learning needs (Agricola, Prins, van der Schaaf, & Tartwijk van, 2018). Agricola et al. (2018) showed that teachers apply a lot of direct regulation in the context of research supervision, and as a result, co-regulation does not occur very often, even if students might be ready for it.

Co-regulation can occur as the result of successful scaffolding: when teachers slowly decrease their support during the meetings, students gradually take on more responsibility (Salonen et al., 2005). Then, students adopt an active role; they can ask questions about and verify their interpretation of the feedback (Prins et al., 2006). Previous research concerning co-regulation shows that students and teachers are able to co-regulate students' learning (Hadwin et al., 2005; Karasavvidis, Pieters, & Plomp, 2000) and that co-regulation plays an important role in the development of students' self-regulation (Salonen et al., 2005). However, teachers have trouble in decreasing their guidance; relinquishing control might be more difficult than increasing control (Van de Pol & Elbers, 2013). Students in their turn have difficulty taking on the responsibility and show passive behaviour (Prins & Mainhard, 2009, August). The aim of this study is twofold; first, we want to test the theory of co-regulation in the context of research supervision; we aimed to provide insight into how teachers and undergraduate students co-regulated students' learning. Second, we want to add to the existing knowledge about how students perceive teacher feedback, and how motivated they are for their research task.

Co-regulation within successful scaffolding

In this study, *co-regulation* is defined as teachers and students who share in the regulation of students' learning; through dialogue and interaction, the student learns with the support of a more capable teacher (Hadwin & Oshige, 2011; McCaslin & Hickey, 2001). Teachers and students co-regulate students' learning by asking questions and requesting information from each other. Co-regulation occurs within successful scaffolding. Wood, Bruner, and Ross (1976) defined *scaffolding* as the adult who controls those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate on those elements that are within his range of competence (p.90). In successful scaffolding, teachers are expected to dominate the teacher-student interactions at the start of a new task with their teacher support. When time passes and student competence increases, teachers can decrease their support and shift more responsibility to the student. In this study, we focus on diminishing teacher support and its relationship to students' assumption of responsibility. Figure 4.1 shows this transitional process of co-regulation for teachers and students based on a model of scaffolding adapted from Van de Pol, Volman, and Beishuizen (2010).

Empirical research on co-regulation between teachers and students is limited; some small-scale studies showed that teachers provided opportunities for active student behaviour and that students took on responsibility (Hadwin et al., 2005; Karasavvidis et al., 2000). Another study showed teachers and students had difficulties in decreasing support and taking on responsibility, respectively (Rasku-Puttonen et al., 2003). These researchers focused on secondary school students (Karasavvidis et al., 2000; Rasku-Puttonen et al., 2003) or graduate students (Hadwin et al., 2005) in different domains. Co-regulation was investigated during teacher-student interactions using the concept of scaffolding; they determined if teachers decreased their support, students took more responsibility between the beginning and the end of a task, and co-regulation occurred.

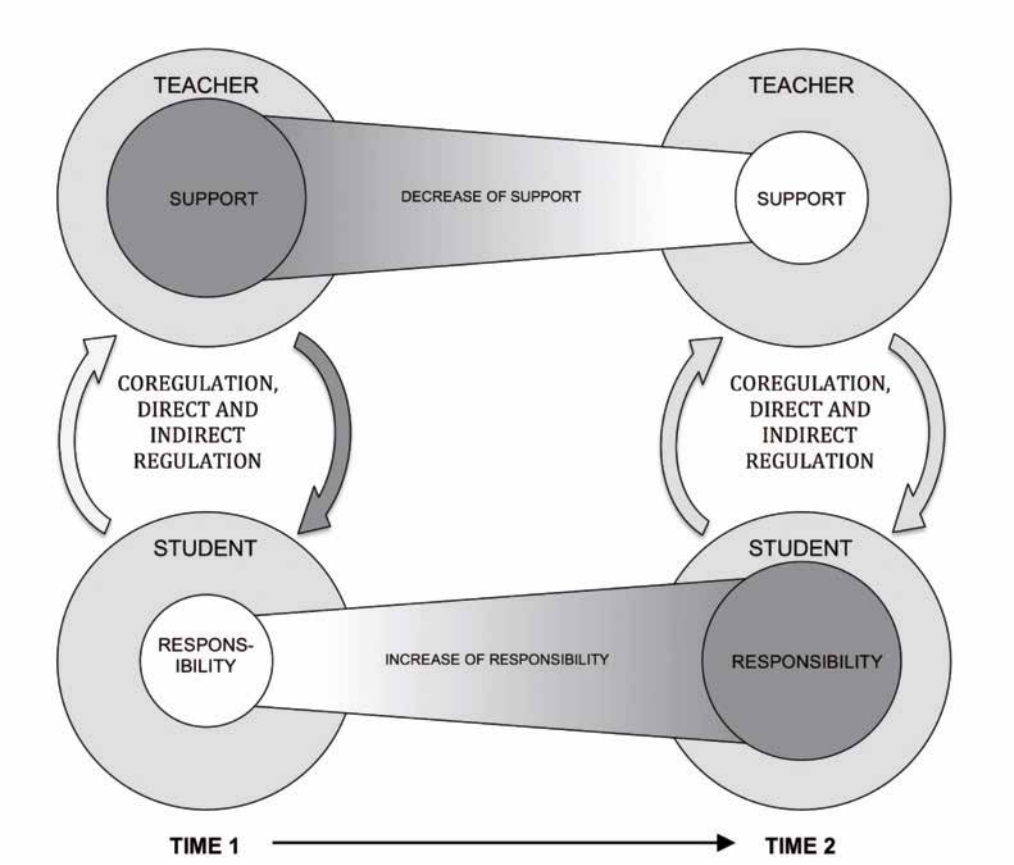


Figure 4.1. Transitional process to co-regulation adapted from Van de Pol et al. (2010).

Hadwin et al. (2005) studied the teacher-student transition of dialogue regulation during a six-credit yearlong research task. Ten graduate students participated and had to develop a research portfolio that demonstrated their research skills. Students met individually with an instructor to review their portfolio. The qualitative discourse analysis did indeed show the hypothesised shift in domination of the dialogue. The researchers concluded that students were merely listening and observing at the start of the research task while teachers dominated the teacher-student interactions. As time passed, teacher support decreased and, consequently, students took on responsibility and self-regulated their learning. Karasavvidis et al. (2000) studied tutorial sessions between a geography teacher and ten secondary school students (grade ten; fifteen years old) on a three-hour correlational reasoning task and found that teachers decreased their support. Rasku-Puttonen et al. (2003), however, did not find a shift towards more student regulation. They observed two history teachers who did not decrease their support, but rather increased their controlling activities at the end of a five-month learning task. Therefore, their 34 secondary school students (thirteen years old) did not take on more responsibility. These three studies show most teachers decreased their regulation, the teacher-student meetings differed in terms of co-regulation, but the scaffolding principle did not always hold as expected.

Co-regulation and scaffolding in research supervision

Undergraduate research supervisors who are scaffolding research projects should apply strong teacher support in the early phase of a project; the result of gradually decreasing this support will lead to more student independence (Shanahan, Ackley-Holbrook, Hall, Stewart, & Walkington, 2015 as cited in Moore, Dueweke, Newton, & Stevens-Russ). Manathunga (2005) described in her study a research supervisor who gave constructive written and verbal feedback for the first months and then the amount of feedback gradually decreased. Shanahan et al. (2015) argue in the initial stages of research often more hands-on supervision is needed than at later points (p.363). At the beginning, students need to know what good research looks like, and then the supervisor tries to move to a point of independence for their students (Lee, 2008). Once research is underway research supervisors should be sensitive to how much guidance each student requires (Malachowski, 1996). Opportunities for co-regulation of learning occur when teachers and students are sharing their responsibility. Hosein and Rao (2017) recommend a combination of a teacher-directed and student-directed approach to develop undergraduate students' knowledge of research methods and to provide space for students and becoming a researcher. However, teachers find research supervision difficult as they are balancing between directive interventions and allowing students to find their own way (Vehviläinen & Löfström, 2014). PhD supervisors also experience this tension when they are trying to move towards student independence; failure to move to this point causes anxiety (Lee, 2008). Vehvilainen and Lofstrum (2014) showed that their research supervisors were concerned with when should one intervene and when to refrain from intervening; they dealt with the problem of ownership and the sharing of responsibility with their students. This study tries to test the theory of co-regulation in research supervision, by determining how it differs at the beginning of the supervision process versus and at the end of it.

Feedback perception

Feedback is closely associated with the co-regulation of learning, as co-regulation results from teacher-student interactions and daily feedback activities (Allal, 2016). Adaptive support has proven to be useful in encouraging students' self-regulation as an outcome of feedback conversations (Carless, 2006; Chi et al., 2001). When students receive teacher feedback, they must first perceive the feedback before they can accept or act upon it (de Kleijn et al., 2013). For example, when students have positive perceptions about the feedback, that feedback has a positive effect on student learning (Harks, Rakoczy, Hattie, Besser, & Klieme, 2014). Harks et al.(2014) argued when students perceive feedback as useful, they feel competent, and a positive change in interest occurs. Then, students actually use the feedback, which leads to better performances. Directive feedback will be most helpful during the early stages of learning, when teacher support gradually decreased as students gain knowledge (Shute, 2008). When teacher feedback encourages students' active role, students get the opportunity to take on responsibility, and this makes co-regulation of learning possible. In this study, we focus on the differing feedback perceptions of students when they are interacting with their teacher.

Motivation

According to the self-determination theory (SDT) all students possess inner motivational resources that can potentially allow them to engage constructively and proactively during learning activities (Reeve, Ryan, Deci, & Jang, 2012). Motivated students are better regulators of learning, and good regulators of learning stay motivated for the task they are doing (Zimmerman & Schunk, 2012). Motivated students are expected to actively contribute to the co-regulation of their learning with their teachers. Within SDT, three levels of motivation are distinguished: the lowest level is amotivation, followed by extrinsic motivation, and intrinsic motivation (Deci & Ryan, 1985). However, many educational activities are not designed to be intrinsically interesting and do not automatically motivate students to

carry them out on their own. Students have to regulate their behaviour and transform the regulation into their own. Ryan and Deci (2000) have ordered the different types of motivation and regulation in terms of the extent to which motivation for one's one behaviour emerges form one's self (p. 61). Amotivation, for example, refers to students who feel no intention to act. External regulation refers to students who satisfy an external demand or obtain a reward. Identified regulation refers to students who have identified with the value of the learning activity. At the far right is intrinsic motivation. The different types of motivation and regulation are placed on a continuum, but students do not necessarily progress through every stage. A student can adopt a new behavioural regulation at any point, depending on their experience or the situation.

The motivational resources that students possess are more or less activated and can be influenced by teachers' actions. Within educational environments, student motivation is generally most positive when students experience high autonomy (Reeve & Jang, 2006). Reeve and Jang (2006) define autonomy as the experience that students' actions originate from themselves (p. 209). Teachers cannot directly give students the experience of autonomy, but they can encourage and support this experience by creating learning opportunities (Reeve & Jang, 2006). Reeve, Ryan, Deci, and Jang (2012) and Reeve and Jang (2006) investigated the instructional behaviours of autonomy-supportive teachers and identified examples of this behaviour: listening and asking what students want and need; creating independent work time; and offering praise and encouragement. These teaching behaviours fit the scaffolding principle of adaptive teaching and offer opportunities for co-regulation of learning.

Present Study

Undergraduate research has been defined as "an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline" (Council of Undergraduate Research, 2018). Experiences with undergraduate research are important to improve for example students' communicating skills, critical thinking skills, and problem solving skills (Seymour, Hunter, Laursen, & DeAntoni, 2004). An undergraduate thesis is a first step in research, demanding the development of research and writing skills (Wisker, 2012). Teachers should encourage students' self-regulation by decreasing their support when students' understanding increases. We expected our teachers to decrease their support, and our students to take on responsibility. We measured this at two different moments in the research process: in the starting phase, when the research plan was written, and towards the end of the project, when the final draft version of the thesis is discussed. Therefore, the following research questions were addressed:

- How does the *co-regulation* between teachers and students during research supervision meetings shift in the course of a five-month research project?

- How does students' *feedback perception* and *motivation for their research task* shift in the course of a five-month research project?

4.2 Method

Design

In this exploratory study, a mixed methods study design was used (Creswell & Clark, 2011; Luck, Jackson, & Usher, 2006). The quantitative and qualitative data were used to paint a more complete picture of co-regulation, feedback perception, and motivation in research supervision (Bazeley, 2018). Using the qualitative data, we tested the theory of co-regulation within research supervision. Using the quantitative data, we tried to add new knowledge about feedback perception and motivation. We used a concurrent embedded strategy. Concurrent meant that the qualitative and quantitative data were collected at the same time; embedded meant the qualitative method addressed a different question (about co-regulation) than the quantitative method did (about feedback perception and motivation) (Creswell & Clark, 2011). In this study, we focused on triangulation by data source as we collected data from different students and teachers, at two different times. We also applied triangulation by method and by data type, as we quantitatively analyzed the questionnaire data and qualitatively analyzed the video observations (Meijer, Verloop, & Beijaard, 2002).

Context

This study was conducted within the context of the writing of an undergraduate thesis and face-to-face research supervision meetings in higher education. Students were in the final year of their bachelor of health programme at a Dutch university. The students wrote their thesis alone or in pairs and had 20 weeks to conduct their research project and write their thesis (30 ECTS; 840 hours). During the course, the students had approximately eight supervision meetings with their teacher; two of these meetings were selected for data gathering.

Two supervision meetings in the research process were used to collect the data. The first supervision meeting was observed during week 3; this meeting was selected because students were working on the draft version of their research plan, they had not handed in their final version, and they still needed help from their teacher. The second supervision meeting was observed during week 18; this meeting was selected because students were working on the draft version of their final thesis. The third week was called Time 1 and the eighteenth week was called Time 2.

Research course

Students worked on a research plan in which they wrote a theoretical framework, their research questions, and a methods section. Before students could start data gathering, an independent assessor (not the teacher) determined if their research plan was of sufficient quality. Most students worked on their plan for five weeks before handing in their final version. After the approval of their research plan, students continued with their research project. They gathered and analysed data, and wrote a results and discussion section. At the end, students wrote a final draft version of the thesis and sent it to their teacher. Teachers read the final draft version of the students' thesis and provided feedback during the last supervision meeting. Based on the received feedback, students finalised their thesis. Again, an independent assessor assessed the final version of their thesis. Figure 4.2 shows an overview of the research course.

Figure 4.2. Overview of the twenty-week undergraduate research course.

Participants

A total population of 87 students and 10 teachers were part of the research course and agreed to participate in the study. Teachers and students were informed that the researchers were investigating the interaction between teachers and students. All participants gave informed consent before data collection started. The supervision meetings of 85 students and ten teachers were observed and videotaped in week 3. The supervision meetings of 28 students and six teachers were observed and videotaped in week 18. Most students carried out their research project in pairs. Because we were interested in teacher-student interactions over time, we wanted the interaction opportunities to be similar for all participants in this study. For that reason, we decided to exclude students who worked on their thesis alone or who had their supervision meetings alone. The remaining 20 students (ten pairs) (*M* age = 22.7; 90% female) and six teachers participated in this study. Each teacher with two students was defined as a triad. Data on these ten triads were used for further analysis.

Measures

Co-regulation. The degree of regulation of learning processes for teachers and for students can be represented as a continuum ranging from very low to very high (Vermunt & Verloop, 1999). We used a continuum of regulation of learning for students and teachers and distinguished four different levels as Hadwin et al. (2005) did: 1) teacher direct regulation; 2) teacher indirect regulation; 3) student indirect regulation; and 4) student direct regulation. Co-regulation was measured with teachers and students' indirect regulation; indirect regulation occurs when teachers and students are questioning and requesting information from each other, when they are sharing thoughts and ideas, and regulating together. As a result, teacher direct regulation and student direct regulation are not considered to be co-regulation.

Hadwin et al. (2005), Karasavvidis et al. (2000), and Rasku-Puttonen et al. (2003) determined teacher and student regulation of learning based on the function of speech and communication. They coded teacher and student utterances on direct and indirect regulation. As language users, teachers and students signal their intended meaning and interpretation of their utterances by using characteristic words. With these characteristic words, they signal the communicative function of a phrase. Within studies on collaborative learning, the function of communication is also researched as *dialogue acts* (Erkens & Janssen, 2008; van der Schaaf, Baartman, & Prins, 2012). Erkens and Janssen (2008) distinguished five different communicative functions: 1) *argumentative* utterances indicate a line of argumentation or reasoning; 2) *elicitative* utterances indicate questions or proposals requiring a response; 3) *imperative* utterances indicate commands; 4) *informative* utterances indicate transfer of information and; 5) *responsive* utterances indicate confirmation, denial, or answer.

In this study, we combined the coding of the function of speech from co-regulation research with the dialogue act coding from collaborative learning research. Instruction, demonstration, and explanation were defined as argumentatives and imperatives (direct regulation), while prompting and asking questions were defined as elicitatives (indirect regulation) (Erkens & Janssen, 2008; Hadwin et al., 2005; Karasavvidis et al., 2000). The supervision meetings of ten triads were observed at Time 1 (week 3) and Time 2 (week 18) to determine the shift in co-regulation.

Feedback perception. To determine a shift in students' perception of feedback, the Feedback Perception Questionnaire (FPQ) was used at Time 1 and Time 2 (Strijbos, Narciss, & Dünnebier, 2010). The FPQ consists of 18 items that use a five-point Likert scale ranging from 1 (fully disagree) to 5 (fully agree). The 18 items were divided into six scales of three items. The six scales measured *Fairness* (e.g. I would consider this feedback justified), *Usefulness* (e.g. I would consider this feedback helpful), *Acceptance* (e.g. I accept this feedback), *Willingness to Improve* (e.g. I shall improve my work), *Affect Positive* (e.g. I feel satisfied receiving this feedback on my work) and *Affect Negative* (e.g. I feel frustrated receiving this feedback on my work).

Reliability analysis and factor analysis were conducted with the questionnaire data of the 85 students who filled out the questionnaire at Time 1. Exploratory factor analysis was conducted to empirically explore the underlying structure of the eighteen items of the feedback perception questionnaire of Strijbos et al. (2010). As we anticipated the scales to be correlated, a principle component analysis with oblique (oblimin) rotation was applied. The pattern matrix and scree plot were used to determine the number of components, and factor loadings were used to interpret and label the components (Costello & Osborne, 2005). The non-fixed principle component analysis provided a four-component structure. For this four-component model, sampling appeared to be adequate (*Kaiser-Meyer-Olkin* measure of sampling adequacy = .87; individual item values ranging from .52 to .83), and inter-item correlations appeared to be sufficiently large (Bartlett's test of sphericity χ^2 (153) = 908.35, $p < .001$). Based on these results, and the factor solution of Strijbos et al.(2010), we chose to use the four-component solution. This solution accounted for 69.1% of the total variance. The Eigenvalues (after rotation) showed that the factor Willingness to Improve explained the most variance (43.5%) in the data structure and contributed most to the factor solution. Following the outcome of this analysis, we decided to use the four scales that Strijbos et al. (2010) described with two exceptions; we did not apply the merged Affect scale, and the two items of the Acceptance scale that loaded on factor 2 were added to the Affect Negative scale (see Appendix A). This resulted in four scales: *Willingness to Improve, Affect Negative, Affect Positive,* and *Adequacy of Feedback*. Cronbach's alpha and item-rest correlations were analysed for each scale. All feedback perception scales were considered reliable (Cronbach's alpha > .70). After the factor analysis, four reliable scales were determined, and the four scales - Willingness to Improve (n = 3 items; Cronbach's alpha = .71), Affect Negative (n = 5 items; Alpha = .83), Affect Positive (n = 3 items; Alpha = .80) and Adequacy of Feedback (n = 7 items; Alpha = .90) - were used in further analyses.

Motivation. To determine a shift in students' motivation, the Situational Motivation Scale (SIMS) was used at Time 1 and Time 2 (Guay, Vallerand, & Blanchard, 2000). The SIMS consisted of 16 items, which used a seven-point Likert scale ranging from 1 (does not correspond at all) to 7 (corresponds exactly); the 16 items were divided into four scales of four items. The scales measured *Intrinsic Motivation* (e.g. Because research is fun), *Identified Regulation* (e.g. Because I am doing it for my own good), *External Regulation* (e.g. Because it is something I am supposed to do) and *Amotivation* (e.g. There may be good reasons to do this, but personally, I don't see any).

Reliability analysis and factor analysis were conducted with 85 students who filled out the questionnaire at Time 1. Exploratory factor analysis was conducted on the 18 items. As we anticipated the scales to be correlated, a principle component analysis with oblique (oblimin) rotation was applied. The pattern matrix and scree plot were used to determine the number of components; factor loadings

were used to interpret and label the components (Costello & Osborne, 2005). The non-fixed principle component analysis provided a four-component structure. For this four-component model, sampling appeared to be adequate (*Kaiser-Meyer-Olkin* measure of sampling adequacy = .77; individual item values ranging from .46 to .85) and inter-item correlations appeared to be sufficiently large (Bartlett's test of sphericity χ^2 (120) = 648.49, $p < .001$). Based on these results, we chose to use the four-component solution as Guay et al . (2000) did. This four-component solution explained 66.6% of the total variance. The Eigenvalues (after rotation) showed that the factor Intrinsic Motivation explained the most variance (32.5%) in the data structure and contributed most to the factor solution. Following the outcome of this analysis, it was decided to use the four scales that Guay et al. (2000) described: a scale *Amotivation*, a scale *External Regulation*, a scale *Identified Regulation*, and a scale *Intrinsic Motivation*. Cronbach's alpha and item-rest correlations were analysed for each scale. All motivation scales were found to be reliable (Cronbach's alpha > .70). After the factor analysis four reliable scales were determined, and the four scales Intrinsic Motivation (Alpha = .82), Amotivation (Alpha = .86), Identified Regulation (Alpha = .79), and External Regulation (Alpha = .70) were used in further analyses. See Figure 4.3 for an overview of the study.

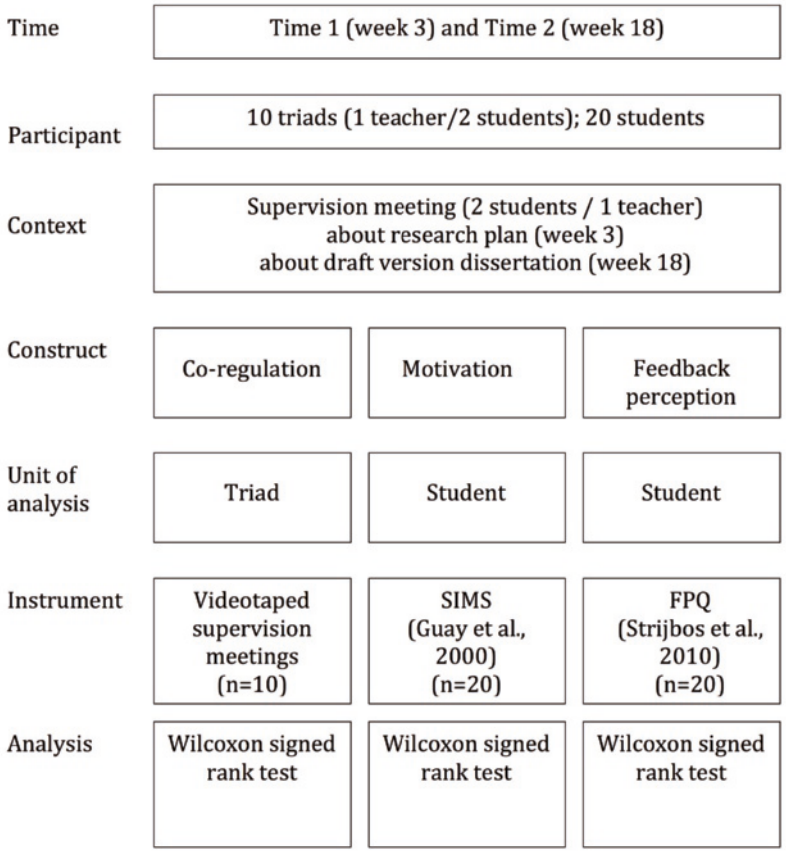


Figure 4.3. Overview of the study.

Materials and procedure

Video camera. The supervision meetings were videotaped with a fixed camera. On the day of observation, the first author installed and started the video camera, but was not present in the observation room during the videotaping of the meeting. Students were used to cameras being present because they often videotaped their own conversations for self-reflection. Teachers reported that they were aware of the camera for the first few minutes, but after that, forgot its presence.

Questionnaires. Directly after the supervision meeting, students were asked to fill out the Feedback Perception Questionnaire (FPQ) (Strijbos et al., 2010) and the Situational Motivation Scale (SIMS) (Guay et al., 2000). Students filled out the questionnaires in a different room than the one the supervision meeting took place in. Of the total population of 87 students, 85 filled out the FPQ and SIMS during week 3; these data were used to conduct factor and reliability analyses on both questionnaires.

Video transcription. All 20 videotaped supervision meetings (n=10 at Time 1; n=10 at Time 2) were transcribed verbatim into simple transcripts. Videos were transcribed literally, with punctuation, pauses, continuers (e.g. hm, yeah) and turn taking, but without intonation or non-verbal behaviour. During transcription speech turn taking was used as the first segmentation criterion, because it fits the natural course of the conversation (Chi, 1997). Thus, a speaker got his/her own paragraph and a blank line was used between speakers. As each meeting consisted of a triad, this resulted in three different speakers' turns of the teacher, student 1, and student 2.

Data analysis

Co-regulation. Co-regulation was analysed in two steps. First, dialogue act coding was used to code teachers' and students' utterances on five communicative functions. The unit of analysis consisted of each teacher's turn and student's turn. Second, teacher's and student's communicative functions were used to determine direct and indirect regulation with each triad as the unit of analysis. Both steps are described in detail in the next paragraph.

Dialogue act coding. All transcripts were imported in the program Multi Episode Protocol Analysis (MEPA). MEPA is a computer program that is used for the analysis and coding of discussions (Erkens, 2005). MEPA offered facilities for automatic coding based on a rule system that automatically categorised utterances into dialogue acts (Erkens & Janssen, 2008). This rule system used if-then rules for pattern matching, i.e. to look for typical words or phrases. For example, the segmentation filter of MEPA used 300 rules to scan for punctuation characters (i.e. "?", "!", "."), connectives ("however", "so") and starting-discourse markers (i.e. "well"). The utterances were segmented before and after the marker. This so-called Dialogue Act Coding (DAC) filter coded the segmented utterances based on recognition of words and phrases. The DAC filter recognised words and phrases that signified the communicative function of the message. Five different communicative functions and twenty-nine dialogue acts were distinguished (see Table 4.1). All utterances (both students and teacher) were coded on the five communicative functions and on the 29 dialogue acts with the program MEPA. Frequencies of the communicative function codes were computed for each supervision meeting.

Direct and indirect regulation. To determine the regulation of learning during the supervision meetings, the communicative functions were transformed to direct and indirect regulation for teachers as well as students.

Teacher direct regulation (TDR) occurred when the teacher initiated action and regulated student learning (e.g. by evaluating the student's research questions). When the teacher used an argument, the DAC filter coded this segment as an argumentative. When the teacher used a directive or commanding utterance, the DAC filter coded this segment as an imperative. The argumentative and imperative segments were summed and TDR was assigned.

Teacher indirect regulation (TIR) occurred when the teacher invited the students to regulate their learning (e.g. by posing a question like 'What are your strong points?'). When the teacher asked a question, the DAC filter coded this segment as an elicitative and TIR was assigned.

Student indirect regulation (SIR) occurred when the students requested help from the teacher to regulate their learning (e.g. by posing a question 'How can I do better on this task?'). When the students asked a question, the segment was coded as an elicitative. The segments were summed for both students and SIR was assigned.

Student direct regulation (SDR) occurred when the student initiated and completed the regulation of learning alone (e.g. by explaining how s/he carried out a certain task, or indicating a certain difficulty). When the student used an argument, the DAC filter coded this segment as an argumentative. When the student used a directive or commanding utterance, the DAC filter coded this segment as an imperative. The two segments were summed for both students and SDR was assigned.

Table 4.1 Description of Categories for Analysis of Regulation of Learning with Dialogue Act Coding

Segment	Regulation	Communicative function	Dialogue act
Teacher / Student	Direct regulation	Argumentatives	Reason
			Contra
			Conditional
			Then
			Disjunctive
			Conclusion
			Elaboration
		Imperatives	Action
			Focus
Teacher / Student	Indirect regulation	Elicitatives	Question Verify
			Question Set
			Question Open
			Proposal Action
Teacher / Student	Other regulation	Responsives	Confirmation
			Deny
			Acceptation
			Reply Confirm
			Reply Deny
			Reply Accept
			Reply Statement
		Informatives	Performative
			Evaluation Neutral
			Evaluation Positive
			Statement
			Action
			Social

Shifts in co-regulation, feedback perception, and motivation. For the analysis of co-regulation, the raw frequencies of the twenty supervision meetings were not comparable across time and across triads because the duration of supervision meetings differed. To account for that fact, the raw frequencies of TDR, TIR, SIR, and SDR were converted to percentages. A within-triad analysis was done on the co-regulation, feedback perception, and motivation data. Because these data were not normally distributed, we applied the non-parametric Wilcoxon signed rank tests. We tested for differences between Time 1 and 2 on the median percentages of TDR, TIR, SIR, and SDR; on the four perception scales; and on the four motivation scales that were found to be reliable. For this analysis, the completed questionnaire data for the 20 students at Time 1 and 2 were used. Exploratory correlation analysis was done between the feedback perception scales and motivation scales.

Co-regulation excerpts. A between-triad analysis was done on co-regulation to explore triad patterns. We defined consistent regulation of learning when triads had a high TDR and low SDR at Time 1 and 2, and when triads had a balanced TDR and SDR at Time 1 and 2. To apply this label of consistent regulation, we used the group means of TDR at Time 1 (M = 47.08%) and at Time 2 (M = 47.31%) and the group means of SDR at Time 1 (M = 28.39%) and at Time 2 (M = 29.33%). For each triad, we determined if the TDR and SDR score was higher or lower than the mean score at Time 1 and 2.

Code	Description	Discourse marker, i.e.
ArgRsn	Reason, ground	"Because ..."
ArgCnt	Counterargument	"However, ..."
ArgCon	Condition	"If ..."
ArgThn	Consequence	"Then ..."
ArgDis	Disjunctive	"Or ..."
ArgCcl	Conclusion	"So, ..."
ArgEla	Continuation	"Furthermore, ..."
ImpAct	Order for action	"W8!"
ImpFoc	Order group member to focus	"Hey!"
EliQstVer	Yes/no question	"Agree?"
EliQstSet	Set question/multiple choice	".... or....?"
EliQstOpn	Open question	"Why?"
EliPrpAct	Proposal for action	"Let's change ..."
ResCfm	Confirmation of info	"Right"
ResDen	Refutation of info	"No"
ResAcc	Acceptance of info	"Oh"
ResRplCfm	Affirmative reply	"Sure"
ResRplDen	Negative reply	"No way"
ResRplAcc	Accepting reply	"Okay"
ResRplStm	Statement reply	" ..."
InfPer	Action performed by saying it	"Hello"
InfEvlNeu	Neutral evaluation	"...easy ..."
InfEvlPos	Positive evaluation	"Nice!"
InfStm	Task information	" ..."
InfStmAct	Announcement of actions	"I'll do ..."
InfStmSoc	Social statement	"Love you ..."

4.3 Results

Descriptives of dialogue act coding

In total, 12 hours and 15 minutes of supervision meetings were transcribed and 25.968 dialogue acts were coded, with 6.856 argumentatives, 332 imperatives, 2.261 elicitatives, 7.699 informatives, and 8.827 responsives (see Table 4.2).

Table 4.2 Descriptive Results of Dialogue Act Coding for Teacher-student Regulation per Triad at Time 1 and Time 2

Triad	T	Teacher Direct Regulation				Teacher Indirect Regulation			
		Time 1		Time 2		Time 1		Time 2	
		f	%	*f*	%	*f*	%	*f*	%
8	8	248	62.31	341	61.78	84	21.11	106	19.20
9	8	298	60.82	233	52.13	88	17.96	65	14.54
3	3	175	56.82	245	47.76	50	16.23	94	18.32
2	2	162	46.02	388	47.03	66	18.75	187	22.67
10	9	161	43.40	192	45.07	58	15.63	39	9.15
5	4	263	43.33	208	38.31	74	12.19	49	9.02
6	7	144	43.11	151	40.27	26	7.78	38	10.13
4	3	109	41.76	338	51.37	44	16.86	115	17.48
1	2	97	41.63	475	54.47	62	26.61	229	26.26
7	7	121	31.59	175	34.93	64	16.71	48	9.58

Note. f = frequency of utterances coded within one supervision meeting in that week; % = relative frequency of utterances coded as proportion of total amount of utterances within one supervision meeting in that week; T = teacher

Shifts in co-regulation

The within-triad analysis with the Wilcoxon signed rank tests showed no differences between Time 1 and 2 for triads' TDR, TIR, SIR, and SDR and thus no differences for triads' co-regulation (TIR and SIR) (see Table 4.3). The between-triad analysis of the coded results in Table 2 showed huge differences between triads. Many triads showed high levels of teacher direct regulation (TDR) and moderate levels of student direct regulation (SDR). These high levels of direct regulation lead to quite low levels of co-regulation; teacher indirect regulation (TIR) and student indirect regulation (SIR) were very low compared to their direct regulation. Other triads seemed to show more of a balance in their co-regulation of learning. Over time, triads showed a very consistent regulation of learning pattern. Two different patterns were distinguished for six of the ten triads. Three triads (3, 8 and 9) showed consistent low co-regulation over time with low indirect regulation (TIR and SIR) and high direct regulation (TDR and SDR). Three other triads (5, 6 and 7) showed consistent moderate to high co-regulation over time with moderate to high levels of indirect regulation (TIR and SIR) between students and teacher (see Figure 4.4).

Student Indirect Regulation				**Student Direct Regulation**			
Time 1		**Time 2**		**Time 1**		**Time 2**	
f	%	*f*	%	*f*	%	*f*	%
14	3.52	31	5.62	52	13.07	74	13.41
22	4.49	29	6.49	82	16.73	120	26.85
22	7.14	35	6.82	61	19.81	139	27.10
27	7.67	46	5.58	97	27.56	204	24.73
41	11.05	47	11.03	111	29.92	148	34.74
13	2.14	31	5.71	257	42.34	255	46.96
18	5.39	35	9.33	146	43.71	151	40.27
26	9.96	44	6.69	82	31.42	161	24.47
19	8.15	32	3.67	55	23.61	136	15.60
61	15.93	82	16.37	137	35.77	196	39.12

Table 4.3 Wilcoxon Signed Rank-test Results Comparing Time 1 and 2 on Co-regulation, Feedback Perception and Motivation

	Time 1			Time 2			Difference			
	Mdn	Min	Max	Mdn	Min	Max	*T*	*z*	*p*	*r*
Co-regulation										
Teacher Direct Regulation	.43	.32	.62	.47	.35	.62	25.00	−.26	.80	.06
Teacher Indirect Regulation	.17	.08	.27	.16	.09	.26	19.00	−.87	.39	.19
Student Indirect Regulation	.08	.03	.15	.07	.04	.16	27.00	−.05	.96	.01
Student Direct Regulation	.29	.13	.44	.27	.13	.44	22.00	−.56	.58	.13
Feedback perception										
Willingness to Improve	5.00	3.33	5.00	5.00	4.00	5.00	23.50	−.412	.68	.07
Affect Negative	1.00	1.00	2.60	1.40	1.00	3.00	21.50	−1.03	.30	.16
Affect Positive	3.33	2.00	4.33	3.83	1.00	4.67	71.50	−.96	.34	.15
Adequacy of Feedback	4.57	3.00	5.00	4.29	2.71	5.00	33.50	−.84	.40	.13
Motivation										
Intrinsic Motivation	5.25	4.00	6.25	4.75	2.25	5.75	25.00	−2.83	.005**	.45#
Amotivation	1.63	1.00	4.00	3.38	1.00	5.75	30.50	−2.19	.03*	.35#
External Regulation	4.13	1.75	6.00	4.75	2.25	5.75	56.00	−1.57	.12	.25
Identified Regulation	5.63	4.00	6.75	4.75	2.25	5.75	23.50	−2.09	.04*	.33#

*Note1. * p < .05 ** p < .01 # r ≥ .30;*
Note2. Mdn = median rank score; Min = minimal rank score; Max = maximum rank score; T = test statistic; z = z-score; p = significance level; r = effect size

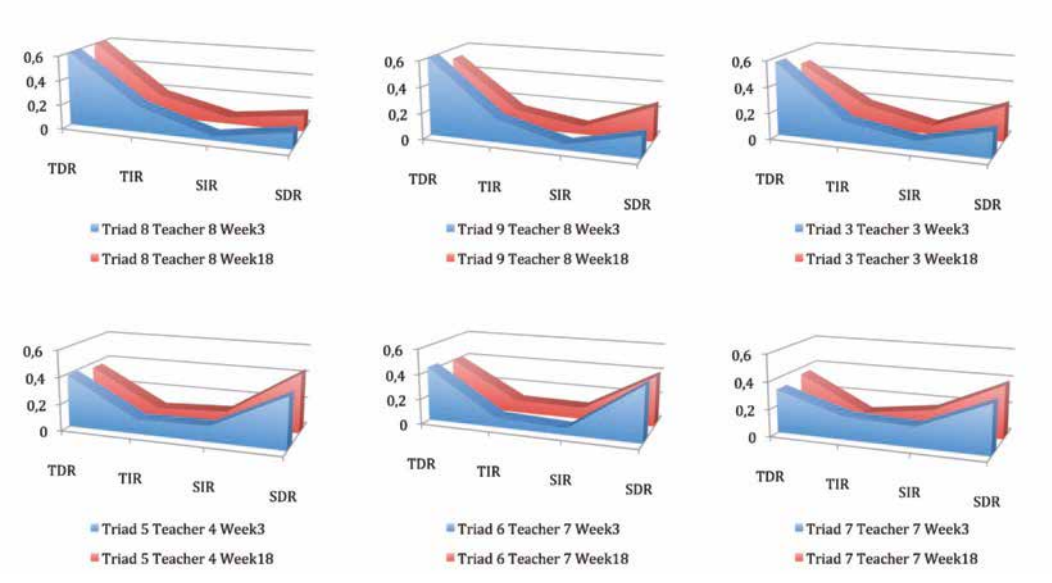


Figure 4.4. Triads with a consistent co-regulation of learning pattern over time

To illustrate the pattern of low co-regulation, we provide an excerpt of the observation of triad 8 at Time 2. In this excerpt the high direct regulation of teacher 8 is shown; teacher's utterances are frequently coded with argumentatives and informatives (see Table 4.4).

Table 4.4 Excerpt of low co-regulation (Triad 8; Teacher 8; Time 2; Lines 925-939)

Line	Speaker	Utterance	Code
925	Teacher8	Actually, your main research question is more descriptive…	InfStm
926	Teacher8	…what is the effect?…	EliQstOpn
927	Teacher8	…what are the strategies?	EliQstVer
928	Teacher8	And it is not…one group has more than the other.	ArgThn
929	Teacher8	Because, you did not pose a research question about that at all.	ArgRsn
930	Teacher8	And when it becomes obvious there are differences between males and females…	ArgCon
931	Teacher8	…well then you zoom in to it.	ArgThn
932	Student1	Yes	ResCfm
933	Teacher8	It is tempting to test these differences when you have the data.	ArgThn
934	Student1	Yes	ResCfm
935	Student2	Yes	ResCfm
936	Teacher8	But it is actually…	ArgCnt
937	Teacher8	…it is actually not necessary…	InfStm
938	Teacher8	…because you haven't got a research question about it…	ArgRsn
939	Teacher8	…thus, you are doing something you are not asking.	ArgCcl

To illustrate the pattern of high co-regulation, we provide another excerpt of the observation of triad 5 at Time 1. In this excerpt the high direct regulation of the students is shown; students' utterances are frequently coded with argumentatives and informatives (see Table 4.5).

Table 4.5 Excerpt of high co-regulation (Triad 5; Teacher 4; Time 1; Lines 422-438)

Line	Speaker	Utterance	Code
422	Teacher4	Because, do you have any clue in which direction to do your literature review…	ArgRsn
423	Teacher4	…when you are talking about strategies…	ArgCon
424	Teacher4	…and how to define strategies.	InfStm
425	Student1	We have searched for coping strategies…	InfStm
426	Student1	…and found several studies…	InfStm
427	Student1	…and then we read what these researchers found…	InfStm
428	Student1	…but many publications just described peoples' emotions, instead of the strategies they literally used…	ArgCnt
429	Student1	…so we have…	ArgCcl
430	Student2	…one publication.	InfStm
431	Student1	We found only one publication…	InfStm
432	Student2	…that really focused on strategies.	InfStm
433	Student1	Yes.	ResCfm
434	Teacher4	Uhum	InfStm
435	Student2	The other publications were about the difficulties people encounter…	ArgEla
436	Teacher4	Uhum	InfStm
437	Student2	…and which emotions they had.	EliQstOpn
438	Teacher4	And what kind of combinations of keyword are you using?	EliQstVer

Shifts in Feedback Perception and Motivation

The Wilcoxon signed rank tests also showed no differences between Time 1 and 2 for students' feedback perceptions. The Wilcoxon signed rank tests did show significant differences between Time 1 and 2 for students' motivation. After the supervision meeting at Time 2, students' Intrinsic Motivation and Identified Regulation were significantly lower and students' Amotivation was significantly higher than after the supervision meeting at Time 1 (see Table 4.3). No differences were found for External Regulation. Medium effect sizes were found for Intrinsic Motivation, Amotivation and Identified Regulation.

Correlation between feedback perception and motivation

Correlation analyses were performed between the scale scores of the FPQ and the SIMS (see Table 4.6). All feedback perception scales correlated significantly with each other, and almost all motivation scales correlated significantly with each other. The scores on the Amotivation scale correlated significantly with scores on all feedback perception scales. The Identified Regulation scale correlated significantly with the Willingness to Improve scale, the Affect Positive scale and the Adequacy of Feedback scale. The Intrinsic Motivation scale did not correlate with any of the feedback perception scales.

Table 4.6 Correlation Matrix between Feedback Perception Scales and Situational Motivation Scales

	WI	AN	AP	AF	IM	AM	ER	IR
Willingness to Improve (WI)	1.00							
Affect Negative (AN)	-.24*	1.00						
Affect Positive (AP)	.29**	-.46**	1.00					
Adequacy of Feedback (AF)	.49**	-.61**	.60**	1.00				
Intrinsic Motivation (IM)	.18	-.15	.16	.20	1.00			
Amotivation (AM)	-.38**	.34**	-.41**	-.53**	-.38**	1.00		
External Regulation (ER)	.09	-.08	.09	.22*	-.27*	.09	1.00	
Identified Regulation (IR)	.24*	-.09	.29**	.28**	.54**	-.48**	-.09	1.00

*Note. * p < .05 ** p < .01*

4.4 Discussion

Consistent co-regulation from the beginning to the end

The first aim of this study was to test the theory of co-regulation in the context of research supervision; we aimed to provide insight into how teachers and undergraduate students co-regulated students' learning. We answered the research question 'How does the co-regulation between teachers and students during research supervision meetings shift in the course of a five-month research project?' We expected an increase in co-regulation; teachers and students who are sharing thoughts and ideas about the research project they were working on, instead of teachers telling their students what to do. However, the within-triad analysis showed no significant differences among the ten triads in their teacher-student regulation of learning between Time 1 and Time 2. Teacher and student indirect regulation (TIR and SIR) had the same regulation of learning pattern at Time 2 as they had at Time 1. It seemed teachers and students co-regulated their meetings identically at Time 1 and Time 2. The expected difference between the starting phase and final phase of writing and supervising the thesis was not found. A more closer look at the different triads did show two patterns, but not one triad showed a shift in co-regulation; direct regulation and indirect regulation were as high (or as low) on Time 2 as they were on Time 1.

Scaffolding: No decreasing of support or taking on responsibility

The scaffolding principle, with a decrease in teacher support and an increase in student responsibility, should have made more co-regulation possible. As this transition did not occur, co-regulation stayed the same. Within the low student and high teacher regulation triads (5, 6 and 7), the students asked some questions and rarely offered any argument. The teachers in these triads controlled the dialogue with their arguments. This low level of student regulation (students merely observing and being passive) makes sense given that students had just started working on their thesis research (Prins & Mainhard, 2009, August). The teachers showed very active behaviour, and these high levels of teacher direct regulation make sense, since at the beginning of a new task, teachers must engage in more explanation and instruction to increase students' understanding (Hadwin et al., 2005). At Time 2, these teachers had not decreased their support, and students were not able to or did not get any op-

portunities to take on more responsibility. These results were contrary to the conceptual model of Van de Pol et al. (2010) and the results of Hadwin et al. (2005). Teachers and students were showing the same behaviour in the final phase of the thesis. The unchanged high level of teacher direct regulation at Time 2 was not expected for a task on which students had worked on for 5 months; students were expected to be more active during these teacher-student interactions. Rasku-Puttonen et al. (2003) also found that teachers maintained control at the end of the task and that some teachers even increased their controlling activities.

The other three triads (3, 8 and 9) were regulating students' learning processes in a much more equal way. Within these triads, a more balanced regulation of learning occurred. At Time 1, teachers and students were already co-regulating and sharing their thoughts and arguments in an equal way. These teachers gave opportunities to their students for active participation during the supervision meetings, and the students were able to pick up that active role and accept more responsibility. These findings were contrary to the conceptual model of Van de Pol et al.(2010) and conflicted with the results that Hadwin et al. (2005) found, as teachers might have decreased their support even more, and students might have taken on more responsibility. Fortunately, the students who were active at Time 1 remained active at Time 2. Most importantly, this balance in regulation between teachers and students are considered authentic co-regulation; teachers and students shared their thoughts and arguments, prompted, and guided each other. An explanation for the findings above could be that students' autonomy cannot be influenced that easily; it is not just a matter of supporting students' autonomy more or less. Students' learning might not simply improve, but may be a non-linear process (Willison, Sabir, & Thomas, 2017). Teachers might be following their own script and objectives (Nathan & Kim, 2009) and not providing opportunities for their students to take on that active role.

Feedback perception and motivation

The second aim of this study was to add new knowledge to the existing one about how students perceive teacher feedback, and how motivated they are for their research task. We answered the second research question of 'How does students' feedback perception and motivation for their research task shift in the course of a five-month research project?' Results showed no differences in feedback perception between Time 1 and 2. Apparently, the research phase seemed to have no impact on students' perception of feedback. It did not matter what kind of teacher regulation was used. Students perceived feedback as valuable whether it came from a teacher that used high direct regulation or from a teacher who used direct regulation more in balance with student regulation. It seems neither a high level nor a low level of autonomy support is valued more by students. The level of structure, support, and space that teachers provide might depend on context, student characteristics, and educator purpose (Willison et al., 2017). Our findings are in line with the results of Overall, Deane, and Peterson (2011) who found no association between the degree of teachers' support for students' autonomy and students' satisfaction with their supervision.

Results showed significant differences in motivation between Time 1 and 2. Intrinsic Motivation and identified Regulation decreased and Amotivation increased between Time 1 and Time 2. When students started conducting research, it seemed they were quite motivated, but when the work was done and the final feedback was given, motivation dropped. A possible explanation for this drop in motivation could be that students did not see the value of research skills for future life. Murtonen, Olkinuora, Tynjälä, and Lehtinen (2008) argued that when students do not see this value, they may have problems in their motivation to learn research skills. Another explanation could be that the supervisors did not pay enough attention to student's active participation and motivation; Mackiewicz and Thompson (2013) argued that supervisors can enhance student's motivation during supervision meetings by giving praise, encouragement, and statements of sympathy or empathy. Järvelä, Järvenoja, and Malmberg (2012) emphasized that especially students who are poorly motivated need support to become active regulators of their own learning; by reinforcing students' ownership supervisors can give students the responsibility for their writing (Mackiewicz & Thompson, 2013). The students who inter-

acted with 'high regulation teachers' might not have experienced a lot of autonomy support from their teachers, and this may have affected their motivation for research. Autonomy supportive teachers always seek students' initiative and support their intrinsic motivation (Reeve, Bolt, & Cai, 1999). Students who interacted with 'low regulation teachers' might have experienced their teachers as autonomy supportive, but perhaps did not feel competent enough to finish their thesis.

Correlation analysis between feedback perception and motivation showed that Intrinsic Motivation did not correlate to any feedback perception scale. Apparently, it did not matter for their intrinsic motivation what kind of feedback a student received; when students are interested in doing their own research, negative feedback will not influence this. On the other hand, when students have low intrinsic motivation, positive feedback will not help either. The Adequacy of Feedback correlated positively with External Regulation and with Identified Regulation, but negatively with Amotivation. Apparently, the more adequate the feedback is, the more motivated a student will be for doing research.

Limitations and Future Research

This study is subject to some limitations. First, this study focused on a small sample of students and their teachers in a specific context in higher education. Therefore, we were not able to generalise any results to the broader population of students in higher education. In future larger scale studies, students' feedback perception and motivation could be investigated to determine differences between the beginning and the end of a task. Second, we did not focus on the reasons why students and teachers showed certain regulation throughout the supervision meetings and why students' motivation dropped. More research is needed to discover answers to these questions. This information could be used to develop interventions for students to better prepare themselves for these supervision meetings about undergraduate research, and for teachers to adapt their supervision. Information about how autonomy supportive teachers can increase or maintain students' motivation would be helpful.

Implications

In this study, we tried to unravel the research supervision process and to generalise to the theory of scaffolding and co-regulation. Teachers can encourage students' regulation of learning with their supervision; some teachers showed scaffolding behaviour in which they stimulated students' active roles by co-regulating students' learning. These teachers seemed to be sensitive, finding out how much guidance each student requires just as Malachowski (1996) described. Other teachers still seem to search for a balance between giving support and allowing students to find their own way just as the teachers of Vehviläinen and Löfström (2014) did. The results of this study do fit the modes of regulation, including co-regulation, as found in collaborative settings (Hadwin & Oshige, 2011). The reviewed studies on co-regulation by Panadero and Järvelä (2015) showed co-regulation to be an unbalanced regulation of learning, as its use has not been consistent. The results of this study add to that knowledge, as co-regulation did not correspond to the expected scaffolding process in time with teachers who decrease their support, and students who increase their responsibility.

Conclusion

It can be concluded that co-regulation between teachers and students in supervision meetings concerning undergraduate students' research projects does not vary significantly over the course of students' research projects. Our study showed a constant and comparable level of regulation during supervision meetings at the start and at the end of students' research projects. Although some students took more responsibility in regulating than other students did, all students perceived teachers' feedback equally high, more or less. In general, students' motivation was lower at the end of the research project than at the start.

Teacher-student perspectives on teaching: A multiple case study about teachers' in-the-moment decisions and students' perceptions

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Acknowledgement of author contributions: BA, FP, MS, and JT designed the study; BA recruited participants constructed the instruments, collected the data, constructed the coding scheme, and analyzed the data, FP constructed an audit trail report; BA and FP drafted the manuscript, MS and JT contributed to critical revision of the paper, FP, MS, and JT supervised the study.

Abstract

Diagnosing teachers are teachers who perceive diagnostic information about students' learning process, interpret these aspects, decide how to respond, and finally act based on this diagnostic decision. In general, teachers think their lesson planning through and plan their teaching actions. When interacting with their students teachers make in-the-moment decisions inside their heads. In this study, we tried to grasp teachers' in-the-moment decisions, the plans that they made, and students' perceptions of teachers' actions. Teacher decisions and student perceptions were measured with video-stimulated recall interviews, and coded using a content analysis approach. The results showed that the in-the-moment decisions our teachers made had a strong focus on student learning. Teachers often asked questions to empower students or to increase student understanding. These teaching strategies seemed to be adapted to students' needs, as the latter had positive perceptions when their control increased or when they received a stimulus to think for themselves.

5.1 Introduction

Diagnosing teachers are teachers who *perceive* relevant diagnostic information about students' learning process, *interpret* these aspects, *decide* how to respond to this diagnostic conclusion, and finally *act* based on this diagnostic decision (Hoth et al., 2016). Diagnostic information gives teachers insight into students' thinking and skills. They can use this information to interpret whether students, for instance, just made a minor mistake or have a deep misunderstanding. As a result, teachers can decide how to intervene (e.g. by means of feedback or prompts) to stimulate students in their learning process.

Research shows that diagnosing students' learning process is a complex process; teachers are able to diagnose students' learning, but do not always use their diagnoses during teacher support (Klug et al., 2013; Van de Pol et al., 2011). Teachers have difficulties in perceiving and interpreting students' errors and solutions (Stahnke, Schueler, & Roesken-Winter, 2016), or they intervene immediately (Ruiz-Primo & Furtak, 2007). Feinberg and Shapiro (2009) showed that their teachers were able to be good diagnosticians but tended to overestimate the actual performance the students were likely to achieve.

Much of the teacher planning takes place before the teacher-student interaction starts; when no students are present, we are dealing with pre-active teaching (Clark, 2005). A challenging aspect of diagnosing students' learning is that this generally takes place during moment-to-moment teaching (Borko, Roberts, & Shavelson, 2008). When students are present, we are dealing with interactive teaching (Clark, 2005). Teachers make *in-the-moment decisions* all the time when they teach and interact with their students, with literally hundreds of decisions a day (Clark, 2005). During interactive teaching, teachers' in-the-moment decisions play an important role in teachers' diagnoses and their acting (Shavelson & Stern, 1981). Teachers perceive what individual students know, they interpret their own observations, make in-the-moment decisions that finally result in a *teaching action* (Hoth et al., 2016).

One of the most effective teaching actions teachers can use to influence students' achievements is feedback (Black & Wiliam, 1998; Hattie & Timperley, 2007; Hattie, 2009). When students receive teacher feedback, they first consider the feedback before they accept or act upon it (de Kleijn et al., 2013). The effectiveness of feedback is related to students' perceptions of the feedback; how students interpret feedback is critical to the success of formative assessment (Poulos & Mahony, 2008). Fostering positive student perceptions should be one of the primary goals of teachers (Ekholm et al., 2015).

While teachers' teaching actions are observable, their diagnoses and in-the-moment decisions are not and are often hidden (Jacobs, Lamb, & Philipp, 2010). The cognitive processes of students' perceptions are hidden and unobservable as well. In this study, we aim to look beyond the observable behavior of teachers and students and try to reveal teachers' in-the-moment decisions and students' perceptions. Within the context of research supervision, we aim to investigate the teaching actions and in-the-moment decisions teachers make, which actions and decisions they have planned, and what perceptions students have on these actions.

Teachers' in-the-moment decisions and teaching actions

In this study, we defined teachers' teaching actions as all information provided to foster students' learning. Teachers carry out a lot of teaching actions during teacher-student interactions: they ask questions, check student understanding, and give feedback. In-the-moment decisions are defined in many different ways. Some researchers variously defined these decisions as interactive cognitions (Hennissen, Crasborn, Brouwer, Korthagen, & Bergen, 2010; Meijer, Beijaard, & Verloop, 2002; Schepens, Aelterman, & Van Keer, 2007), as interactive decisions (Housner & Griffey, 1985; Richards, 1998; Tsang, 2004), as in-the-moment decision-making (Jacobs et al., 2010; Schoenfeld, 2015; Stahnke et al., 2016), or as in-the-moment noticing (Barnhart & van Es, 2015; Sherin, Russ, & Colestock, 2011). In this study, we use the definition of teachers' *in-the-moment decisions*; we operationalized these decisions as teachers' reasoning for their *teaching actions* (Johnson, 1992; Rich & Hannafin, 2008; Richards, 1998; Tsang, 2004). For example, Rich and Hannafin (2008) observed four pre-service teachers' actions and the in-the-moment decisions they made in the classroom. Their analyses revealed several connections between teachers' in-the-moment decisions and their teaching actions. For example, teachers who aimed for students to take different perspectives (decision) asked questions (action) to prompt this. Richards (1998) defined eight different in-the-moment decisions teachers can make. For example, with the in-the-moment decision of *empowerment* teachers are giving students control.

Teachers' aims and planning of teaching actions

Although teachers carry out many teaching actions when interacting with their students, they do not plan many of these actions. In general, teachers think their lesson planning through; they are engaged in making pre-active decisions on what to teach, how to present it, and how to assess student learning (Lai & Lam, 2011). Several researchers focused on teachers' *planning of teaching actions* and the *aims* they have before the teaching situation occurs (Borko et al., 2008; Clark & Peterson, 1986; Eley, 2006; Housner & Griffey, 1985; Kohler, Henning, & Usma-Wilches, 2008; Westerman, 1991). Several researchers determined which of the planned actions and intended decisions were obtained, and how many times teachers had to improvise based on students' cues and inaccurate answers. For example, Kohler et al. (2008) investigated how 150 student teachers modified their planned actions during classroom interactions with their students. These student teachers made 314 in-the-moment adjustments during teaching based on student difficulties. Housner and Griffey (1985) examined eight elementary school teachers and determined which in-the-moment decisions teachers made, and how often that resulted in a change of instruction in the actions they planned. They found that about 35% of teachers' in-the-moment decisions resulted in a change of instruction. Westerman (1991) studied teachers' decision-making and her expert teachers adapted their teaching actions based on students' cues. The already planned teaching actions were still carried out, and they were not affected by the in-the-moment decision-making.

Students' perceptions of teaching actions

In this study, we defined students' perception as the extent to which students perceive teachers' teaching actions to be supportive of their learning. Many researchers have investigated the perception of feedback. We know teachers and students perceive the feedback process differently (Carless, 2006; Mulliner & Tucker, 2017; Weaver, 2006), and students' understanding of feedback is often not consistent with the intention of the teacher (van der Schaaf et al., 2011). Dowden, Pittaway, Yost, and McCarthy (2013) described students who perceived feedback in a negative light, when this was unlikely to have been the intention of the teacher. Students prefer feedback to be specific and timely (Poulos & Mahony, 2008), to be personalized, and with clear guidance on how to improve their work (Ferguson, 2011b). However, students often do not find teacher feedback very helpful (Hounsell, McCune, Hounsell, & Litjens, 2008a). Orsmond and Merry (2011) found in their research a misalignment between the feedback giver and receiver; they argued that teachers should adapt their feedback more to students' needs, and apply more variation in their feedback. In this study, we were interested in how students perceived teachers' teaching actions, including teacher feedback.

In-the-moment decision-making model

For this study we constructed a decision-making model in which the main variables were combined. Based on the phases of decision-making, we applied two phases in our model: the pre-active planning phase and the interactive teaching phase (Clark, 2005; Westerman, 1991). The pre-active planning phase consists of two steps: one step in which teachers plan their *teaching actions* (Kohler et al., 2008), e.g. planning in terms of giving feedback, while the other step consists of the aims and objectives teachers have, e.g. increasing student understanding. The interactive teaching phase of the model consists of four cyclical steps. The emphasis of the cycle is found in step 1 with the perceive-interpret-decide (PID) model that Hoth et al. (2016) used to define diagnosing teachers. In this first interactive step, teachers perceive and interpret students' ability, motivation, and behaviour, and make *in-the-moment decisions* on how to act. In step 2, based on the in-the-moment decisions, teachers carry out *teaching actions*; teachers give feedback and explanations, and ask questions to, and elicit input from, their students. These teaching actions are performed just as they were planned in the planning phase or were adjusted based on their perception and interpretation in step 1. In step 3, students *perceive* and interpret the teaching actions, and in step 4 they respond and act based on these perceptions. The cycle continues when teachers perceive and interpret students' responses, and again make in-the-moment decisions on how to act (see Figure 5.1).

Present study

Students have to develop essential research skills to complete a research project successfully; they have to review the literature, identify research needs, and develop a research design (Wisker, 2009). Supervision meetings offer opportunities for teacher-student interaction; teachers ask questions and support students by giving explanations and feedback on draft versions of their works. These meetings give teachers the opportunity to diagnose students' research skills and to adapt their support to students' needs (de Kleijn et al., 2015). Although teachers are able to ask a lot of diagnostic questions and gather enough information to diagnose students' research skills, they often intervene with feedback and explanations (Agricola et al., 2018). Teachers only formulate their diagnoses implicitly; they are unobservable, as they stay inside their heads (Agricola et al., 2018). Capturing teachers' in-the-moment decisions can reveal their diagnosing process and gives insight into why certain teaching actions are performed. Students' feedback perceptions are unobservable as well; what they think remains unclear.

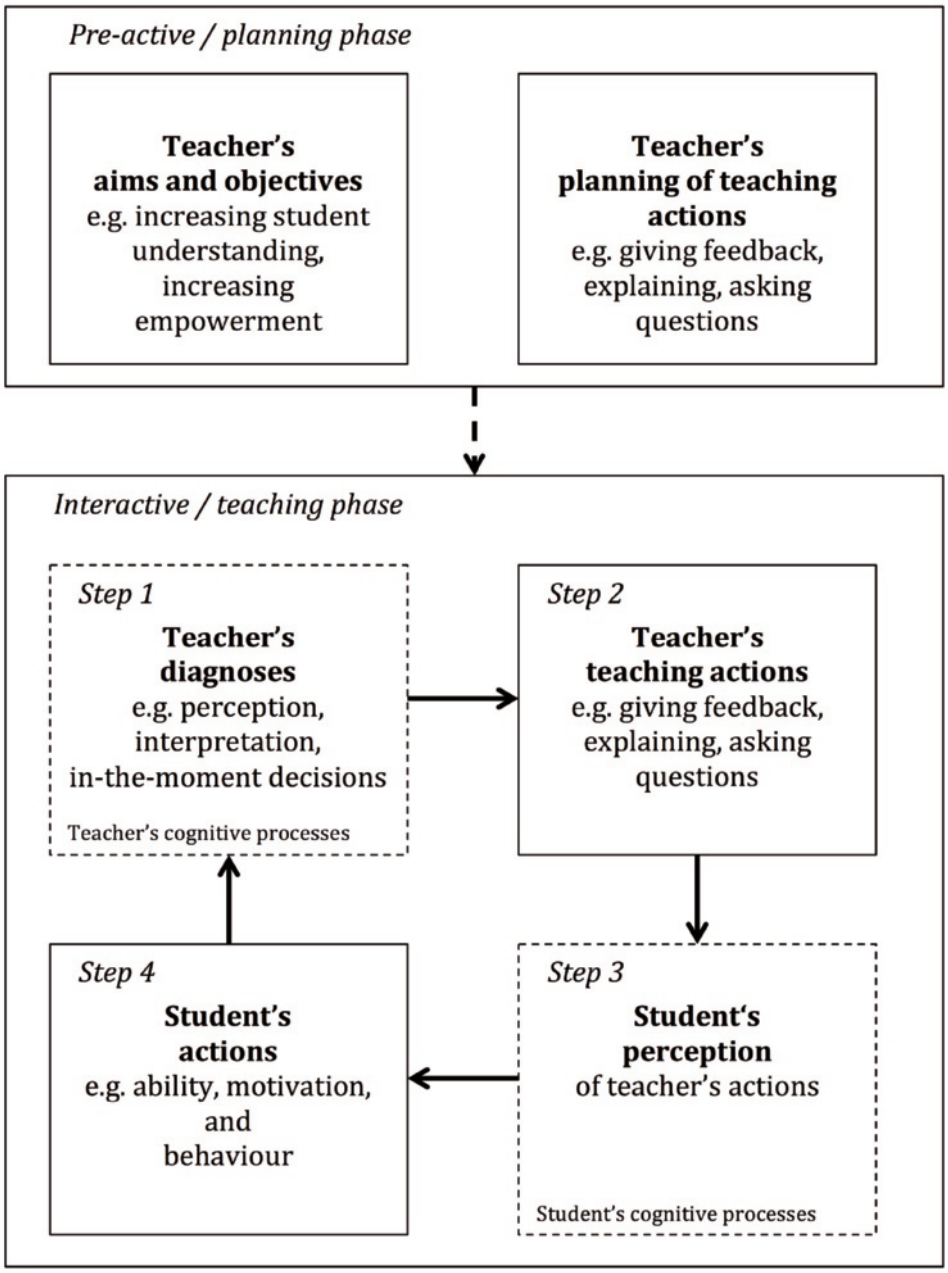

Figure 5.1. Model with the pre-active/planning phase (aims, objectives, and planning of teaching actions), and the interactive/teaching phase (teachers' diagnoses and teaching actions, students' perceptions and actions), based on the PID model of Hoth et al. (2016).

This study on teacher and student thinking will contribute to our understanding of teacher-student practices; the study aimed to determine which in-the-moment decisions teachers make when interacting with their students. Based on teacher planning and student perceptions, we will formulate which decisions are desirable, and give suggestions for teachers on how to move in this direction. Within the context of teacher-student interactions and research supervision, we tried to grasp the in-the-moment decisions inside teachers' heads that lead to teaching actions, and students' perception of these actions. We addressed the following research questions:

1 Which different types of in-the-moment decisions do research supervisors report, and how are they connected to teaching actions?

2 Which of the reported in-the-moment decisions were already aimed for, and which reported teaching actions were already planned?

3 How do students perceive teachers' teaching actions?

5.2 Method

Design

In this exploratory study, a multiple case study design was used (Yin, 2014). The research questions focused on different cases. Research questions 1 and 2 focused on the teacher as a case; research question 3 focused on the student as a case. We adopted a qualitative approach in the form of interviews with both teachers and students. This approach was chosen to yield a detailed narrative of teachers' in-the-moment decisions and students' perceptions.

Context

This study was conducted within the context of the writing of an undergraduate dissertation and face-to-face research supervision meetings in higher education. Students were in the final year of their bachelor of health programme at a Dutch university. The students wrote their dissertation alone or in pairs and had 20 weeks to conduct their research project and write their dissertation (30 ECTS; 840 hours). During the course, the students had approximately eight supervision meetings with their teacher; one of these meetings was selected for data gathering.

Participants

Seven teachers with a mean age of 39.0 years (SD = 10.0) and mean supervising experience of 9.1 years (SD = 10.7) voluntarily agreed to participate. Nine students with a mean age of 22.6 years (SD = 1.4) agreed to participate in a videotaped observation. Six of these nine students agreed to participate in stimulated recall interviews (see Table 5.1). The students wrote their dissertation alone or in pairs. Before data collection started, teachers and students were informed that the study was investigating the interaction between teachers and students and the support that teachers provided and how students perceived the feedback during the supervision meetings. All participants gave informed consent before data collection started.

Table 5.1 Characteristics of participants

Meeting	Role	Id	Name	Age	Sex	Education	Teaching
1	Teacher	T1	Thelma	58	F	MSc	32
	Student	S1	Louise	22	F	PUE	
2	Teacher	T2	Emilia	34	F	MSc	10
	Student	S2a	Sophie	23	F	VE	
	Student	S2b	Maisie	22	F	HCGE	
3	Teacher	T3	Lorelai	40	F	MSc	3
	Student	S3	Rory	20	F	HCGE	
4	Teacher	T4	Mel	45	F	PhD	5
	Student	S4	Kim	24	F	HCGE	
5	Teacher	T5	Sandra	36	F	MSc	10
	Student	S5	Melissa	24	F	HCGE	
6	Teacher	T6	Farrah	31	F	MSc	3
	Student	S6a	Jaclyn	23	F	HCGE	
	Student	S6b	Kate	23	F	HCGE	
7	Teacher	T7	Cagney	29	F	MSc	1
	Student	S7	Lacey	20	F	HCGE	

Note. Education: HGCE = higher general continued education; PUE = pre-university education; VE = vocational education; Teaching = teaching experience in years

Stimulated recall procedure

A wide range of methodological possibilities is available for researchers studying teacher and student cognition: observations, self-report instruments, verbal commentaries, and reflective writing (Borg, 2015; Clark, 2005). Most researchers have used stimulated recall to investigate and measure teachers' in-the-moment decisions (Borko et al., 2008; Eley, 2006; Hennissen et al., 2010; Housner & Griffey, 1985; Johnson, 1992; Meijer et al., 2002; Rich & Hannafin, 2008). Some researchers have used stimulated recall interviews to measure student perceptions (Wiltbank et al., 2018), students' pedagogical thinking (Mylläri et al., 2011), or their long term memories (Stolpe & Björklund, 2013). Stimulated recall involves the use of audiotapes or videotapes of skilled behaviour, which are used to aid a participant's recall of his thought processes at the time of that behaviour (Calderhead, 1981). Video stimuli from fixed cameras are often used, but these are limited as the camera perspective is different from the perspective of the decision-maker (Omodei & McLennan, 1994). A head-mounted camera can overcome this problem: it focuses on the environment as if it were the eyes of the participant. A head-mounted camera captures a powerful stimulus to the spontaneous recollection of *in-the-moment decisions* that were made during the recording (Omodei, McLennan, & Wearing, 2012). In this study, a stimulated recall interview (SRI) procedure was used in which the videotape of a teaching episode was replayed to enable the teacher to recollect their in-the-moment decisions and to enable the students to report on their perceptions.

Procedure and materials

During our data gathering, we followed the decision-making phases of Westerman (1991) and distinguished – next to the pre-active and interactive phase – a post-active phase.

Pre-active phase. Pre-active planning interviews took place just before the supervision meeting started. The first author acted as interviewer and asked each teacher about their background, e.g. their faculty status and how long they had been teaching. Then, the interviewer asked the teachers about their aims, and about the planning of their teaching actions. The pre-active interviews lasted for a maximum of 10 minutes. The interviews were videotaped with a fixed camera.

Interactive phase. Then the teacher-student supervision meeting took place and was videotaped with a head-mounted camera on the head of the teacher and a fixed camera. The head-mounted camera was pointed towards the student to measure the teaching actions from the perspective of the teacher. The fixed camera was used to videotape both participants of the supervision meeting, again to measure the teaching actions (see Figure 5.2). On the day of the observation, the first author installed and started the video cameras, but was not present in the observation room during the videotaping of the meeting. The students were used to cameras as they often videotaped their own conversations for assessment and self-reflection. The teachers reported that they were aware of the camera for the first few minutes but after that forgot its presence.

Figure 5.2. Research supervision meeting between a teacher (left) with head-mounted camera and a student.

Post-active phase. In the post-active phase, an SRI was conducted with each teacher and each student. Before the SRI started, the first author instructed each participant according to the guidelines that were used by other researchers (Meijer et al., 2002; Schepens et al., 2007): 1) each participant was asked to relive their supervision meeting; 2) the participants were asked to stop the videotape themselves when they remembered a significant moment or observed a significant teaching action; 3) when participants became too involved in watching themselves, the interviewer stopped the video and asked what the participant was thinking at that moment.

Teacher SRI. An SRI was conducted with each teacher immediately after the supervision meeting. The first 15 minutes of the supervision meeting were used as a stimulus. The videotape of the head-mounted camera was replayed to enable the teacher to recollect and report on their teaching actions and recollect their in-the-moment decisions on which the actions were based (see Figure 5.3).

Figure 5.3. Head-mounted camera view from teacher's perspective (left), used as a video stimulus during stimulated recall interview between the first author and the teacher (right).

Student SRI. An SRI was conducted with each student immediately after the SRI with the teacher. The fixed camera captured the teaching actions that were used as a stimulus for the stimulated recall interview on each student's *perception.* The first author used the same instruction for the student as for the teacher. The videotape of the fixed camera of the supervision meeting was replayed to enable the student to recollect and report on the teacher's teaching actions. During the interview the students were asked to stop the videotape themselves when they saw a significant teaching action about which they were asked for their perception.

Measures and instruments

Aims and planning of teaching actions. We measured teachers' *aims* and *planning of teaching actions* with a small semi-structured interview guide (see Appendix J). The aims were measured to determine which in-the-moment decisions during the supervision meetings were already aimed for. The planning of teaching actions was measured to determine which teaching actions during the supervision meetings were already planned.

In-the-moment decisions and teaching actions. We measured *teachers' in-the-moment decisions* and *teaching actions* with a stimulated recall interview protocol. When the video stimulus was stopped, the interviewer used a semi-structured interview guide to ask about the in-the-moment decision and teaching action (see Appendix J).

Students' perceptions of teaching actions. We measured *students' perceptions* of teachers' teaching actions with a stimulated recall interview protocol. When the video stimulus was stopped, the interviewer used a semi-structured interview guide to ask about each student's perception of the teaching action (see Appendix K). See Figure 5.4 for an overview of the study.

Data preparation

Transcripts. Four different transcripts were prepared: 1) the pre-active interview; 2) the supervision meeting; 3) the teacher SRI; and 4) the student SRI. The videos were transcribed verbatim into simple transcripts: literally, with punctuation, pauses, continuers (e.g. hm, yeah), and turn taking, but without intonation or non-verbal behaviour. In each transcript, a speaker received his/her own paragraph and a blank line was used between speakers. Speech turn taking was used as a segmentation criterion, because it fits with the natural course of the conversation (Chi, 1997).

SRI episodes. Each interview transcript consisted of several SRI episodes. In these episodes, teachers addressed their in-the-moment decisions, and students addressed their perceptions. Each SRI episode started with the moment the video was stopped, and the interview started. Each SRI episode ended when the video of the supervision meeting (the stimulus) was restarted. These SRI episodes were considered as the units of analysis during the coding of the in-the-moment decisions and teaching actions, and students' perceptions.

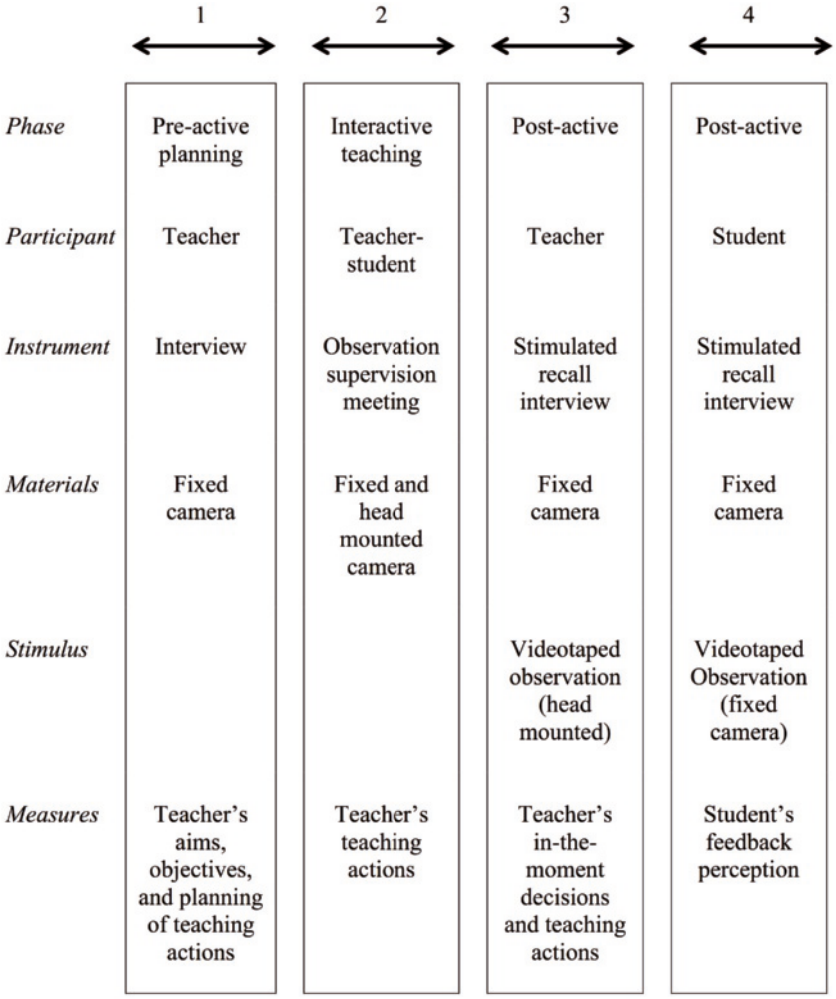

Figure 5.4. The four phases of the data collection.

Data analysis

In-the-moment decisions and teaching actions. The transcripts of the videotaped SRIs consisted of extended text over many pages – not easy to see as a whole. They also included sequential information that made it difficult to look at two variables (e.g. in-the-moment decisions and teaching actions) at once or across cases. To overcome these issues, we imported all transcripts into the qualitative data analysis software (QDAS) program NVivo® (QSR International Pty Ltd., Version 11, 2016).

Deductive content analysis. As we used a relatively structured interview guide with little additional questioning beyond what was specified beforehand, we applied a deductive content analysis (Boeije, 2010). An in-the-moment decision coding system and a teaching action coding system were created (see Appendix L). This coding system was based on the classification schemes of Rich and Hannafin (2008), Johnson (1992), and Richards (1998). This frame of analysis had already been developed in our introduction and we were looking specifically in our data for the teachers' in-the-moment decisions and teaching actions. Ninety SRI episodes were coded with an in-the-moment decision code and a teacher's action code. Each in-the-moment decision and teaching action was coded independently in order to classify the underlying in-the-moment decisions guiding specific teaching actions. The transcript part of the supervision meeting also helped us to code a teaching action when teachers did not address their teaching action explicitly during the interview. When two different teaching actions were addressed by the interviewee within one SRI episode, this episode was segmented into two units, which were separately coded with two different in-the-moment decisions and teaching actions.

Cross-case analysis. A cross-case analysis was carried out with the QDAS of NVivo® to determine the decisions and actions across all seven teachers. A matrix query was run in NVivo®, in which specific pairs of actions and decisions for all SRI episodes were identified. To analyse the data, we applied a combination of a *variable-oriented* strategy and a *case-oriented* strategy. First, the decision-action connections were presented in a predictor-outcome matrix (Miles & Huberman, 1994). The predictor-outcome matrix sorted the cases (the seven teachers) by degrees of the in-the moment decisions being studied, and the outcome of the teaching actions as a result of this. With the variable-oriented strategy the most frequently coded in-the-moment decisions were determined. Second, we aimed to increase our understanding of the meaning of the in-the-moment decisions. With the case-oriented strategy, we selected several exemplary cases from the most frequently coded decisions in our interview data. These decisions were described in detail, and illustrated with an exemplar from the interview transcripts.

Between-case analysis. Then, a between-case analysis was carried out to gain more insight into the different decision-action connections among the seven teachers. We determined connection patterns among teachers, focusing on the decision-action connections that were coded three times or more in the cross-case analysis. To measure the connection between decisions and actions we created connection nodes in NVivo®. We defined the connection between an in-the-moment decision and a teaching action as a one-way connection with a definite direction: an in-the-moment decision evoked a teacher's teaching action. For example, when a teacher wanted students to increase understanding, he decided to give feedback. All SRI episodes were coded with a decision-action connection code in the same way as the deductive analysis was performed. Again a matrix query was run in NVivo®, in which specific connections of actions and decisions among the seven teachers were identified. These connections were presented in a case-ordered descriptive matrix (Miles & Huberman, 1994).

Techers' aims and planning teaching actions. The transcripts of the videotaped pre-active interviews were also imported into the QDAS program NVivo®. A deductive coding analysis was carried out on the aims and planning of teaching actions with the same in-the-moment decision coding system and teaching action coding system (see Appendix L). In the case-ordered descriptive matrix of the between-case analysis, we determined for our seven teachers which in-the-moment decisions were already aimed for, and which teaching actions were already planned. These intended decisions and planned actions were described.

Students' perception of teaching actions. First, each SRI episode was coded for a positive perception, a negative perception, or as miscellaneous. Then we performed a conventional content analysis on each positive and negative perception; the coding categories were derived directly and inductively from the transcript data (Hsieh & Shannon, 2005). A student perception coding system was created (see Appendix M). A cross-case analysis was carried out with the QDAS of NVivo® to determine the student perceptions for the six students. A matrix query was run in NVivo®, in which the specific perceptions for each student were identified. These perceptions were presented in a case-ordered descriptive matrix (Miles & Huberman, 1994). The case-ordered descriptive matrix sorted the cases (the six students) by degrees of the perceptions being studied. To increase our understanding of the meaning of students' perceptions, we selected several exemplary cases from our coded interview data (Miles & Huberman, 1994). The most frequently coded perceptions as depicted in the case-ordered matrix were described in detail, and illustrated with an exemplar from the interview transcripts.

Audit trail. To ensure the quality of this study, an audit trail was created (Akkerman, Admiraal, Brekelmans, & Oost, 2008). The object of this validation procedure was focused on all the steps of the data gathering and analysis. The auditor verified the research design, the procedure for data gathering and data analysis according to three criteria: visibility, comprehensibility, and acceptability. The first author prepared the procedure and presented all the findings to the auditor, accompanied by a justification of all decisions made. The second author acted as the auditor and conducted a summative audit. This type of audit meant the judgment of the auditor could not be used to improve the study, but merely aimed at validating the results that were reported (de Kleijn & Van Leeuwen, 2018). The auditor reported on the strengths and limitations and gave input to realize a more transparent method section. The audit report can be found in Appendix N.

5.3 Results

In-the-moment decisions and teaching actions

The teachers stopped the replayed videos 97 times during the SRIs. These SRI episodes were coded for a teaching action and in-the-moment decision. Eight times a teaching action was coded with a non-verbal teaching code; teachers reported teaching actions such as nodding, observing, or writing down. Twelve times a teaching action was coded as miscellaneous; teachers reported on non-relevant topics, or gave a reflection on their own behaviour as shown in the video instead of determining an in-the-moment decision. As we were interested in teaching actions that gave opportunities for teacher-student interactions, these non-verbal and miscellaneous coded teaching actions were not used, and 77 SRI episodes remained for further analysis.

Deductive content analysis. Coding results showed that the seven teachers made six main in-the-moment decisions: empowerment, encouragement, involvement, social needs, understanding, and instructional management. The instructional management decision had four subcategories: checking student understanding, gathering information, initiating new topic, and planning next step. The social needs decision had three subcategories: emotion, expectation, and motivation. Teachers reported five main teaching actions that resulted from these decisions: asking questions, eliciting input, explaining, giving feedback, and instructing.

Cross-case analysis with exemplars. The decision-action connections were determined by running a matrix query, which resulted in a case-ordered effect matrix (see Appendix O). In total, 95 decision-action connections were coded, and 26 different types. With the variable-oriented approach, the matrix showed some clear connection patterns between the in-the-moment decisions and teaching actions. The in-the-moment decisions of encouragement, involvement, and initiating new topics were evidently coded less often than others. Based on the frequency of coding, we chose to describe and illustrate six in-the-moment decisions: the decision of empowerment, checking student understanding, gathering information, planning next step, social needs, and increasing student understanding. With the case-oriented approach, we provide exemplars from the interview data to illustrate these main in-the-moment decisions and how they are related to the teaching actions.

Empowering students. Teachers made in-the-moment decisions to *empower* students; these teachers gave opportunities to their students to express and share the arguments for the choices they made. Teachers allowed their students to ask some questions about difficulties they encountered.

> *I am not satisfied with her (student) answer; she is giving a solution, but I would like to hear her framing the problem first, that's why I am asking her some more questions to come up with that.* (Mel T4; episode 8, minute 21.07)

To empower these students, teachers asked their students questions about their own ideas; they elicited them to argue, or elicited them to ask their own questions. The result of teacher's empowerment was not always aligned with the teacher's intention of the meeting.

> *I tended to lead our conversation somewhat, but that's not what I want, I want the student to do the work, that's why I ask if they have any questions. And when I do, they (students) ask me about their time schedule… well that's not interesting at all in my opinion, I want to talk about their research aim, and their research questions.* (Emilia T2; episode 6; minute 21.25)

Checking student understanding. Teachers made in-the-moment decisions to *check student understanding*, based on the students' responses. The teachers perceived and interpreted student understanding; before giving any explanation or feedback, the teachers asked some questions or elicited input from the students.

> *See, I am doing it, I am checking verbally which mind switch they made last week…I am really testing my gut feeling; am I interpreting your non-verbal reaction in the right way, and what have you been adjusting?* (Emilia T2; episode 3; minute 08:13)

The students' answers provided new information, and the teachers obtained confirmation (or not) of their perception and interpretation of the students' understanding.

Gathering information. Teachers checked student understanding, but also made in-the-moment decisions to gather more information from the students. They needed more information and asked students questions or elicited input.

> *I am really interested in the reasons why they did this, but I need some more information before I say anything about it…I am getting all kinds of thoughts, but the funny thing is, a bit later it seems not relevant anymore, because they are not going to do anything with it.* (Farrah T6; episode 3; minute 14:36)

Planning next step. Teachers made the decision to plan a next step. Planning the next step could, for example, mean the teacher was making deliberate choices on which feedback parts to elaborate further, and which parts to skip because they were less relevant.

I have got some negative feedback to discuss with the student. I already gave some positive feedback, and I don't want to recall all the negative parts, thus I am really trying in my head to focus on what I shall discuss with the student, and what the student can read, what I need to address now. (Sandra T5; episode 13; minute 38:01)

In this example, the teacher just instructed the student which topic to focus on or not; sometimes it was more of a shared decision. Planning a next step could also mean that the teacher perceived a topic that could be discussed at that moment, but instead the teacher deliberately focused on other topics first.

I am writing the frustration down, to discuss it as a topic later on…but I wanted to wait for that discussion, after we talked about the content of the dissertation…in my opinion it doesn't make sense to deepen this frustration…I first wanted to stress the positive parts of the research to the student. (Sandra T5; episode 3; minute 10.09)

This did not mean this topic was ignored, but the teacher planned that the topic would be discussed later during the same meeting.

Increasing student understanding. Teachers made the in-the-moment decision to *increase student understanding.* Teachers focused on students' pitfalls, mistakes, and misunderstandings and tried to increase student understanding. In this example, the teacher is giving an explanation to increase student understanding.

I am giving the student an explanation because I could see she has not understood it completely yet; the student has her own ideas, my explanation gives her a new perspective, and because of that she is thinking about this new idea I proposed to her that she did not think about before. (Thelma T1; episode 4; minute 19:21)

Teachers decided to increase understanding by giving explanations or feedback, or asked questions to increase understanding. This strategy stimulated students to present arguments, and in that way increased their own understanding of the subject.

I just asked this open-ended question…and the students proactively gave arguments as to why they chose a quantitative method of data gathering, and they share quite a lot of opinions…I think, well, just making these choices is really good for their research project. (Farrah T6; episode 8; minute 38:53).

Social needs. Teachers made the decision to pay attention to students' social needs, to their emotions, expectations, or motivation. They paid attention to students' social needs mainly at the beginning of their conversation.

I am asking the student if they were in a rush while writing their discussion section…with that question I am trying to figure out if they gave more time to some parts than to others, and if those parts are the ones they would like to receive feedback on. (Cagney T7; episode1; minute 03:45)

The decision to pay attention to these social needs is often made based on meetings in the past – moments when certain emotions were discussed, motivation dropped, or expectations were partly met.

Between-case analysis. For the between-case analysis, we selected from the 26 coded decision-action connections of the cross-case analysis, the connections that were coded three times or more. A case-ordered descriptive matrix was run in NVivo®, resulting in 75 decision-action connections distributed among the seven teachers (see Appendix P).

Intended in-the-moment decisions and planned teaching actions

The pre-active interviews were coded on the planning of teaching actions and on teachers' aims. Thirteen decision-action connections were coded in the pre-active interviews. In the between-case ordered matrix, the teaching actions that were already planned and teacher decisions already aimed for were determined. Six of the 13 decision-action connections were already aimed at/planned for. Three teachers aimed to check student understanding by asking them questions or eliciting input from them. Two teachers aimed to increase student understanding by giving them feedback, and one teacher aimed to empower students by asking them questions. Thirty-six decision-action connections were not aimed at or planned for.

Students' perceptions of teaching actions

The six students stopped the replayed videos 76 times during the stimulated recall interviews. These SRI episodes were first coded with a positive perception (n = 43), a negative perception (n = 15), or as miscellaneous (n = 18). The coding was miscellaneous when the students did not describe their perceptions, but rather reflected on their own behaviour, or described other irrelevant topics.

Inductive content analysis with exemplars. Coding results showed eight positive perceptions: increase of understanding; stimulus to think; student control; personal attention; trigger to investigate; teacher understanding; shared understanding; and timing of feedback (see Appendix Q). Four negative perceptions were found: poor quality of teacher support; shared misunderstanding; teacher misunderstanding; and insufficient teacher control. Three students described only positive perceptions (Kim S4, Melissa S5, and Lacey S7); and the other three students only negative ones (Rory S3, Jaclyn S6a, and Kate S6b). Based on the frequency of coding, we chose to describe and illustrate six student perceptions in more detail.

Increase of understanding. Students perceived an increase of their own understanding. These perceptions were positive as a result of the teachers who gave feedback and explanations.

> *Well, I like it that she (teacher) is saying the text has to be written down more specifically, but also that she is giving examples of where in the text (in the dissertation) it should be more specific, or is not specific yet.* (Lacey S7; episode 7; min 19:50)

When the teacher gave an explanation, especially with the help of examples, this seemed to provoke positive student perceptions among different students.

> *She (the teacher) is explaining it very clearly and it is really helpful…she is giving some examples that are clarifying…and it is really making you think, where we should pay some more attention.* (Kim S4; episode 13; min 27:09)

It was not only teacher feedback and explanations that caused students to have positive perceptions, students also perceived an increase of student understanding due to the teacher's questioning.

Stimulus to think. Students also had positive perceptions when they were stimulated to think for themselves. Teachers provided this stimulus with questions, which prompted students to come up with an answer themselves.

She is just asking again and again, to let me think about why…what do you want to accomplish, what is the problem, what is the dilemma you are working on…just to get a clearer picture of what we are aiming for….I like it this way as it is making you think just in another direction than you did before. (Kim S4; episode 7; min 14:06)

Student control. Students also reported positive perceptions on receiving student control as a consequence of teacher questioning. The students described this perceived student control as getting space to argue, receiving the opportunity to share their opinion, or no need to be taken by the hand.

Yes, she is actually…asking me about what has been going well the last few weeks, she is asking about the feedback I have been taking up, and she is asking me what parts I am unsure of…thus she is giving me space to point out what my troubles are, what I am unsure of, but also what is going well. (Melissa S5; episode 3; min 14:52)

Personal attention. Students had a positive perceived personal attention. Often the teachers asked questions like "how are you doing today?", or "how are you feeling?" With these questions teachers paid attention to students' emotions, motivation, or expectations.

Well…I think it is quite logical that she (teacher) is asking about it. She wants to know what we think of it, and what we expect to get feedback on. (Lacey S7; episode 1; min 2.11)

Poor quality teacher support. Students had negative perceptions when teacher support was reported to be of poor quality. The students reported poor quality when teacher feedback or explanations were unclear, unhelpful, or not easy to understand.

I am trying to justify the choices we have made to receive more clarity, but instead she (the teacher) comes along with our arguments and I am completely lost as a result of it (min 39:21)… *(the feedback) does not have much value as I do not understand it…I do believe feedback is very important, but I am not sure what to do with it.* (Kate S6a; episode 12; min 42:51)

Shared misunderstanding. Students reported negative perceptions when they experienced a misunderstanding between the teacher and themselves: for example, when the teacher and the student both give an explanation with arguments, but they do not understand each other.

I think it is kind of weird that they (an introduction and the theoretical framework) are the same (min 24:43)…*she (the teacher) is doing the same as I am, giving the same arguments in exactly the opposite way* (min 25:22)…*she does understand me, I do understand her, but there is something we do not share in our understanding.* (Rory S3; episode 7; min 25:55)

5.4 Discussion

In-the-moment decisions and teaching actions

Our first research question addressed the question "What different types of in-the-moment decisions do research supervisors report, and how are they connected to teaching actions"? The six different decisions extracted from our teacher data have opened the black box of research supervisors' interactive thinking. Several of these decisions correspond to research findings on teachers' decision-making in other contexts and domains. The affective student-centred decision of empowerment, for example,

which was found for our teachers, corresponds to the decision to reinforce and to teaching students to think for themselves as coded by Tsang (2004), but then in the pre-service language teaching domain. The decision to check student understanding, found for our teachers, corresponds to the decision that teachers should know students' needs and problems, also found by Tsang (2004). And the decision of planning a next step fits the classroom management concerns pre-service teachers have when enforcing class rules, or easing teaching load as Rich and Hannafin (2008) found.

Rich and Hannafin (2008) categorized their teaching decisions into teacher-centred and student-centred decisions. Partly based on the distinction drawn by Rich and Hannafin (2008), we categorized our six teacher decisions into three different types of decisions: 1) affective student-centred decisions, like empowering students to argue for themselves, and paying attention to students' social needs; 2) cognitive student-centred decisions, like checking and increasing student understanding; and 3) cognitive teacher-centred decisions, like gathering information, and planning certain steps to focus on. Our teachers frequently reported that asking questions and eliciting input were the result of these three types of decisions. Teachers often made the in-the-moment decision to empower students, or check their understanding by asking questions and eliciting input. Thus teachers used teaching strategies that typify a form of indirect teacher regulation: teachers give students the opportunity to take control. These indirect regulation findings were partly unexpected as teachers often showed direct regulation with a lot of feedback and explanations during supervision meetings about research projects (Agricola, van der Schaaf, Prins, & Tartwijk van, Submitted). These teaching strategies in which teachers apply less direct regulation, and adapt their support to students' needs, fit the scaffolding principle of adaptive teaching (Rasku-Puttonen et al., 2003).

Already planned actions and intended decisions

Our second research question addressed the question "Which of the reported in-the-moment decisions were already aimed for, and which reported teaching actions were already planned"? During our stimulated recall teacher interviews many different teaching actions were addressed, and many in-the-moment decisions determined. Only six of the 42 decision-action connections were already aimed for/planned, as reported during teachers' pre-active interviews. Our teachers had some aims and plans, but needed to be flexible in the way they were attained through their teaching. It seems many new topics were raised during the meetings, and the discussions went into directions teachers did not plan. These findings fit the results that Westerman (1991) found for her expert teachers, who predicted possible problems and changed their lessons when they did not go as planned. Planning of teaching is a creative skill; experienced teachers do not follow a script, but search for good ideas and translate them into the classroom (Clark & Peterson, 1986). Novice teachers find it difficult to anticipate the ways in which their plans will unfold during teacher-student interactions (Malachowski, 1996).

Student perceptions

Our third research question addressed the question "How do students perceive teachers' teaching actions"? We answered this question with an inductive content analysis and the coding of students' perceptions. We described six perceptions in detail, and connected these perceptions to the teaching actions students referred to. Three students reported only negative perceptions. Their teachers used questioning and eliciting input to empower students, or to check understanding. But instead of a positive perceived student control, these students searched for clear guidance from their teachers, and had negative perceptions when this was not the case. These results fit the findings of Orsmond and Merry (2011): their teachers were only focused on misunderstanding and rarely addressed the development of students' learning. Their students searched for teacher guidance as well, and were only trying to identify what the teacher wanted.

Three other students reported only positive perceptions. These positive perceptions can be explained as being due to teachers' questioning, which created opportunities for students to experience autonomy and increase their responsibility (Reeve et al., 2012). When the teachers used the teaching action of asking questions, the students had several positive perceptions of receiving student control, personal attention, or a stimulus to think for themselves. These three perceptions correspond perfectly with the in-the-moment decisions our teachers made when they decided to empower students to pay attention to social needs, or to increase student understanding. Sometimes, when teachers empowered students and gave opportunities to students to ask their own questions, it did seem to comply with students' needs, but it also led to topic discussions, which were not always on the teacher's agenda. Our teachers did not have prescheduled agendas or scripts to follow, but rather improvised based on the students' questions and answers.

Limitations of stimulated recall

No single approach to studying teacher and student cognitions is free of problems. Yinger (1986) doubted the validity of stimulated recall: teachers would rationalize and make up explanations under pressure instead of accurately reporting their interactive thinking. Indeed, some of our participants had difficulties in reliving the meeting during the interview, and reflected on their own behavior instead. That is why in further analyses we did not focus on these reported actions, decisions, or perceptions. Yinger (1986) also argued that video as a stimulus during recall interviews presents a different and new perspective compared to during the teaching situation; and the interview questions can influence participants' thinking. In this study, we have minimized the time delay between teaching event and recall to a minimum, just as Gass and Mackey (2000) argued. With the interview questions and prompts, we tried not to alter the cognitive process being employed at the time of the teaching situation. We stimulated rather than presented new insights, allowed an unstructured response and implied an indirect route to the focus of the research just as Lyle (2003) proposed. The procedure we adopted in this study, in which the respondent has a greater role in selecting the stimulus, and verbalizing their thinking in a free and open-minded manner, is the commonly stimulated recall strategy used today (Borg, 2015). We used a head-mounted camera method that offered a powerful stimulus to the spontaneous recollection of decisions that were made during the recording and captured the participants' perspective as accurately as possible (Omodei et al., 2012; Pelaccia et al., 2014; Unsworth, 2005). The stimulus of the head-mounted camera decreased the self-awareness induced by viewing oneself in action that could lead to selective reporting.

Implications

Research on teacher thinking will not make teacher education easier, but it makes teacher preparation more interesting (Clark, 2005). It does not really answer questions about what novice teachers should be taught or deliver a description as to how they should be prepared. But it can provide examples of methods that teachers can practise and apply while interacting with their students. From our study it can be concluded that empowering students and paying attention to students' social needs, for example, can evoke positive student perceptions. But when this teaching strategy becomes a routine script that is applied to each student, adaptive teaching is not in place and students could get frustrated by teachers trying to give them control the whole time. Teachers should be flexible enough to shift from an indirect regulation strategy with lots of questions to a more direct regulation strategy with clear guidance and feedback when students need it. This flexibility should not only occur between different student meetings: adaptive teaching should be applied within each meeting. Teachers' planning of their lessons or research supervision meeting offers opportunities to be flexible; it is easier to adapt a prepared lesson plan than not having a lesson plan at all. Novice teachers in particular should learn how to plan, and what planning can and cannot achieve (Malachowski, 1996).

Future research

We have used a pre-active planning phase and an interactive teaching phase to explore the decision-making process of our teachers. In future studies, we would like to focus more on the reflective phase of Westerman (1991), in which teachers can be asked to evaluate and reflect on the quality of their teaching actions, their in-the-moment decisions, and their planning of teaching actions. When investigating teacher and student thinking, researchers depend on think-aloud protocols during the act, or retrospectively on stimulated recall procedures. In future studies we would like to ask teachers and students to think aloud about the same preselected teaching episodes. When the alignment between teachers' decisions, their actions, and students' perceptions is measured, we can determine the adaptiveness of teaching. Finally, we would like to conduct an intervention study in which teachers' professional development in applying adaptive teaching strategies is promoted. With a focus on student learning, teachers could experiment by asking questions to promote student control and provide stimuli to think for themselves.

Conclusion

The in-the-moment decisions our teachers made were merely student centred and had a strong focus on student learning. Many questions were asked to empower students or to increase their understanding. These teaching strategies often seemed to be adapted to students' needs; students had positive perceptions when student control increased, or when they were stimulated to think for themselves. A delicate balance was found, as the same teaching strategies led to negative student perceptions as well. These students experienced a lack of clear guidance and were not ready for empowerment yet. Teachers have to stay sensitive: before applying any intervention they first have to diagnose students' needs.

The development of research supervisors' pedagogical content knowledge in a lesson study project

This chapter is based on: Agricola, B.T., Van der Schaaf, M.F., Prins, F.J., Tartwijk, van, J. (*Submitted*). The development of research supervisors' pedagogical content knowledge in a lesson study project.

Acknowledgement of author contributions: BA, FP, MS, and JT designed the study; BA recruited participants constructed the instruments, collected the data, constructed the coding scheme, and analyzed the data; BA and MS drafted the manuscript, FP and JT contributed to critical revision of the paper, FP, MS, and JT supervised the study.

Abstract

In this study, we aimed to identify how the learning activities elicited in a lesson study project contributed to self-perceived change in supervisors' pedagogical content knowledge (PCK). Lesson study is a method which combines professional development and educational development. During a lesson study project, teachers collaborate in a team and develop, teach, evaluate, and redesign a research lesson. During the 4-month lesson study project described here, four supervisors designed a protocol for research supervision meetings aimed at enhancing undergraduate students' learning. During the project, they experimented with open questioning and giving positive feedback instead of giving instruction and explanations. A mixed-methods design was used in this study. Data on the supervisors' learning activities and PCK were gathered using learner reports, video-recordings of meetings, and exit interviews. The analyses of these data showed that the lesson study project contributed to the development of the supervisors' PCK on instructional strategies and student understanding. The learning activity that contributed most to these changes was reflecting on their own practice and that of their students.

6.1 Introduction

What research supervisors tend to do most when interacting with their students during research supervision, is intervene (Agricola et al., 2018). Diagnosing students' research skills and being able to supervise them adequately when interacting with them, demands specific supervisor knowledge. In this study, we examined how a lesson study project helped supervisors to develop such knowledge. We focused in particular on supervisors' pedagogical content knowledge (PCK).

Lesson study is a method for professional development in which teachers who want to improve aspects of the learning of their students collaborate in a team (Dudley, 2013). In a lesson study project, they develop, teach, and observe a research lesson and examine its impact on student learning (Lewis & Hurd, 2011; Stepanek et al., 2006). When designing the research lesson, they are guided by a research theme. One team member teaches the research lesson while the others observe and collect data on student learning (Stepanek et al., 2006). After evaluating and adjusting the research lesson, another team member teaches the adjusted lesson (Verhoef, Tall, Coenders, & Van Smaalen, 2014). In general, teachers appreciate such a cyclical lesson study project, because they control the process and can adapt it to their own situation, because they examine teaching and learning issues that matter to them, and because the results can be directly applied in their own practice (Cerbin & Kopp, 2006). The observation and focus on student learning in lesson study is the key to teachers' development (Cajkler, Wood, Norton, & Pedder, 2014). Lesson study can help teachers to develop the knowledge which they need to teach students (Lewis & Hurd, 2011).

As early as in 1987, Shulman proposed categories of teacher knowledge. He distinguished between content knowledge, general pedagogical knowledge, curricular knowledge, knowledge of learners, of educational contexts, of educational goals, and pedagogical content knowledge. He described teachers' pedagogical content knowledge (PCK) as "that special amalgam of content and pedagogy that is uniquely the province of teachers" (p. 8). Later Magnusson, Krajcik and Borko (1999) distinguished five components of science teachers' PCK. The first component they distinguish is science *teachers' orientations* toward teaching science. This component pertains to the knowledge and beliefs about the purposes and goals for teaching science at a particular grade level (p.97). The second component is named *knowledge of the science curriculum*. This is the knowledge about goals and objectives of the curriculum, as well as specific curricular materials. The third component is science teachers' *knowledge of students' understanding* of science. Magnusson et al. describe this as knowledge and beliefs

about prerequisite knowledge for learning specific scientific knowledge, as well as their understanding of variations in students' approaches to learning as they relate to the development of knowledge within specific topic areas. *Knowledge of assessment* is the fourth component. This component refers to knowledge about what is important to assess and about the methods to do this. The fifth and last component is *knowledge of instructional strategies*. This component pertains the strategies which are useful to help students comprehend specific research concepts and develop specific skills.

A model that is useful to analyze how teachers' knowledge grows, is Clarke and Hollingsworth's (2002) Interconnected Model of Professional Growth (IMPG). The IMPG represents the teachers' professional world with four different domains: *the personal domain (PD)* with teachers' knowledge, beliefs and attitudes; *the domain of practice (DP)* with teacher's experimentation; *the domain of consequences (DC)* with consequences of teacher's actions for student learning; and *the external domain (ED)* with sources of information like scientific articles or a training (see Figure 6.1).

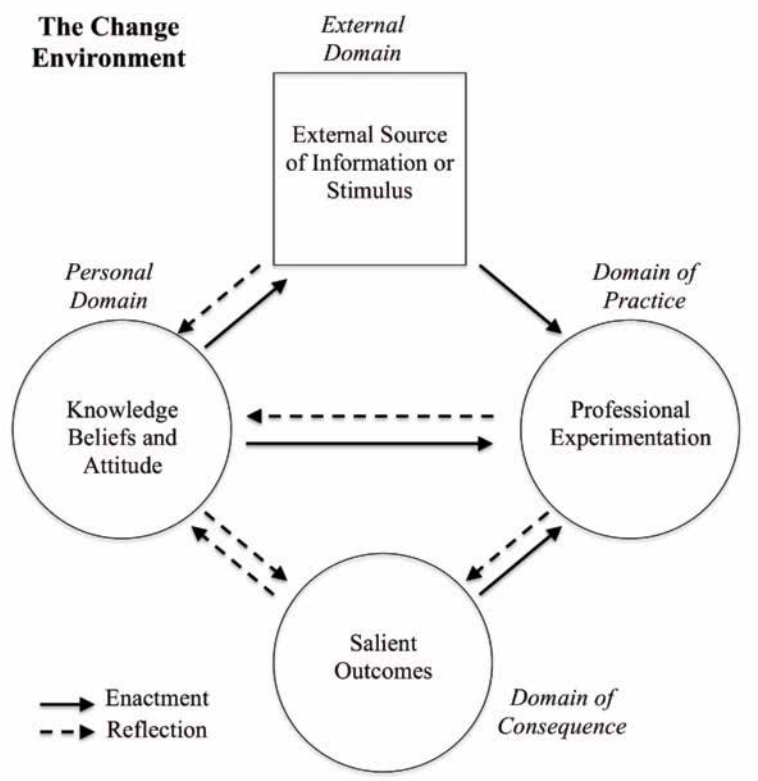

Figure 6.1. The Interconnected Model of Professional Growth (Clarke & Hollingsworth, 2002).

The IMPG can be helpful for analyzing research data specific to each of the four domains, and is also helpful for the identification of patterns in teacher professional growth (Zwart, Wubbels, Bergen, & Bolhuis, 2007). According to Clarke and Hollingsworth (2002) when learning happens in one domain, it is often translated to another domain through the mediating processes of enactment and reflection. Enactment is for example the translation process from something the teacher knows, believes, or experienced, to teacher's action in the domain of practice. Reflection is for example the translation process from an active and careful consideration of teacher's action in the domain of practice to the

gained knowledge in the personal domain. As a result, enactment can lead to a change in behavior, and reflection to a change in cognition. Based on these different translation processes, a pathway of change can be constructed within the IMPG to illustrate teacher learning. Clarke and Hollingsworth (2002) defined a pathway of change that existed of one or two translations between domains as a *change sequence*; these knowledge changes were considered as straightforward and superficial. They defined pathways of change with multiple change sequences (> 2) that last over time as a *growth network*; these knowledge changes were considered complex and lasting. Researchers have used the translation processes of the IMPG to describe secondary school teachers' professional development as a result of for instance a peer coaching trajectory (Zwart et al., 2007), a one-year post-graduate teacher education program (Justi & van Driel, 2006), a one-year action research project (Wongsopawiro, Zwart, & van Driel, 2017), and a lesson study project (Schipper, Goei, de Vries, & van Veen, 2017).

Present study

In higher education, supervisors and students often have supervision meetings during the writing of their undergraduate thesis. These meetings offer opportunities for supervisor-student interactions; supervisors can gather information about and diagnose students' understanding (Agricola et al., 2018). Supervisors can intervene with feedback, and students can ask questions to verify the feedback. For supervisors' feedback to be adaptive to students' needs, research supervisors need to diagnose students' research skills (de Kleijn et al., 2015). Supervisors need to learn how a diagnostic conversation can be held. Following Bakkenes and her colleagues, we define supervisors' learning as "…an active process in which teachers engage in learning activities that lead to changes in knowledge and beliefs (cognition) and/or teaching practices (behavior)" (Bakkenes et al. 2010, p.536). Bakkenes et al. (2010) distinguished several *learning activities* which can lead to teacher learning. A lesson study approach gives supervisors the opportunities to engage in these learning activities. Depaepe, Verschaffel, and Kelchtermans (2013) argued to investigate teachers' PCK in the context in which the knowledge is used or discussed, e.g. during student-teacher interactions or teacher discussions. We addressed the following research question: How does a lesson study approach stimulate the development of teachers' PCK in students' research supervision?

6.2 Method

Participants and context

Lesson study teams are self-directed and require teachers (in our study supervisors) who want to learn together, to observe each other, and to teach in front of peers (Stepanek et al., 2006). The lesson study team consisted of five members, the facilitator and the four teachers who agreed to participate; they worked at the same Dutch university. The teachers supervised their students in their final year, and students worked in pairs and wrote their undergraduate thesis in the academic year 2016/2017. The participating teachers and their students were all female; this was representative for the number of women teaching and attending this bachelor of health program (see Table 6.1). The students who were involved in the study were all female and nearly the same age (S1: 21 years; S2: 22 years; S3: 23 years). Teachers and students signed informed consent forms for observation and data gathering.

Table 6.1. Characteristics of participating teachers

Participant	Id	Alias	Age (years)	Education	Supervising (years)
Teachers (T)	T1	Carrie	49	MSc	2
	T2	Samantha	34	MSc	9
	T3	Charlotte	46	PhD	7
	T4	Miranda	37	MSc	7
Facilitator (F)	F	John James	42	MSc	5

Lesson study intervention

As suggested by Stepanek et al. (2006), we used four phases when planning one lesson study cycle (see Figure 6.2): (1) the preparation phase, (2) the teaching and observation phase, (3) the discussion phase, and (4) the evaluation phase (Stepanek et al., 2006; Verhoef & Goei, 2015 August; P. Wood & Cajkler, 2016). In total three lesson study cycles were completed. During these cycles several instruments and materials were used and developed by the participants.

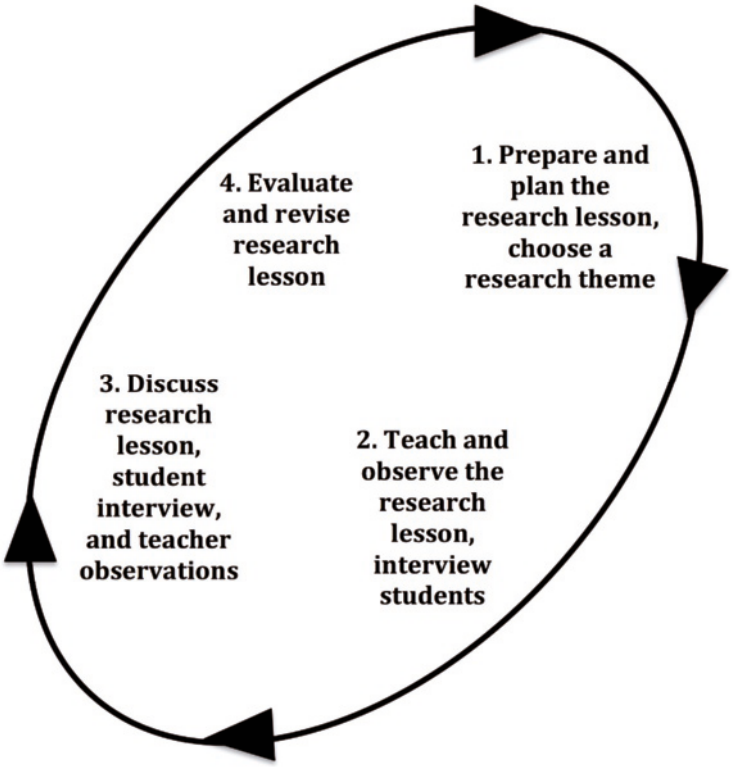

Figure 6.2. The Lesson study cycle adapted from Stepanek et al. (2006).

Measures of PCK and learning activities

Data on supervisors' PCK and learning activities were gathered using nine videotaped observations of the lesson study group meetings; four learning reports per supervisor; and an exit interview per supervisor. See Table 6.2 for an overview of all gathered data.

Table 6.2 Overview of data gathering during lesson study phases

	LS Phase	Meeting	LS instrument	Measures	T1	T2	T3	T4
Cycle 1 March-May	Preparation	LS meeting 1	Discrepancy analysis					
		LS meeting 2	CIMO logic	Video observation 1				
				Learning report 1				
		LS meeting 3	LS preparation form	Video observation 2				
				Learning report 2				
		LS meeting 4	LS preparation form	Video observation 3				A
	Teach and observe	Research lesson	Observation form					
	Discussion	Teacher-student	Student interview					
	Evaluation	LS meeting 5	LS preparation form	Video recording 4				
				Learning report 3				
		LS meeting 6	CIMO logic	Video observation 5				A
Cycle 2 May-June	Preparation	LS meeting 7	LS preparation form	Video observation 6				A
	Teach and observe	Research lesson	Observation form					
	Discussion	Teacher-student	Student interview					
	Evaluation	LS meeting 8	LS preparation form	Video observation 7				A
				Learning report 4				N
Cycle 3 June- July	Preparation	LS meeting 9	LS preparation form	Video observation 8		A		
	Teach and observe	Research lesson	Observation form					
	Discussion	Teacher-student	Student interview					
	Evaluation	LS meeting 10		Video observation 9		A		
				Teacher interview				

Note. LS= Lesson Study; T = teacher; A = absent at LS meeting; N = learning report was not handed in

Videotaped observations of lesson study meetings. Nine preparation, discussion, and evaluation meetings were selected for a videotaped observation. The first lesson study meeting was not used for analysis as this meeting functioned as an instruction in which the facilitator presented and explained to the participants about the lesson study approach. During the lesson study meetings, the supervisors expressed and shared their PCK changes as statements of changed cognitions, beliefs, or practices, and their corresponding learning activities.

Learning report. A learning report was used, in which the supervisors were asked to describe a self-chosen learning experience with the help of four questions. The learning report was based on an existing learning report used to measure student teachers' learning and their learning experiences (Endedijk, Brekelmans, Verloop, Sleegers, & Vermunt, 2014). The first question focused on the supervisors' PCK change: 1) "What did you learn in the field of research supervision, what are your three most important insights?" In the second question, they were asked about their learning activities: 2) "How did you learn this, for example, in which way, from whom, where, and when?" And finally they were asked about the consequences for their practice: 3) "What consequences does this learning experience have for your own research supervision?," and about 4) "What consequences does this learning experience have for the students you supervise?" Participating supervisors were asked to fill in this learning report four times during the lesson study process.

Teacher interview. The first author interviewed every participating teacher at the end of the lesson study process. The interview guide was based on the open-ended questions of the learning reports. The interviewer asked some more specific questions, with input from the supervisor's answers in the learning reports.

Procedure and materials of the lesson study approach

Preparation phase. During the first preparation meeting, the supervisors conducted a discrepancy analysis (Stepanek et al., 2006). The supervisors brainstormed about a list of characteristics that an ideal student would be able to demonstrate during a supervision meeting: a student who pro-actively asked questions, took up responsibility, and took up their feedback. Then, the supervisors identified the characteristics for where students actual were: often a passive learner with roughly the opposite characteristics as the ideal one. The discussion about the ideal and actual student resulted in new student and teacher insights and input for the research theme: a lot of students did not show the desired behavior, and the supervisors concluded that a reason for this was that they did not stimulate this behavior. The discrepancy analysis resulted in a case student to focus on during the design of the research lesson (see Table 6.3).

Table 6.3 Results of combined supervisors' discrepancy analyses: Ideal student versus actual student

The ideal student	The actual student	Research theme
Is cooperative	Is insecure about choices made	Substantiate student choices
Communicates about his progress	Asks for confirmation	Stimulate student independence
Substantiates his choices	Is anxious to make mistakes	Stimulate student responsibility
Searches for information himself	Demands clearness and structure	Give space to make mistakes
Asks for help and feedback	Wants everything to be instructed	Stimulate proactive behaviour
Challenges his supervisor	Complies to assessment criteria	Stimulate autonomy
Is proactive and takes initiative	Has trouble finding information	
Takes up feedback	Overestimates his own ability	
Is critical of himself	Has trouble to start independently	
Initiates new ideas	Forgets prior knowledge	
Asks questions	Waits and sees what happens	

CIMO logic. The participating supervisors used the Context Intervention Mechanism Outcome (CIMO) logic when designing the research lesson. Using the CIMO logic is preferred as it does not only specify the proposed Intervention and the desired Outcome; it also specifies the Context of the design, just as the Mechanism by which the outcome is achieved (Denyer, Tranfield, & Van Aken, 2008). Specifying the design mechanism within the CIMO logic helps to understand how and why the intervention worked (Bronkhorst, Meijer, Koster, & Vermunt, 2011). The participating supervisors applied the CIMO logic during cycle one, and after evaluation of the research lesson adapted the CIMO logic for cycle two and three (see Table 6.4). Based on the CIMO logic, supervisors chose a lesson study topic they wanted to investigate and aimed to answer questions such as: does supervisor questioning have a positive impact on student's pro-actively arguing, and on student's self-understanding of their research skills?

Table 6.4 Results of CIMO logic applied by research supervisors during lesson study cycles 1 and 2

	Lesson study Cycle 1	**Lesson study Cycle 2**
Context	Supervisor-student meeting about student's research skills needed for conducting research project and writing of undergraduate thesis	The same context as cycle 1.
Intervention	Asking open questions and using prompts	Asking questions and using prompts alternated with positive feedback.
Mechanism	By using open questions and prompts the student will have to substantiate, argue, and consider the choices he made. Student's own answers, arguments, and thoughts will give the student new insights and will give the student opportunities to take responsibility and have a feeling of independency.	By using positive feedback the student will experience confirmation and trust. From the basis of confirmation and trust, it will be easier for him to think about improvements when the supervisor asks him to.
Outcome	Utterances of new insights can be observed, e.g. "Now I understand…". The extent of independency can be measured by observing student's answers to the questions asked. Active behaviour can be observed during the meeting as well.	Feelings of confirmation and trust are hard to observe, but can be verbally observed with utterances, e.g. "I am glad to hear…" And again, non-verbal active behaviour and happy facial expressions can be observed.

Literature. The facilitator selected some literature for the participants. An article about 'promoting students' research self-efficacy' (Overall et al., 2011) and an article about 'adaptive teaching' (Van de Pol et al., 2011) were sent as sources of inspiration for selecting a research topic. One article about 'instructional dialogues' (Ruiz-Primo, 2011), and two articles about 'one-to-one tutoring' (Chi et al., 2001; Graesser et al., 1995) were sent as inspiration for possible interventions that could be used in the research lesson.

Design of research lesson. The supervisors designed the research lesson in which the new approach (questioning) was implemented. During the design of the research lesson the supervisors kept the case student in mind just as Dudley (2013) argued. Supervisors constructed a lesson preparation form for the research lesson (see Appendix R), an observation form to evaluate student learning (see Appendix S), and a small interview guide to evaluate student's perception of the intervention (see Appendix T). The supervisors decided which supervisor would teach the research lesson, which case student typified the passive learner and would be invited for the research lesson, and which supervisor would interview the student.

Teaching and observation phase. The *teaching and observation* phase existed of the research lesson in which one of the supervisors was having the supervision meeting with the selected case student while the others observed the meeting and made notes with a focus on student learning (Dudley, 2013; Saito, Hawe, Hadiprawiroc, & Empedhe, 2008). Next to the room in which the research lesson was delivered, the other three supervisors and the lesson study facilitator were sitting in the observation room. A one-way screen divided these two rooms. A microphone was placed in the research lesson room, and a speaker in the observation room. The observers observed and listened to the research lesson without disturbing the supervisor and student. The research lesson was videotaped. After the research lesson, one of the observers held an interview with the student using the interview protocol to evaluate student's learning experience of the experiment.

Discussion phase. The *discussion* phase existed of analyzing and discussing the research lesson: the teacher observations were examined, as well the student interview and the experiences of implementing the research lesson (Demir, Sutton-Brown, & Czerniak, 2012). Within this phase, all teachers had to focus on their own observations compared to what they predicted, on the way students learned and the effect of teaching on students' learning, and how this could be improved next time.

Evaluation phase. The *evaluation* phase existed of a revision of the research lesson based on the teacher observations and the student interview of the discussion phase. These data were used to make changes to the research lesson. Supervisors changed their instructional approach; they added positive feedback to the questioning strategy, leading to a new CIMO logic (see Table 6.4). During the second and third lesson study cycle, this new approach was implemented in new research lessons.

Data analysis

Transcripts. A research assistant transcribed all the nine videotaped observations and four interviews verbatim into simple transcripts. Videos were transcribed literally, with punctuation, pauses, continuers (e.g. hm, yeah) and turn taking, but without intonation or non-verbal behaviour. In each transcript, a speaker received his/her own paragraph. We imported all transcripts and the learning reports into the qualitative data analysis software program NVivo® (QSR International Pty Ltd., Version 11, 2016).

Indicators of change. First, to find which PCK components had changed we followed Wongsopawiro et al. (2017) and Zwart et al.(2007) and searched in our data for *indicators of change in teacher knowledge, practice or beliefs.* An indicator of change existed of a statement or utterance of the supervisor, as found in the learning reports, in the transcripts of the lesson study meetings, and in the transcripts of the exit interviews. Three different indicators of perceived change were coded: a statement was coded as an indicator of (1) *change in teacher knowledge* when the supervisor used one of the following utterances: e.g., I have learned; I know how; I understand why; I believe now that. A change in teacher practice was defined as a change in teacher's perceived or intentional behaviour (Wongsopawiro et al., 2017). We coded a statement as (2) *change in teacher practice* when the supervisor used one of the following utterances: e.g. Now I am doing; I used to do this but now I am doing that; I tend to do more; I am doing things differently now; I was surprised students liked it. Finally, we coded a statement as an indicator of (3) *change in teacher beliefs* when the supervisor used one of the utterances: e.g. I am confident in; I feel that I now can. The codes were used in the analyses.

PCK components. Second, following Wongsopawiro et al. (2017) and Justi and Van Driel (2006), we coded every indicator of teacher change as one of the five PCK components for research supervision, which were an adapted version of the components distinguished by Magnusson et al. (1999): (1) Supervisors' orientation to teaching research courses; this component implies supervisors' general

view about how they conceptualize research teaching. (2) Supervisors' knowledge of the research curriculum, including goals and objectives of the curriculum, as well as specific curricular materials. (3) Supervisors' knowledge of students' understanding of research; this refers to supervisors' knowledge about students' research skills, in order to help them develop these skills; and about which parts students find difficult. (4) Supervisors' knowledge of assessment of research skills; it concerns knowing which parts of the research skills are important to assess, as well as knowing which methods can be used to assess these research skills. (5) Supervisors' knowledge of instructional strategies; it is about knowing which specific strategies are useful to help students comprehend specific research concepts. Each PCK component was coded as fitting in the Personal Domain (PD) of the IMPG.

Learning activities. Third, to determine which learning activities were, according to the supervisors, underlying the changes in PCK components, we searched for the learning activities the supervisors reported in relation to this change. These learning activities were often reported just before or right after the indicator of change/PCK component. Building on the activities of Bakkenes et al. (2010) we distinguished five learning activities: (1) supervisors can experiment in the teaching activity itself and try out a new teaching method; (2) they can interact with and get ideas from others, by observing and discussing with colleagues, and reading articles; (3) they can consider their own practice, and (4) student practice; (5) and experience friction between what is expected and what happens. Each reported learning activity was coded on one of these five learning activities.

Each coded learning activity was then coded as belonging to one of the three other domains of the IMPG: to the External Domain (ED), when the teacher learned from other teachers during the lesson study meetings, or from reading literature; to the Domain of Practice (DP), when the teacher learned from reflecting on practice during the research lesson or during their own supervision practice; or to the Domain of Consequence (DC), when the teacher learned from reflecting on student learning or student functioning as a consequence of their acting.

Within our data we distinguished segments; a segment was defined as the coding of each PCK component with its learning activities. A new segment in the data occurred when a supervisor reported a new indicator of change and thus new PCK component. The PCK components were leading for the segmentation; sometimes the supervisors reported one or more learning activities before the specific PCK component was reported. In the lesson study observation data, more than one supervisor participated, and thus segmentation was also applied when another supervisor reported a new indicator of change (see Appendix U for the coding scheme of the coding procedure).

Translation processes. Fourth, the IMPG translation processes were coded. As each PCK component and corresponding learning activities were coded to one of IMPG domains, sequences were formed within each segment. Within these segments, we coded the IMPG translation processes as used by Justi and Van Driel (2006) and Wongsopawiro et al. (2017) (see Appendix V).

Pathways of change. Fifth, pathways of PCK change were analyzed. For each PCK component that was reported, we determined in which domain the entry point occurred. Entry points were considered as the start of each pathway. The chronological order in which the supervisor reported a PCK component or a learning activity, determined the entry point. Change sequences and growth networks emerged based on the sequences of one or more translation processes. Often our supervisors reported different learning activities for each PCK component, and several change sequences were reported within each segment. We considered pathways with multiple change sequences (> 2) as more complex changes and defined them as a *growth network*. We illustrated several growth networks with a pictorial representation. These representations were described in detail based on teacher utterances from our data.

Audit trail. To maintain and insure the quality of this study, an audit trail was carried out (Akkerman et al., 2008). The object of this validation procedure focused on all the steps of the data gathering and data analysis. The underlying question was whether the auditor could verify the research design, the

procedure of data gathering and data analysis according to three criteria: visibility (transparency), comprehensibility, and acceptability. The first author acted as auditee and prepared the procedure and presented all the findings to the auditor, accompanied with a justification of all decisions made. An independent junior researcher acted as the auditor and conducted a formative audit. This type of audit meant the formative judgment of the auditor could be used to improve the study (de Kleijn & Van Leeuwen, 2018). The audit report gave input to realize a more transparent method section, to adapt some steps in the analysis of data, and to describe some examples for the limitation paragraph in the discussion section (see Appendix W).

6.3 Results

Indicators of change

We coded 77 supervisor-reported indicators of change within our data, These indicators pertained to a change in their knowledge, practice or beliefs (see Table 6.5). Most indicators of change were reported as a change in teacher knowledge (64 times); several changes in teacher practice were reported (10 times); and some changes in teacher beliefs (2 times). An example of an indicator of change in teacher knowledge was: 'That's what I have learned, to stimulate students to figure out things themselves, to let them argue their work; I am trying to do that with open questions, but also when I am giving feedback on draft versions of their work' (Carrie; Exit interview).

Table 6.5 Frequencies and percentages of reported indicators of change, PCK components, and learning activities

	Carrie	Samantha	Charlotte	Miranda	Total	
	f	*f*	*f*	*f*	*f*	%
Indicator of change in						
Teacher knowledge	12	14	21	17	64	84.2
Teacher practice	2	1	5	2	10	13.2
Teacher attitude or beliefs	1	0	1	0	2	2.6
PCK component of						
Instructional strategies	10	10	17	12	49	64.5
Student understanding	3	5	9	8	25	32.9
Orientation to teaching	1	0	1	0	2	2.6
Assessment of research	0	0	0	0	0	0.0
Research curriculum	0	0	0	0	0	0.0
Learning activities						
Considering own practice	14	19	44	21	98	39.5
Considering student practice	13	14	36	25	88	35.5
Getting ideas from others	7	8	8	8	31	12.5
Experimenting	4	6	3	4	17	6.9
Experiencing friction	4	4	4	2	14	5.6

Note: % = percentage of total number of indicators of change / PCK components (n = 76) or learning activities (n = 248).

PCK components

Each of the seventy-seven indicators of change was coded as a PCK component. Within the adapted framework of Magnusson et al. (1999), our supervisors reported three of the five different PCK components (see Table 6.5): (1) Knowledge of instructional strategies, e.g. *'I have learned how quickly I am giving feedback'* (Samantha; Exit interview); (2) Knowledge of students' understanding of research, e.g. *'Students would like answers for all their questions, they want to know if they are on track'* (Charlotte; Learning report2): and (3) Orientation to teaching research skills, e.g., *'During the lesson study meeting, Charlotte said to me: I would do it in the exact same way as you did; such a confirmation is giving me confidence'* (Carrie; Exit interview). The PCK components of assessment and of curriculum were not reported by our supervisors.

Learning activities

All PCK components outcomes were connected to the learning activities that were reported by our supervisors within the data. Within the framework of Bakkenes et al. (2010), our supervisors reported five different types of learning activities (see Table 6.5): (1) Considering own practice, when supervisors reflected on their own teaching practice, e.g. *'I would like to stay alert on not giving instruction immediately, but first asking the student what they already know or have searched for, or what they think is the best option'* (Samantha; Learning report1); (2) Considering student practice, when supervisors reflected on student's learning or functioning e.g. *'Some students are really working independently, and searched for answers themselves'* (Carrie, Exit interview); (3) Getting ideas from others, when supervisors took notice of the views or practices of other supervisors e.g. *'I have learned from discussing and observing the supervision meeting of the research lesson'* (Charlotte; Learning report4); (4) Experimenting, when supervisors purposefully tried out a new teaching strategy or new approach in practice, e.g. *'Two students wanted to use a statistical test and I said to them: you first have to find out for yourselves, I can help you putting the data in the Statistical Package for the Social Sciences, but you really have to do it yourselves'* (Carrie; Exit interview); and (5) Experiencing friction, when supervisors experienced a completely unexpected event or realized their usual teaching approach did not work any longer e.g. *'This experiment did not go as planned, students were not happy and frustrated on the short term, but hopefully in the long run, they become more independent'* (Miranda; Learning report2).

Translation processes

We coded the PCK components and learning activities as belonging to one of the four domains of the IMPG. As a result, nine possible translation processes could be coded (cf. Figure 1). In total 207 IMPG translation processes were coded; the domain of practice was involved for 70.5% of the three most frequently coded translations (see Table 6.6).

Table 6.6 Frequencies of the nine IMPG translation processes between the four domains

		Carrie	Samantha	Charlotte	Miranda	Total	
		f	*f*	*f*	*f*	*f*	%
1. DP to DC	Reflection	8	11	27	14	58	29.0
2. PD to DP	Enactment	10	7	19	10	47	22.2
3. DC to DP	Enactment	4	6	19	11	40	19.3
4. ED to PD	Reflection	4	5	7	3	19	9.2
5. PD to DC	Reflection	3	4	6	7	19	9.7
6. DP to PD	Reflection	3	2	4	3	14	5.8
7. DC to PD	Reflection	0	2	3	2	6	3.4
8. PD to ED	Enactment	0	1	2	0	3	1.4
9. ED to DP	Enactment	0	0	0	0	0	0.0

Note: PD = personal domain; ED = external domain; DP = domain of practice; DC = domain of consequence; % = percentage of total number of translations (n=207)

Pathways of PCK change

Sixty-two pathways of PCK change were constructed for each supervisor, each data source, and each PCK component. Considering the PCK component, most pathways that were reported by our supervisors within the data were pathways for the PCK of Instructional strategies (37 times), and for the PCK of Student's understanding (22 times).

Within each data source, supervisors reported different entry points. Some supervisors first reported that they either changed their practice (12 times; entry point: domain of practice), or evaluated student outcomes (4 times; entry point: domain of consequence). Some reported they got new ideas from other supervisors or learned from reading literature (18 times; entry point: external domain). In most cases the entry point started within the personal domain (25 times); supervisors reported something they had learned.

Twenty-one change sequences were constructed; seven times with only one translation process, and fourteen times with two. We constructed forty-one growth networks with three or more processes; twenty-eight times a growth network existed of three processes; seven times of four processes; three times of five, one time of six, and two times of nine processes. In the next section we represent pictorials of four growth networks and on the PCK components of instructional strategies and student understanding.

Growth networks of PCK of instructional strategies

In Figure 6.3, two growth networks for the PCK of instructional strategies are represented. On the left, the growth network that was reported most frequently is represented. It had an entry point in the external domain, through the personal domain and domain of practice, and ended in the domain of consequence. Supervisors reported this pathway fourteen times, mostly in their learning reports. In Figure 6.3, this pathway is represented on the left and reported by Carrie during her second learning report. Carrie's PCK change originated with the four supervisors who discussed the design of the experiment for the first research lesson about the instructional strategy of asking questions (entry point; ED). Carrie got new ideas from the discussion with the other supervisors; it gave her insight of how to apply this strategy herself (PD). With this newly achieved PCK, Carrie experimented with her own students (DP), and evaluated student's reaction (DC).

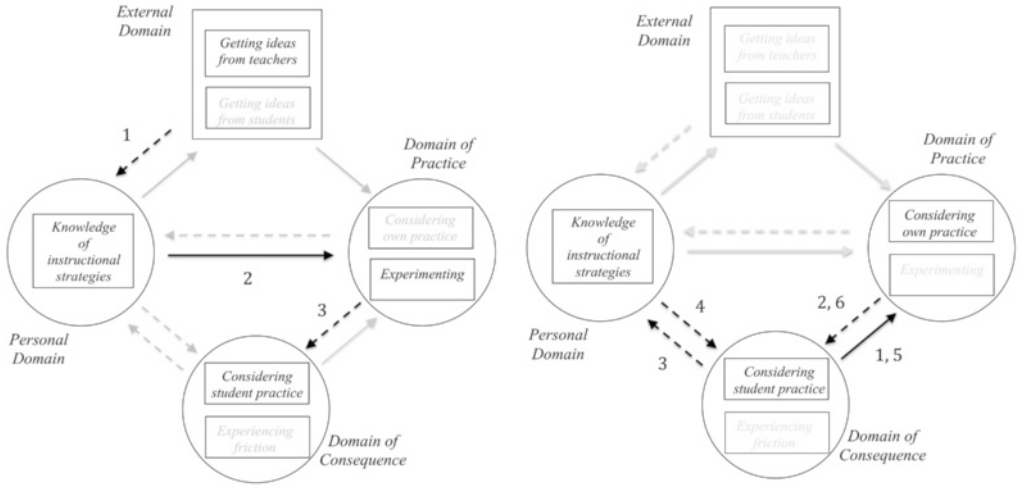

Figure 6.3. Representations of growth networks of the PCK of instructional strategies, one with four IMPG translation processes (Left/Carrie/Learning report2), and one with six processes (Right/ Samantha/Observation1)

We already showed in table 6 that many translations were made from the domain of practice to the domain of consequence and vice versa (processes 1 and 3). The growth network on the right in Figure 6.3 illustrates these translations for the PCK of instructional strategies. The change took place during a lesson study meeting. In this meeting, Samantha discussed the dependent behavior of a student she was supervising (entry point; DC). She reported her intervention of not just simply answering student's answers, but instead sending the student away with a new task (DP) and how the student reacted in a positive way, indeed showing more independent behavior (DC). Then Samantha formulated what she learned about this experiment (PD), how hard the student was still trying (DC), and that Samantha applied the same intervention to other students (DP). She concluded that students can and should be independent learners (DC).

Growth networks of PCK of student understanding of research

In Figure 6.4, two growth networks of the PCK of student's understanding are represented. The network on the left, illustrates the longest pathway of PCK change in our data. This reported PCK change of Miranda originated during the second lesson study meeting. She discussed an experiment with the other supervisors in which she tried not to say anything to the students during their group meeting but instead let them take the initiative. She left the classroom on purpose (entry point; DP) with the aim to give room to the students. When she came back, she discovered this had worked, because students were working very hard (PD). But after a short while, one student asked Miranda what other topics would be discussed during their meeting (DC). Miranda responded by saying they could think of topics themselves (DP). In reaction, one of the students asked the other students to give feedback on a draft version of her work (DC). When no one answered, Miranda tried to stimulate the other students to give an answer (DP). When reflecting on the meeting, Miranda argued that students were not able to act in a proactive way (DC). She mentioned that the next meeting could not continue without students actively participating (DP). Students asked if they could have an individual conversation with Miranda instead (DC), and again Miranda emphasized to them that setting up an agenda themselves is what was needed (DP).

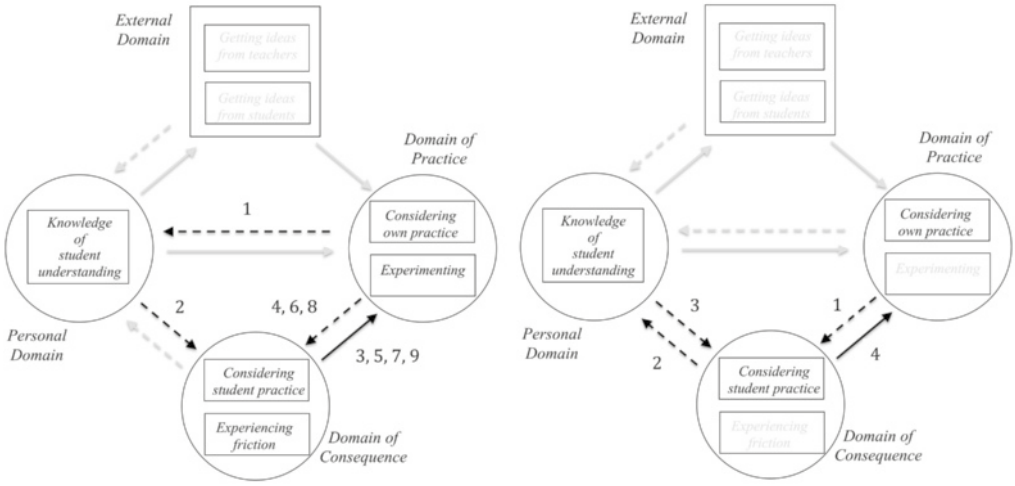

Figure 6.4. Pictorial representations of two pathways of the PCK of student's understanding, one with nine IMPG translation processes (Left/Miranda/Observation2), and one with four processes (Right/Charlotte/Observation5).

The fourth growth network on the right illustrates Charlotte's PCK change of student understanding as result of the research lesson. The change originated during the sixth lesson study meeting, the evaluation of her own research lesson. Charlotte mentioned a conversation she had with two other students about the positive feedback she was giving to them (DP; entry point). Students appreciated the positive feedback Charlotte gave, however they became uncertain when she provided students several questions following that feedback (DC). Charlotte found it interesting that merely asking questions gave students a feeling of uncertainty (PD). In reaction to students' responses Charlotte explained her students why she used the strategy of asking questions (DP), although students showed understanding, they still feared failure (DC).

6.4 Discussion

In this study, we aimed to answer the research question 'How does a lesson study approach stimulate the development of teachers' PCK in students' research supervision?' Within the data of the learning reports, meeting observations, and exit interviews, we analyzed supervisors' PCK and learning activities.

A change in supervisors' PCK of instructional strategies was reported most often. Supervisors reported they especially changed their PCK regarding asking questions and giving positive feedback on issues related to doing research. The finding of these two instructional strategies can be easily explained as they were the object of the lesson study approach. Asking questions and giving positive feedback were the two main instructional strategies the supervisors experimented with during the three research lessons, and as a result of that their PCK of instructional strategies changed. A change in supervisors' PCK of student understanding was the second component that was often reported. Supervisors reported they changed their PCK of students' dependent behavior, of students' active participation, and their PCK of students' perception of negative feedback.

The main learning activities that changed supervisors' PCK were 'considering their own practice' and 'considering student practice'. These findings are in line with the results reported by Bakkenes et al. (2010), as the teachers in their study also reported considering their own practice as the most important learning activity. Furthermore, the learning activities of our supervisors were in line with the goals of the lesson study approach. Teachers developed, taught, and observed several research lessons, they considered student practice when examining its impact on students, and considered their own practice when evaluating these lessons together (Stepanek et al., 2006).

Although, the lesson study approach resulted in 21 change sequences, we found 41 growth networks indicating many complex changes of supervisors' PCK. The entry points of the growth networks started in all four IMPG domains; but especially in the personal and external domain. This finding are in line with the results of Zwart et al. (2007), whose pathways had the most entry points in the personal and external domain as well.

In line with Wongsopawiro, Zwart and Van Driel (2017), we showed that the IMPG was useful to identify changes in research supervisors' PCK. When focusing on the constructed IMPG pathways, we can conclude that the professional growth of our research supervisors was not linear but existed of a complex network of translating processes. Clark and Hollingworth (2002) argued the domain of consequence plays a crucial role in the development of PCK. The knowledge pathways of our supervisors often involved the domains of practice and consequence.

Limitations and implications

This study has some limitations. First, it was a small-scale study with one lesson study team and four participating supervisors, with the intention to understand supervisors' change in PCK. Therefore, generalization to other bachelor programs and/or other domains cannot be made based on our study. In primary education and secondary education, the lesson study approach has been studied more intensively. Lesson study has already shown to be an effective professional development program in primary education (Baricaua Gutierez, 2016; Vrikki, Warwick, Vermunt, Mercer, & Van Halem, 2017), and in secondary education (Cajkler et al., 2014; Verhoef, Coenders, Pieters, van Smaalen, & Tall, 2015).

Second, for optimal teacher learning during a lesson study approach, Dudley (2013) and Cerbin and Kopp (2006) recommended teachers to follow a procedure in which a focus on the student is emphasized. In our study, the supervisor of the second research lesson experienced some troubles in performing the experiment as designed beforehand. She started out with an open questioning strategy, just as planned, but when the student did not give any adequate responses in her perception, she failed to proceed with this strategy and fell back in giving instruction. Although, the supervisor learned a lot, and practiced even more indirect regulation than she was used to, the other participating observers could only focus on teacher performance during the evaluation meeting. This shifted focus from student to teacher may have hampered an impact of this second research lesson on supervisors' change of PCK. During the other two research lessons the supervisors did focus much more on how the student responded to the lesson, rather than on the teacher who happened to be teaching the research lesson.

Third, sometimes it is not very clear how different types of teacher knowledge can be distinguished; such as between PCK and general pedagogical knowledge. PCK represents an integration of knowledge types; it is a blend of content and pedagogy. Just as Magnusson et al. (1999) argued, it remains important to be aware that for PCK these boundaries are necessarily arbitrary and ambiguous.

Conclusion

The results of this study add to the existing literature about lesson study, by showing that lesson study is a promising method for teacher learning in higher education. We succeeded in showing that a lesson study intervention can have an impact on changes in supervisors' PCK in higher education. We encourage more research in higher education with the lesson study approach, and based on our results we expect other lesson study teams to develop changes in their PCK. This study showed that teachers supervising research assignments in higher education can experience different changes in their PCK as a result of their participation in a lesson study project. Supervisors' PCK changes were merely found for their knowledge of instructional strategies and their knowledge of students' understanding of research. Our supervisors followed different pathways for their PCK change. The key learning activities during the lesson study approach were supervisors' considerations of their own practice and their considerations about the practices of their students.

General discussion

7.1 Summary and contributions of this dissertation

In the studies brought together in this dissertation, we explored student-teacher interactions during feedback conversations in higher education. The overarching *research problem* we focused on was: How do teachers' *diagnoses*, *checks of diagnoses*, and *interventions* during student-teacher feedback conversations in higher education relate to (a) the quality of students' and teachers' interactions, (b) the quality of students' self-regulation, and (c) students' perceptions of teacher feedback, and (d) students' motivation?

Five studies were conducted, with which we not only wanted to contribute to the literature on student-teacher interactions during research supervisions, but also aimed to improve educational practice. In the study described in chapter 2 of this dissertation, we investigated the impact of verbal feedback and feedback request forms on students' feedback perception, self-efficacy, and motivation. Supervisors' diagnostic behaviour during feedback conversations was explored in the study presented in chapter 3. Students' and supervisors' co-regulation was investigated in the study discussed in chapter 4. In the study described in chapter 5, we developed a better understanding of supervisors' diagnostic behaviour by exploring their in-the-moment decisions and perceptions of their students. Finally, the effects of a lesson study project on supervisors' pedagogical content knowledge was investigated in the study described in chapter 6.

In this final chapter, I discuss the main contributions of the entire research project to the aims of the dissertation. We aimed to contribute to the field of student-teacher interactions in several ways. First, we aimed to unravel the complexity of face-to-face feedback conversations between teachers and students in higher education. More specifically, we aimed to explore how these student-teacher interactions took place, why they interacted the way they did, and to stimulate teachers to interact differently. I highlight four themes: verbal feedback; supervisors' diagnosis; students' and supervisors' co-regulation of learning; and redesigning feedback conversations with lesson study. I also reflect on the research methodology we used in the studies brought together in the dissertation. Finally, I give suggestions for future research and reflect on our research's implications for practice of teaching.

Verbal feedback during feedback conversations

In many degree programmes in Dutch higher education and elsewhere, students mostly receive written feedback on their work. However, feedback that takes the form of written comments is often ineffective (Carless et al., 2011): Such feedback is often unclear, too brief, and not focused on the problems with which students are struggling, and can therefore lead to frustration and dissatisfaction (Ferguson, 2011; Hounsell et al., 2008; Price et al., 2010; Weaver, 2006). In the research presented in chapter 2, we compared the perceptions of feedback of students who received verbal feedback with the perceptions of students who received written feedback; we found that the group who received verbal feedback perceived this feedback as better in terms of quality, quantity, timing, and usefulness. In the discussion section of chapter 2, we argued in line with Beaumont, O'Doherty, and Shannon (2011) that students perceive feedback in a more positive way when feedback does not only judge their work, but also fosters dialogue. With this study, we showed the importance of giving feedback verbally: in line with Nicol (2010), we argue the interactions during feedback conversations proved to be helpful for the understanding and interpretation of the feedback. These findings guided our research on feedback conversations and student perceptions which was presented in the next chapters.

Diagnosis as prerequisite during feedback conversations

Diagnosing students' research skills adequately is crucial for the quality of research supervision (de Kleijn et al., 2015). Students need several research skills when they are writing their thesis about a research project: e.g., they have to write a research plan; review the literature to develop a conceptual framework; determine the aim and focus of their study; and compose the research questions. In chapter 3, we defined supervisors' diagnostic skills as their ability to judge students' research skills. When supervisors diagnose students' research skills accurately, they can develop and apply more effective and efficient supervising strategies, with consideration of students' needs (Hedin & Gaffney, 2013; Südkamp et al., 2012). Research supervisors need to be sensitive to all the differences between students: the level and amount of teacher support has to be adapted to students' needs and the nature of the required support will differ from student to student (Engebretson et al., 2008; Shanahan et al., 2015; M. Todd et al., 2006). In the research described in chapter 3, we used a framework that summarizes three diagnosis models that were developed in the context of primary and secondary education (Klug et al., 2013; Ruiz-Primo & Furtak, 2007; Van de Pol et al., 2011), and used it to quatify and interpret supervisors' diagnostic behaviours.

The main findings presented in chapter 3 indicated that the research supervisors asked an adequate number of diagnostic questions; the number of diagnostic questions asked has the potential to present them with enough information to formulate a diagnosis about students' research skills. However, our supervisors formulated only a few diagnoses in their feedback conversations, and applied many interventions. They seemed to struggle with the balance between intervening and providing support, on the one hand, and allowing students to find their own ways to develop their own problem solving approaches, on the other hand (M. Todd et al., 2006; Vehviläinen & Löfström, 2014). We concluded that the absence of an explicit diagnosis can cause a lack of shared understanding between the supervisor and the student about the student's research skills, which prevents them from working towards common goals: students do not understand supervisor feedback properly, and supervisors do not understand why their feedback is not used. We argued supervisors did not share their diagnosis, as they merely formulated their diagnoses implicitly; their diagnoses could not be observed, because they stayed inside the supervisors' heads. In chapter 5, we continued on the finding that diagnosing students' learning process is a complex process: teachers either do not use their diagnoses (Klug et al., 2013), have difficulties in diagnosing students' errors (Stahnke et al., 2016), overestimate student performance (Feinberg & Shapiro, 2009), or intervene immediately (Agricola et al., 2018; Ruiz-Primo & Furtak, 2007).

In chapter 5, we captured supervisors' in-the-moment decisions to reveal their process of diagnosing and to give insight into why they perform certain teaching actions. In-the-moment (tacit) decisions are made by teachers when they teach and interact with students (Clark, 2005). We argued these in-the-moment decisions are the crucial elements for teachers to determine their diagnosis; based on their diagnosis teacher act accordingly. A cyclic teacher decision-making model was proposed in chapter 5, which included teachers' diagnoses and actions, and students' perceptions and actions. The main findings were that the student-centred and in-the-moment decisions that the supervisors made, had a strong focus on student learning. For example, supervisors asked a lot of questions to empower students to think for themselves or to increase their understanding. The perceptions of many students tended to be more positive when student control of their learning process increased or when they were stimulated to think independently. However, other students felt unprepared for such interactions, and considered themselves to be lacking of clear guidance. We conclude that teachers should stay sensitive for the needs of specific students and should adapt their teaching strategies to these needs.

Co-regulation of student learning during feedback conversations

Co-regulation relies on scaffolding and refers to the transitional process of a student who is becoming a self-regulated learner by interacting with a more capable other, such as a teacher (Hadwin & Oshige, 2011). Co-regulation refers to the social regulation of learning in which students temporarily regulate their cognition, behaviour, motivation, and emotions together with their teacher (Räisänen et al., 2016). Feedback conversations give opportunities to students and teachers to interact, and consequently for co-regulation of students' learning processes. Within successful scaffolding, teachers can be expected to dominate student-teacher interactions at the start of a new student task with their teacher support. During students' learning trajectories, their research skills increase. For teachers, this means that they can decrease their support and gradually can shift more responsibility for the task to the student. In a small number of studies, such a shift was indeed observed (Hadwin et al., 2005; Karasavvidis et al., 2000), while other studies showed that teachers had difficulties in decreasing their support and students with taking on responsibility, respectively (Rasku-Puttonen et al., 2003).

Our findings described in chapter 4, showed that co-regulation between students and teachers did not vary significantly over the time of a research course. Analysis of these student-teacher interactions showed some supervisors were very eager to teach. These supervisors were willing and wanting students to learn as much as possible from their teaching. In their enthusiasm, they offered much feedback and many explanations, resulting in students acting quite passively. Other supervisors seemed to be more autonomy-supportive to the students; these supervisors' students took more responsibility in regulating their learning than other students did. This balance of collaboration between supervisors and students who were regulating students' learning processes together is considered to be true co-regulation. We argue co-regulation is not easy and so few supervisors can do it, even an experienced supervisor will struggle with this. We conclude that students' learning process cannot be easily influenced. It is a non-linear process; it accelerates and decelerates and supervisors cannot just readily increase or decrease their support for students. Several supervisors have to reach beyond their own repertoire: they should not simply follow their own scripts (Nathan & Kim, 2009), but should provide opportunities for students to take an active role.

The power of lesson study to redesign feedback conversations

Research supervisors have to develop a sense of what good diagnostic skills are, and to develop their pedagogical content knowledge (PCK) in order to be able to judge their students' research skills adequately (Südkamp et al., 2012). In chapter 6, we described a lesson study project that aimed to further enhance supervisors' knowledge about how to carry out research supervisions. As members of a lesson study team, the supervisors developed, taught, and observed a research lesson, and examined its impact on student learning (Lewis & Hurd, 2011; Stepanek et al., 2006). In chapter 6, we provided a detailed and specific description of the lesson study intervention itself. We also presented the data gathered on supervisors' learning activities and the knowledge they developed, to which we referred as the supervisor's PCK (Magnusson et al., 1999) of research supervision. The learning activities and PCK components were conceptualised as pathways of change and domains of PCK in line with the Interconnected Model of Professional Growth (Clarke & Hollingsworth, 2002).

We showed that lesson study is a powerful professional development programme which includes valuable learning activities that stimulate an increase in research supervisors' PCK about instructional strategies and student understanding. Asking questions was one of the two main instructional strategies with which the supervisors experimented during the research lessons. The teaching strategy of asking questions provided supervisors with valuable information about students' understanding, enabling them to diagnose students' research skills. We argue that an increase of supervisors' PCK of

instructional strategies also increases supervisors' diagnostic skills. According to the supervisors, the learning activities that contributed most to the growth of their PCK were considering their own practice and considering the practice of students during the lesson study meetings and research lessons. We conclude that supervisors can redesign and change their supervision practice as a result of lesson study participation.

7.2 Reflection on methodology

In this section, I provide a critical reflection on the methods used in this dissertation. Three different aspect of these methods are highlighted: the use of case study research; the quality measures of qualitative research; and the use of head-mounted video and stimulated recall interviews to measure teacher thinking.

Case study research

The majority of studies in this dissertation consists of qualitative case studies or mixed-method case studies. The aim of these studies was to explore and to explain student-teacher interactions within socio-constructivist models of scaffolding and co-regulation. Yin (2014) summed up different concerns about case study research, addressing issues such as the need for rigor, generalisability, and the generation of massive and consequently unreadable documents. We mitigated these issues and increased rigor by adopting systematic approaches in data gathering and analyses. We generalised the findings of the case studies to propose novel theories rather than to make overarching statements about whole populations, aiming to expand and generalise the theories of scaffolding and co-regulation. In the next section, we recapitulate the ways in which we enhanced the quality of our studies.

Quality measures

The *interrater reliability* of the coding procedure was estimated in chapter 3 for the on-topic coding procedure and for the coding of the four diagnostic phases (Krippendorff, 2004); the proportion agreement was determined for the segmentation procedure (Riffe et al., 2005). Three different members of our research group discussed the interpretation of the transcripts, exchanged their views, and came to an agreement.

Triangulation was applied to check for internal validity of our qualitative studies. In the triangulation procedure, three measurements are carried out to determine the exact position of a point in 'the landscape' (Meijer et al., 2002). Miles and Huberman (1994) distinguished five different kinds of triangulation: 1) by data source, 2) by method, 3) by researcher, 4) by theory, and 5) by data type. In this dissertation, we have used all five types of triangulation across our studies. For example, in chapter 3, we triangulated by researcher, determining interrater reliability between three researchers. In chapter 4, we triangulated by method, by using observations of supervision meetings, motivation questionnaires, and feedback perception questionnaires; by theory, by combining theories of scaffolding and co-regulation; and by data source, by acquiring data with teachers and students at different times. In chapter 5, we triangulated by method, by using observations and interviews; and by data source, as both teachers and students participated. Finally, in chapter 6, we again triangulated by method, by using learning reports, observations, and exit interviews; and by data source, again by measuring at different times.

Audit trail procedures were applied as another way to check the validity of our qualitative research designs, our analyses, and the claims that we made. Based on the three criteria of visibility, comprehensibility, and acceptability, we conducted an audit trail procedure (Akkerman et al., 2008). All documents and materials resulting from the data gathering and the data analysis were assessed by an auditor. In the study described in chapter 5, we applied a summative audit trail procedure, whereas in the study presented in chapter 6 we used a formative one (De Kleijn en Van Leeuwen, 2018). For these studies, two different auditors were chosen. For the study presented in chapter 5, the auditor was one of the PhD supervisors, while in that presented in chapter 6, it was a junior researcher not involved in the project. The first auditor had a high level of expertise in the study's topic and methodology. As a result, he was able to provide a professional and critical assessment report. Although the second auditor might be considered to be more objective than the first, as she was not involved in the project, more meetings were needed to explain the aim of the study and the aim of the audit trail procedure.

There are many ideas about the criteria that qualitative studies should meet. We argue that the applied procedures of checking for interrater agreement and understanding, the triangulation, and the audit trail have increased the internal validity of the studies presented in this dissertation.

Head-mounted video stimulated recall interview

Within the stimulated recall strategy for data gathering, which we used in the study described in chapter 5, participants had an active role in selecting the stimulus during the interview procedure (Borg, 2015). The stimulus used during the supervisor interviews was derived from a head-mounted camera. So far, studies that used head-mounted cameras mainly focused on examining motoring skills of for instance fire brigade station officers (Omodei et al., 2012) and river surfing sports athletes (Mackenzie & Kerr, 2012). Head-mounted video stimulated recall interviews were also conducted in some studies in the medical domain, about formulating diagnostic hypotheses by emergency physicians (Pelaccia et al., 2014) and about the clinical reasoning of occupational therapists (Unsworth, 2005). The head-mounted camera method that we used in chapter 5 offered a powerful stimulus to the spontaneous recollection of the in-the-moment decisions that were made by our supervisors; it captured the participant's perspective as accurately as possible. The head-mounted stimulus decreased supervisors' self-awareness; selective reporting was prevented, as supervisors did not view themselves in action. We argue that the use of head-mounted cameras is a major advantage when examining teachers' in-the-moment decisions in interaction with their students.

7.3 Suggestions for future research

In this section, we present several suggestions on new directions for future research. Firstly, generalisation of our findings to other domains would be a suitable aim for future studies. Lesson study has proven to be a successful professional development programme for teachers who teach students in classrooms (Schipper et al., 2017; Verhoef et al., 2015). We added to that knowledge with the finding that lesson study is also suitable for designing face-to-face feedback conversations. The supervisors who participated in our study were able to apply indirect student-centred teaching strategies, to diagnose student understanding, and to empower students to think for themselves. The focus on student learning asked of participating teachers has been shown to be the key learning aspect of a lesson study approach. Lesson study offered opportunities for supervisors to switch from their own teaching repertoire to new supervising strategies. It would be interesting to investigate whether other lesson study teams could develop their PCK in the same way as our supervisors did.

Secondly, the results of the study described in chapter 6 showed that the lesson project was successful as an intervention with the aim to stimulate supervisors' PCK. A possible explanation for the success of this intervention is the intensive way in which the supervisors were guided in this four-month project. We had ten meetings, asked the supervisors to read literature, to develop their own instruments, and to write learning reports. Although one-shot, short-term interventions might be less effective than long-term interventions (Van Veen, Zwart, & Meirink, 2012), we argue that future research could focus on ways to make this form of professional development less time-consuming. When supervisors do not have the appropriate diagnostic skills available, they could also be offered instruction during two-monthly video clubs (Van Es & Sherin, 2010) or guided reflection meetings (McCullagh, 2012). It would be interesting to investigate whether such professional development programmes can have the same impact as a lesson study project.

Thirdly, although the empirical explorations showed that the intervention of verbal feedback had a significant effect on students' perceptions of teacher feedback, no effect of feedback request forms was found. This is surprising, as previous research has shown that feedback request forms can engage students more in the feedback process (Bloxham & Campbell, 2010; M. Gielen & De Wever, 2015). We argued that the one-way written instruction might not have been sufficient to explain the usefulness of the forms. As a result, students were not able to produce high quality requests and/or the teachers did not pay enough attention to this individualised part of the feedback. We argue that alternative approaches to the feedback forms could lead to, for example, an increase of students' motivation and/or learning. Training students using worked-out examples together with information on how to use the feedback request forms could lead to these effects in future studies (Van Gog, Kester, & Paas, 2011).

7.4 Implications for practice

The studies presented in this dissertation have several implications for educational practice. Firstly, we showed that verbal feedback can have a great impact on student perceptions. Based on the results of chapter 2, the bachelor program of Nutrition and Dietetics has implemented verbal feedback as the main feedback form on all their performance assessments. We showed that a two-way communication route offers several possibilities, e.g., the teacher explains and the student verifies teacher feedback. Several students had very positive perceptions of the verbal feedback their supervisors used and stimulated them to regulate their own learning. However, these positive perceptions might have been reported by students who were already actively engaged, which shows that students assuming responsibility for their learning process can be considered an important outcome of this study.

Secondly, when teachers start a feedback conversation with their students an indirect regulation strategy is needed. Teachers who start the conversation by asking questions provide opportunities for their students to take the lead; students can subsequently take responsibility for their learning process once they are ready for it and can show the skills they already master. At the same time teachers can diagnose students' understanding and adapt their support to students' understanding.

Thirdly, when teachers do not possess the appropriate diagnostic skills or cannot apply them when needed, lesson study can be the professional development programme to develop teachers' pedagogical content knowledge on the instructional strategy of asking questions and of diagnosing student understanding. Our supervisors experienced this method as positive. Their PCK changed as a result of their participation. However, it must be noted that participating in a lesson study project is time-consuming for teachers.

7.5 Who's in control? Finding balance in student-teacher interactions

In many of the feedback conversations we have observed, student-teacher interactions were characterized by a teacher-centred approach with a lot of teacher interventions and direct regulation towards students' learning. From a scaffolding perspective, this seems to be an acceptable teaching strategy when students are starting with a new task. Several teachers did not decrease their regulation in a phase that students' independent functioning was expected. Although it remained unclear in our studies if teachers were unable to decrease their support, our research did show that teachers can learn to apply effective scaffolding techniques to enhance the active role of the students during feedback conversations. Our lesson study approach has been shown to be an effective method to enrich teachers' PCK of instructional strategies. We showed that teachers are able to apply indirect regulation strategies, such as asking questions and prompting, to stimulate students to think for themselves. The significance of this project lies in the empirical evidence it provides about how teachers can strengthen the role of students; how teachers can stimulate students to take on responsibility for their own learning process. We hope that the studies presented in this dissertation will inspire teachers, as well as researchers, to find the balance in student-teacher interactions, and conclude as we did: both students and teachers should be in control.

7

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Appendices

Appendix A

Randomization results

Research Randomizer Results:

32 Sets of 4 Unique Numbers Per Set

Range: From 1 to 4 -- Unsorted

Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8	Set 9
4	1	2	2	3	4	2	4	3
3	2	1	1	1	3	4	3	2
1	3	4	4	2	2	1	1	1
2	4	3	3	4	1	3	2	4

Set 10	Set 11	Set 12	Set 13	Set 14	Set 15	Set 16	Set 17	Set 18
3	2	1	2	2	1	4	3	3
2	3	4	3	4	4	2	2	2
4	4	3	4	3	3	3	4	4
1	1	2	1	1	2	1	1	1

Set 19	Set 20	Set 21	Set 22	Set 23	Set 24	Set 25	Set 26	Set 27
2	4	3	1	4	1	3	3	4
1	1	2	4	1	3	2	2	2
3	3	4	2	3	2	4	1	3
4	2	1	3	2	4	1	4	1

Set 28	Set 29	Set 30	Set 31	Set 32
3	4	4	1	1
1	2	1	4	2
4	3	3	2	3
2	1	2	3	4

Appendix B

Summary of simulated patient case description

- You are Mary Smith, a 70-year-old woman who presents to the outpatient office for an appointment with the dietitian about your diabetes.
- You are a pleasant, cooperative client with good eye contact.
- You are not someone is who is particularly knowledgeable about diabetes or any health issues and try to avoid doctors as much as you can. You feel that it's all way over your head – too complex for you to bother with.
- The student's task is to obtain a focused history and counsel you regarding your situation. Following the encounter, the student will then document the encounter in a patient note.
- This encounter is an exercise in the student's pursuing and delving into your food and exercise habits and then counseling you to change the behaviors that need adjustment for optimal diabetes control.
- Listen carefully to the questions and answer only what's asked. You are not trying to withhold information. Mary Smith is pretty much clueless when it comes to her disease, so you are not portraying someone who is hiding information. Rather, someone who genuinely doesn't have the knowledge or skills to manage herself.
- You are tired and don't feel good. Come to think of it, you've been feeling tired all the time of late. You try not to eat sweets. You do not exercise regularly.
- Mother had diabetes. Died at age 80 from pneumonia Father: died of heart attack at age 58. Older sister died last year of a heart attack at age 72
- You live alone in a small one-floor home. You had 30 year of marriage. Husband was a smoker, died a long time ago from lung cancer.
- Used to enjoy going out, but you haven't so much in the last few months because you feel so tired and have to go to the bathroom all the time.
- You watch a lot of TV these days.
- Habits: Never smoked. No alcohol. Drink 3-4 cups of tea/day (no coffee). No alcohol. Don't exercise and not very physically active.
- Education/Vocation: College degree in Education. Retired (about 10 years ago) elementary school teacher.

Appendix C

Rubric-scoring sheet with assessment criteria (assessor)

		Criteria	Unsatisfactory	Proficient	Outstanding
1	Dietetic diagnosis	The student makes a dietetic diagnosis on the basis of analysis and interpretation of anthropometric, biochemical and dietary data collected from the client.	☐	☐	☐
2	Disease and nutrition.	The student explains the relation between disease and nutrition to the client and shows understanding of the pathogenesis of the disease.	☐	☐	☐
3	Treatment goals	The student discusses with the client possible evidence- based methods of treatment and sets goals with the client on the basis of the dietetic diagnosis.	☐	☐	☐
4	Dietary advice (nutrient level)	The student discusses with the client the nutritional or dietary advice on the level of macro- and micronutrients, vitamins and minerals.	☐	☐	☐
5	Dietary advice (food consumption level)	The student translates the nutritional or dietary advice into a food consumption regime according to currently accepted standards, scientific views and guidelines.	☐	☐	☐
6	Eye contact, attitude and empathy	The student has eye contact with the client, and demonstrates sensitivity to the client's level of knowledge and cultural background.	☐	☐	☐
7	Memorizing information	The student gives information and helps the client to memorize the dietary advice.	☐	☐	☐
8	Adaptation to client	The student counsels the client to follow dietary advice in his/ her living environment making use of communication and motivation techniques adapted to the client.	☐	☐	☐
9	Sequential order of methodical practice	The student makes a dietetic diagnosis on the basis of analysis and interpretation of anthropometric, biochemical and dietary data collected from the client.	☐	☐	☐
10	Structure and initiative	The student maintains structure during the conversation, taking and releasing initiative adapted to client's needs.	☐	☐	☐

To pass the test, criteria 1-5 may not be scored unsatisfactory; criteria 6-10 may be scored unsatisfactory twice

Appendix D

Feedback request form (student)

Dear student,

You are asked to fill out this feedback request form together with the videotaped performance of your assessment.

The assessor will provide you with feedback based on the assessment criteria. During the assessment and the provision of feedback, the assessor will use your request form to pay attention to the topics you think are important to get feedback on. On this form you can address these topics.

What kind of topics could you address?

After the two practice conversations in week 3 (dietetic research) and week 4 (dietetic diagnosis and treatment plan) you were asked to write a self-reflection report. This report contains some positive topics you already mastered and some topics you still had to work on and had to improve. These improvement topics are suitable to get specific feedback on when your assessor is viewing your performance.

Try and fill out the following questions:

1. Student name:
2. Student number:
3. During the phase of the dietetic diagnosis I would like feedback on the way I:
4. During the phase of the treatment plan I would like to get feedback on the way I:
5. During my conversation with the patient I would like feedback on the following topics regarding my professional attitude / communication skills / conversational structure:

Appendix E

Feedback and Assessment Perception Questionnaire items

A Quality of feedback (QUAL)

	Variable	Question
1	I01_Qual*	The feedback mainly tells me how well I am doing in relation to others.
2	I02_Qual	The feedback helps me to understand things better.
3	I03_Qual	The feedback shows me how to do better next time.
4	I04_Qual	Once I received the feedback I understood why I got the mark I did.
5	I05_Qual*	I don't understand some of the feedback.
6	I06_Qual*	I can seldom see from the feedback what I need to do to improve.

B Use of feedback (USE)

	Variable	Question
7	I07_Use	I listened to/read the feedback carefully and try to understand what the feedback is saying.
8	I08_Use	I use the feedback to go back over what I have done in this performance.
9	I09_Use*	The feedback does not help me with any subsequent performances.
10	I10_Use	The feedback provides insight into my strengths during the performance.
11	I11_Use	The feedback provides insight into my weaknesses during the performance.
12	I12_Use	The feedback helps me developing my dietetic skills.
13	I13_Use	The feedback provides insight into what I need to improve.
14	I14_Use*	I tend to only read the marks.

C Quantity and timing of feedback (QUAN)

	Variable	Question
15	I15_Quan	I received plenty of feedback.
16	I16_Quan	The feedback came back very quickly.
17	I17_Quan*	There is hardly any feedback on my performance.

18	I18_Quan*	When I get feedback wrong or misunderstand it I don't know what to do about it.
19	I19_Quan*	I would learn more if I received more feedback.
20	I20_Quan*	Whatever feedback I get, it came too late to be useful.

D Examination and learning (EXAM)

	Variable	Question
21	I21_Exam*	Preparing for the performance was mainly a matter of memorizing.
22	I22_Exam	I learnt new things while preparing for the performance.
23	I23_Exam	I learnt new things as a result of the performance.
24	I24_Exam*	In a while I probably forgot most of the performance.
25	I25_Exam*	With this performance you can get away with not understanding and still get good marks.
26	I26_Exam	The criteria of the performance were very clear.
27	I27_Exam*	With this performance it is not clear what criteria must be met to succeed.
28	I28_Exam*	The performance was not very challenging.

E Usefulness of feedback (USEF)

	Variable	Question
		The feedback is...
29	I29_Usef*	Too extensive
30	I30_Usef*	Inconsistent
31	I31_Usef	Very easy to understand
32	I32_Usef	Specific
33	I33_Usef	Unambiguous
34	I34_Usef	Comprehensible
35	I35_Usef*	Complex
36	I36_Usef*	General
37	I37_Usef	Enlightening
38	I38_Usef*	Complicated
39	I39_Usef*	Cluttered
40	I40_Usef	Very easy to assimilate
41	I41_Usef	Manageable
42	I42_Usef	Clear
43	I43_Usef	Adequate to assimilate
44	I44_Usef*	Vague

Appendix F

Motivated Strategies for Learning Questionnaire items

A Intrinsic Goal Orientation (INTR)

	Variable	Question
1	I01_Intr*	In this course, I prefer course material that really challenges me so I can learn new things.
2	I16_Intr	In this course, I prefer course material that arouses my curiosity, even if it is difficult to learn.
3	I22_Intr*	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.
4	I24_Intr*	When I have the opportunity, I choose course assignments that I can learn from even if they don't guarantee a good grade.

B Extrinsic Goal Orientation (EXTR)

	Variable	Question
5	I07_Extr	Getting a good grade in class is the most satisfying thing for me right now.
6	I11_Extr	The most important thing for me right now is in this course is getting a good grade.
7	I13_Extr	If I can, I want to get better grades in this class than most of the other students.
8	I30_Extr	I want to do well in this course because it is important to show my ability to my family, friends, employer, or others.

C Task Value (TSKV)

	Variable	Question
9	I04_Tskv*	I think I will be able to use what I learn in this course in other courses.
10	I10_Tskv	It is important for me to learn the course material.
11	I17_Tskv	I am very interested in the content area of this course.
12	I23_Tskv	I think the course material is useful for me to learn.
13	I26_Tskv	I like the subject matter of this course.
14	I27_Tskv*	Understanding the subject matter of this course is very important to me.

D Control of Learning Beliefs (CONT)

	Variable	Question
15	I02_Cont	If I study in appropriate ways, then I will be able to learn the material in this course.
16	I09_Cont	It is my own fault if I don't learn the material in this course.
17	I18_Cont	If I try hard enough, then I will understand the course material.
18	I25_Cont	If I don't understand the course material, it is because I didn't try hard enough

E Self efficacy for Learning and Performance (SLFEF)

	Variable	Question
19	I05_Slfef	I believe I will receive an excellent grade in this course.
20	I06_Slfef*	I'm certain I can understand the most difficult material presented in the readings for this course.
21	I12_Slfef*	I'm confident I can learn the basic concepts taught in this course.
22	I15_Slfef	I'm confident I can understand the most complex material presented by the teacher in this course.
23	I20_Slfef	I'm confident I can do an excellent job on the assignments and test in this course.
24	I21_Slfef	I expect to do well in this course.
25	I29_Slfef	I'm certain I can master the skills being taught in this course.
26	I31_Slfef*	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

Test Anxiety (TANX)

	Variable	Question
27	I03_Tanx_i*	When I take a test I think about how poorly I am doing compared with other students.
28	I08_Tanx_i*	When I take a test I think about items on other parts of the test I can't answer.
29	I14_Tanx_i*	When I take tests I think of the consequences of failing.
30	I19_Tanx_i	I have an uneasy, upset feeling when I take a test.
31	I28_Tanx_i	I feel my heart beating fast when I take a test.

Appendix G

False Discovery Rate

Table G1 False discovery rates for main effect of feedback mode

		Feedback mode		Rank	False discovery rate
Questionnaire	Variable	F	p		Q(i/m)
FAPQ	Quantity & Timing of Feedback	40.49*	<.001	1	.05(1/11) = .0045
FAPQ	Quality of Feedback	27.10*	<.001	2	.05(2/11) = .0091
FAPQ	Use of Feedback	10.36*	.002	3	.05(3/11) = .0136
FAPQ	Usefulness of Feedback	8.16*	.005	4	.05(4/11) = .0182
MSLQ	Control of Learning Beliefs	6.07*	.015	5	.05(5/11) = .0227
FAPQ	Examination & Learning	4.20	.043	6	.05(6/11) = .0273
MSLQ	Task Value	1.45	.231	7	.05(7/11) = .0318
MSLQ	Test Anxiety	1.37	.244	8	.05(8/11) = .0363
MSLQ	Self-Efficacy	.40	.530	9	.05(9/11) = .0409
MSLQ	Intrinsic Goal Orientation	.37	.545	10	.05(10/11) = .0455
MSLQ	Extrinsic Goal Orientation	.03	.865	11	.05(11/11) = .05

Note. Q = false discovery rate; i = indivual p-value's rank; m = total number of tests; FAPQ = Feedback and Assessment Perception Questionnaire; MSLQ = Motivated Strategies for Learning Questionnaire
**p < .227*

Appendix H

PCA Component loading of feedback perception questionnaire

Table H1. PCA component loadings (N = 85) of Feedback Perception Questionnaire with oblique (oblimin) rotation

Scale	Items	Components			
		I	II	III	IV
Fairness	I am satisfied with this feedback	**.506**	-.297	-.231	.067
	I would consider this feedback fair	**.864**	-.094	.134	.003
	I would consider this feedback justified	**.790**	-.094	.197	-.001
Usefulness	I would consider this feedback useful	**.494**	-.234	-.166	.267
	I would consider this feedback helpful	**.644**	.072	-.341	-.044
	This feedback provides me a lot of support	**.682**	-.016	-.248	.050
Acceptance	I accept this feedback	**.538**	.021	-.226	.304
	I dispute this feedback	.141	**-.719**	.051	.199
	I reject this feedback	.009	**-.821**	-.059	.123
Willingness	I shall improve my work	.118	.111	-.111	**.663**
	I shall invest a lot of effort in my revision	.195	.058	-.061	**.819**
	I shall work on further revision of my work	-.166	-.170	.090	**.817**
Affect	I feel ... receiving this feedback on my work				
Positive	Satisfied	.153	-.237	**-.610**	.057
	Confident	-.005	-.099	**-.813**	.054
	Successful	-.039	.030	**-.876**	-.002
Negative	Offended	.092	**-.751**	.134	-.043
	Angry	-.065	**-.874**	-.094	.053
	Frustrated	.055	**-.740**	-.239	-.260
Eigenvalues		7.84	1.93	1.57	1.10
% Of variance explained		43.53	10.72	8.74	6.12
I			.248	.190	.440
II				.263	.545
III					.449

Note. Loadings above .40 are boldface.

Appendix I

PCA Component loading of situational motivation scale

Table I1. PCA component loadings (N = 85) of Situational Motivation Scale with oblique (oblimin) rotation

Scale	Items	Components			
		I	II	III	IV
Intrinsic motivation					
	Because I think research is interesting	**.571**	.177	.108	.242
	Because I think research that research is pleasant	**.895**	.006	-.052	-.059
	Because research is fun	**.940**	.077	-.022	-.112
	Because I feel good when doing research	**.593**	-.077	-.014	.226
Identified regulation					
	Because I am doing it for my own good	-.021	-.006	-.061	**.888**
	Because I think that doing research is good for me	.348	-.168	.375	.282
	By personal decision	.246	.213	.143	**.433**
	Because I believe that doing research is important for me	.256	-.177	.313	**.500**
External regulation					
	Because I am supposed to do it	.194	**.853**	-.124	.195
	Because it is something I am supposed to do	.125	**.848**	-.063	-.065
	Because I don't have any choice	.275	**.615**	.150	-.163
	Because I feel that I have to do it	-.018	**.792**	.095	-.023
Amotivation					
	There may be good reasons to do this, but personally I don't see any	-.040	.128	**.763**	.158
	I do this but I am not sure if it is worth it	.087	-.046	**.877**	-.110
	I don't know; I don't see what this brings me	.009	-.027	**.945**	-.163
	I do this, but I am not sure it is a good thing	-.140	.009	**.777**	.082
Eigenvalues		5.21	2.69	1.64	1.11
% Of variance explained		32.54	16.82	10.29	6.93
Component correlations	I		.166	.375	.296
	II			.034	.001
	III				.276

Note. Loadings above .40 are boldface.

Appendix J

Interview protocol of in-the-moment decisions and teaching actions

1 Background: Demographic data about participant

1. What is your name and age?
2. Can you describe your current position?
3. What is your faculty status?
4. How long have you been teaching?
5. What teaching experience do you have?
6. What is your former education?

2 Pre-active phase: Aims and planning of teaching actions

1. Can you please describe the supervision meeting you are about to have? *(teaching actions)*
2. What is the purpose of the supervision meeting you are having with the student(s)? *(aims)*
3. What (possible) topics are you addressing in this meeting? *(aims)*
4. What goals do you have as a supervisor for this meeting? *(aims)*
5. Have you got any ideas on how to approach these topics with the student? *(teaching actions)*
6. What do you expect of the meeting itself? *(aims)*

3 Post-active phase: In-the-moment decisions and teaching actions

1. What happens here? *(teaching action)*
2. Can you please walk me through the teaching situation in which you carry out this action? *(teaching action)*
3. Can you describe what action you are performing here? *(teaching action)*
4. Can you tell me about the considerations in carrying out this teaching action? *(in-the-moment decision)*
5. Can you describe why you perform this teaching action? *(in-the-moment decision)*
6. Can you tell me about the decision that you have considered in carrying out this teaching action? *(in-the-moment decision)*
7. What did you think? *(in-the-moment decision)*
8. Where did your idea/assumption come from? *(in-the-moment decision)*
9. What happens with the student(s)?
10. What reaction did the student(s) give?
11. To what extent did you consider this teaching action earlier in the process? *(in-the-moment decision)*
12. What types of other actions went through your mind when you were in this situation? *(teaching action)*

Appendix K

Interview protocol of students' perceptions of teaching actions

1 Background: Demographic data about participant

1 What is your name and age?

2 In what year are you?

3 What is your former education?

2 Post-active phase: Perception of teaching action

1 What is happening here? Can you describe the teaching action?

2 How do you perceive the support that is given to you? Why?

3 How do you perceive the quality of support that is given to you?

4 How do you perceive the quantity of support that is given to you?

5 How meaningful is this support for you? Why?

6 How meaningful is this support to you in helping you learn? Why?

7 How does teacher support help you in this situation? Why?

8 What purpose does teacher support have here? Why?

9 How does teacher support encourage reflection? Why?

10 How do you act on this support? Why?

11 What is the effect of teacher support on you? Why?

Appendix L

Coding scheme of in-the-moment decisions and teaching actions

Table L1 Final coding scheme for stimulated recall teacher interview transcripts on teaching actions and in-the-moment decisions adapted from (Johnson, 1992; Rich & Hannafin, 2008; Richards, 1998) resulting from the deductive content analysis

Code	Definition
Teaching actions	**Teacher observes own behaviour**
Asking questions	Teacher asks student a question
Eliciting input	Teacher elicits/prompts student to answer
Explaining	Teacher provides student with explanation about concept or procedure
Giving feedback	Teacher provides student with information regarding performance
Instructing	Teacher provides student with information about what to do or how to do it
Non-verbal behaviour	Teacher shows non-verbal behaviour
Nodding	Teacher nods to the student
Observing	Teacher observes student behaviour/answers or reading
Pausing	Teacher gives student the time to answer or rethink
Writing down	Teacher makes notes
Miscellaneous	Teacher reflects and evaluates own behaviour, or non-relevant topics
In-the-moment decisions	**Teacher recalls performing a teaching action giving consideration to:**
Empowerment	giving students control in the conversation
Encouragement	stimulating students to continue, e.g. their line of reasoning
Instructional management	managing teachers' instructional flow of the meeting
Checking understanding	assessing students' knowledge about a concept, or procedure
Gathering information	gathering information about students' knowledge
Initiating new topic	initiating a new topic
Planning next step	thinking how to introduce the next step
Involvement	engaging students' participation and attention
Social needs	addressing social needs
Emotions	students' emotions, e.g. frustration or happiness
Expectations	students' expectations
Motivation	students' motivation
Understanding	increasing students' knowledge about a concept, or procedure

Appendix M

Coding scheme of student perceptions

Table M1 Final coding scheme for stimulated recall student interview transcripts on student perceptions resulting from the inductive content analysis

Code	Definition
Positive perception	Student describes a positive perception based on teacher's action
Increase of understanding	Student perceives increased understanding because teacher gives a good explanation or specific feedback
Stimulus to think	Student perceives the teacher stimulates them to think on their own
Trigger to investigate	Student perceives teacher intervention as a trigger to investigate and do more research
Student control	Student perceives they are in control or get the opportunity to take control
Teacher understanding	Student perceives the teacher understands what the student knows or means
Personal attention	Student perceives the teacher pays attention to personal situation of student, teacher shows empathy, asks about emotions
Shared understanding	Student perceives teacher and student can share understanding about certain content or approach
Timing of feedback	Students perceive teacher support to be timely, given at the right moment
Negative perception	Student describes a negative perception of teacher's action
Poor-quality teacher support	Student perceives teacher explanation and/or feedback to be of poor quality, too unclear, unhelpful, not specific
Teacher misunderstanding	Student perceives the teacher to misunderstand the student's explanation, the student's point of view, or meaning of the text
Shared misunderstanding	Student perceives a teacher and student misunderstanding, not understanding each other, not aligned
Insufficient teacher control	Student perceives insufficient teacher control, expects teacher to take control, to give feedback or explanations
Miscellaneous	Student does not describe the perception of a teacher's action, student describes other irrelevant topics, reflects on their own or teacher's behaviour, in the video or in the past, student describes an observation, but no perception about it

Appendix N

Audit trail report decisions and perceptions

Phase:	After data gathering and data analysis
Purpose:	Summative assessment on final manuscript
Assessment criteria:	Visibility; comprehensibility; acceptability according to the article of Akkerman, Admiraal, Brekelmans, and Oost (2008).
Auditor:	Second author
Auditee:	First author

Stage 1 and 2 Orientation to audit procedure (1) and to study (2)

Auditee

- The auditee decided which part of the study would be audited. The audited part included the data gathering methods (i.e. learning reports, video observations, and interviews) and the analytic procedure (i.e. the coding procedure for the three data sources).
- The auditee provided all relevant documents regarding the data gathering and analysis and explained the documents verbally in an interview:
    - Start document: participants, informed consents
    - Final document: final manuscript
    - Raw data teacher interviews
    - Raw data student interviews
    - Transcription manual
    - Processed data: coding books, Nvivo files
    - Process document
- The auditee invited the auditor for an initial orientation to the study, and negotiated about the aim and the procedure of the audit trail.
- The auditee discussed with the auditor if this was doable within the given time.
- The information/ description of the auditee to the auditor included not only all the relevant documents, but also the assessment criteria: 1) how things were done (visibility), 2) why things were done (comprehensibility), and 3) what has been done to maintain (or even check and 'proof') the quality (acceptability).

Auditor

- The auditor interviewed the auditee, and made sure the auditor had enough information.
- If necessary, the auditor asked the auditee for additional information to ensure the visibility (what) and comprehensibility (why).

Stage 3 Determination of the auditability of the study

Auditor and auditee determined together whether the audit trail was complete, and understandable.

Stage 4 Negotiation of the contract

Auditor and auditee agreed to conduct a summative assessment on the documents of the audit trail, assessed within a few weeks.

Sage 5 Assessment

The auditor followed the audit trail as presented by the auditee, trying to verify all links between problem statement, research design, data gathering and analysis plan. For all these methodological actions and decisions the auditor determined whether the criteria of visibility, comprehensibility, and acceptability were met.

Visibility

- Are decisions described and/or communicated?
- Is the procedure (data gathering and data analysis) written down in a transparent way?

Comprehensibility

- Did the researcher provide enough evidence for the decisions that were made?
- Are the decisions explicated?
- Is the procedure (data gathering and data analysis) written down in a
- comprehensible way?
- Are the differences that emerged between the proposed method and the actual
- analysis written down in a comprehensible way?

Acceptability

- Based on the quality descriptions the auditor evaluates the acceptability.
- Has quality been maintained in terms of reliability and validity throughout all steps undertaken?
- The auditor assesses everything that might ensure vs. harm the quality of the data and analysis.
- With respect to data gathering the auditor could think of the timing of data gathering, the content, and the behavior of the researcher.
- With respect to data analysis the auditor might think of choices in categorization and the way such categories are applied.
- How well is the sample of participants described? Is the sample representative?
- How much tension can be determined between the proposed method of data gathering and the specific circumstances of the teachers and students?
- Did the researcher pay attention to the circumstances of the participants in an acceptable way?
- Is the relationship between researcher and the participants written down in an acceptable way

Stage 6 Renegotiation

The auditor presented her findings to the auditee. There were some discrepancies in the auditor's claims and what was agreed upon. The auditee did not provide the informed consent forms of the participants. After this renegotiation, the auditor finished the assessment and provided a final written report filling out the assessment scheme.

Stage 7 Final auditor report

In the assessment scheme the auditor can systematically summarize the conclusions on the three criteria for trustworthiness of the study. In this audit trail a formative assessment procedure was conducted in which the planned data gathering and data analysis were assessed.

Table N1

Audit trail assessment scheme

Assessment criteria	Audit trail components
	Data gathering
Visibility	The participants as well as the context of the study were described sufficiently. Informed consent forms were presented for all participants. All steps of the data gathering process were clearly described in the final draft of the article. It was clear to me how the stimulated recall procedure was executed. The manual for transcribing the interviews were clear to me. I read a substantial sample of the transcripts, and it was clear to me how the different phases of the data gathering were combined in the transcripts by using different colours in the transcript. During the post-active phase, the instruction for the participants was clear to me.
Comprehensibility	The choice for the sample was comprehensible. For a case study design combined with the richness of the data, the sample size was appropriate for answering the rather descriptive research questions and drawing conclusions based on these research questions. The several phases of data gathering as well as the interview protocol were sufficiently substantiated with scientific literature. The choice for using the head-mounted camera was substantiated sufficiently.
Acceptability	Because of the nature of the design (case study, exploratory, descriptive), I consider the sample as acceptable. The choice for the head-mounted camera is new in the field of education and may have led to a more accurate stimulated recall. The interview procedure/protocol fitted well with the purposes and design of the study. Open questions enabled participants to share their view of what happened during the interaction phase as well as how they reflected on this phase afterwards.

Data analysis

The deductive content analysis as well as the cross-case analysis and the between-case analysis was described sufficiently. I inspected the NVivo files. Coding was done according to the way it was described in the final article.

The choices regarding the coding schemes for the teaching actions and the in-the-moment decisions were comprehensible and based on specified scientific articles. Also, the choices regarding the coding scheme for student's perceptions were comprehensible but the link with scientific articles could have been made a bit stronger.

Tables A3 is an appropriate display of the connection between teacher actions and in-the-moment decisions. The decision of excluding frequencies of 1 and 2 when creating the case-ordered description matrix is defensible, but it excludes 13 of 26 connections in the case-ordered descriptive matrix (table A4).

There hasn't been made a systematic connection between teaching actions on the one hand and the student's perceptions on the other, that is, in a matrix. That required extra coding in NVivo. The choice that has been made in this study is to connect teaching actions and student's perceptions more qualitatively, which will perhaps reveal more insight regarding the third research question.

Data analyses (e.g., NVivo) and presentation of the results (matrices and qualitative descriptives) are according to what is common in the field of educational research.

Appendix O

Predictor-outcome matrix of the coded teacher decision-action connections

Table O1 Predictor-outcome matrix of the coded teacher decision-action connections (n = 95)

	Teaching actions				
In-the-moment decisions	**Asking questions**	**Eliciting input**	**Explaining**	**Giving feedback**	**Instructing**
Empowerment	7	4			
Encouragement		1		1	
Instructional management					
Checking understanding	13	10			
Gathering information	4	3			
Initiating new topic	1				1
Planning next step	3	4			1
Involvement	2				1
Social needs					
Emotions	2		2	2	
Expectations	3				
Motivation	3		1		
Understanding	7	1	12	5	1

Appendix P

Case-ordered descriptive matrix of the coded teacher decision-action connections and those already aimed at/planned for

Table P1 Case-ordered descriptive matrix of most frequently coded teacher decision-action connections (n = 75), and those already aimed at/planned for

Connections between		**Teachers**						
In-the-moment decision	Teaching action	T1	T2	T3	T4	T5	T6	T7
Empowerment	Asking questions		1*	1	3	2		
	Eliciting input		1	1	2			
Checking understanding	Asking questions		2		4*	2*	1	4
	Eliciting input	1		3*	5		1	
Gathering information	Asking questions				2		2	
	Eliciting input			1	1	1		
Planning next step	Asking questions				2	1		
	Eliciting input			2		1	1	
Expectations	Asking questions					1	1	1
Motivation	Asking questions				3			
Understanding	Asking questions	1			1		2	
	Explaining	3		3	3	1		2
	Giving feedback			1	2		1*	1*

*Note. A teaching action that was already planned for and an in-the-moment decision already aimed at during the pre-active interview are indicated with an **

Appendix Q

Predictor-outcome matrix of the coded student perceptions

Table Q1 Case-ordered descriptive matrix of coded student perceptions (n = 59)

Student perception of teacher support		Students					
Direction	Perceived	S3	S4	S5	S6a	S6b	S7
Positive	Increase of understanding		4	3	1		5
	Stimulus to think	1	6	3			2
	Student control	2	2	3	1	1	
	Personal attention		1	1	1		1
	Trigger to investigate		2				1
	Teacher understanding			1		1	
	Shared understanding					1	
	Timing of feedback						1
Negative	Poor-quality teacher support				3	2	
	Shared misunderstanding	2			1	1	
	Teacher misunderstanding	1			1	1	
	Insufficient teacher control	1			1	1	
Miscellaneous		3	5	1	2	4	3

Appendix R

Lesson study instrument: Lesson preparation form

Table R1 Lesson study instrument: Lesson preparation form

Date research lesson:	Student:
May 1st, 2017	Lesson Study team:
	Performing teacher:
Title of research lesson	Intervention at writing the conclusion/discussion section of the thesis
Lesson goals	After the supervision meeting, the student is able to continue independently with adjusting the discussion section.
Why these lesson goals?	The assessment criteria expect the student to be able to conduct a research project and write a discussion/conclusion section on his own.
Intervention	The teacher will be using open-ended questions adapted from Chi et al. (2001) during a one to one teacher-student conversation about a draft version of the thesis and student's research skills.
Preparation	The student has sent a draft version of the thesis to the teacher, the teacher has read, assessed, and written feedback.
Which objectives are covered in the research lesson?	1) What are the main results of student's research project, 2) What choices has the student made, 3) How to determine the order of topics in your text.
What is the position of the lesson in the curriculum?	This teacher-student conversation is about finalizing the undergraduate thesis, and by that graduating from the undergraduate program of Nutrition and dietetics. Students received research courses which prepared them for conducting a research project on their own.
What is the initial situation of the student, what can be expected of student's prior knowledge and attitude?	The student made a good start with the writing of the discussion / conclusion section. The discussion still needs improvement, there are many unclear and complex formulations in the text, making it difficult to follow what is meant. There is already a slightly flared and converging structure in the text, but what can be improved more is is clearly emphasizing what is really important. Some topics are still missing in the discussion. Here and there it remains superficial. The practical recommendations do not fit well within the discussion / conclusion. And there are still grammar and spelling errors in the text.
Why was chosen for this method of teaching strategy?	By asking open questions, the student will be stimulated to think independently about the choices he made or choices still to be made in writing the discussion.

Appendix S

Lesson study instrument: Research lesson observation form

Table S1 Lesson study instrument: Example of research lesson observation form

1. Initial situation: What knowledge, skills and attitude does this student have at the beginning of the lesson?

The student has made a start with the conclusion / discussion section of the thesis. The discussion in particular needs improvement. The discussion still misses essential parts, and remains superficial here and there. The practical implications as described do not fit in well with the discussion and conclusion. There are also several grammar and spelling errors in the text.

2. Desired end situation: What knowledge, skills and attitude does this student have at the end of the lesson?

The student can continue to adjust the discussion section independently.

3. Observation Codes:

I = the student acts Independent, gives right answer to teacher questions

P = the student acts Pro-active, thinks actively, comes up with suggestions

C = the student asks Clarifying questions

W = the student Waits, is consumptive, asks the teacher for approval

K = the student answers I do not Know

N = the student does Not really participate, only wants to know what is not good

Lesson phase	**Teacher activity**	**Student reactions** **Which student behaviour is observed?**	**Codes**

4. Evaluated situation:

Has the desired final situation been achieved with the student?; How much has the student progressed?; How do you know that?

Appendix T

Lesson study instrument: Interview guide student

Interview questions

1 What did you think of the supervision meeting?

2 What did you enjoy most about the conversation?

3 What did you learn? (What do you know more or can you do better after this conversation?)

4 Which aspect of the conversation worked best for you?
(At what point did you have the most focus, did you have the feeling I am learning the most?)

5 If the same conversation was held with another student, what would you change?

6 Why would you change that?

7 To what extent did you feel understood by your teacher?

8 Did you feel encouraged to ask questions?

9 How much confidence did your teacher give in your research skills?

10 To what extent did your teacher listen to how you want to tackle it?

11 How do you feel that your questions have been answered? (Complete and careful?)

12 To what extent did your teacher make sure that you understood what you should do?

13 To what extent did your teacher give you freedom and choice options?

Supplemental questions

- Can you explain that?
- How did that happen?
- And what did you think then?
- Can you tell us more about that?
- Why?

Appendix U

Coding scheme

Table U1 Final coding scheme for indicators of change, PCK components, learning activities, and domain of IMPG

Code	Definition
Indicator of change	**An indicator of change is the entry point for a pathway of knowledge.**
Change in teacher knowledge	The teacher used the expression of I have learned, I know how, I understand why etc.
Change in teacher practice	The teacher used the expression of Now I am doing, I used to do this but now I am doing that, I tend do more etc.
PCK component	**Each indicator of change is coded on one of the five PCK components**
Assessment	Knowledge of methods of assessment, how to assess student learning, and knowing which parts of content knowledge must be assessed
Curriculum	Knowledge of the curricular goals, how to implement/plan research curriculum.
Instructional strategies	Knowledge of how to transform content knowledge into teaching strategies, e.g. which strategy works and when.
Student understanding	Knowledge of areas of student difficulty, knowing which concepts students find difficult to learn, which problems they experience, which misconceptions they have, which content knowledge they miss.
Teaching orientation	Knowledge about their own goals and beliefs regarding teaching. content knowledge to students, teachers' conceptions.
Learning activities	**Every PCK component is the result of one or more learning activities during the lesson study.**
Considering own practice	The teacher reflected on his/her own teaching practice.
Considering student practice	The teacher reflected on student learning/functioning.
Experiencing friction	The teacher experienced a completely unexpected event or realized their usual teaching approach did not work any longer.
Experimenting	The teacher purposefully tried out a new teaching strategy or new approach in practice.
Getting ideas from others	The teacher got notice of the view or practice of another teacher, or got notice of the view of students or practice supervisor.
Domain of IMPG	**Each coded PCK and corresponding learning activities are coded to the domains of the IMPG.**
Domain of consequence	The teacher considered their own practice and reflected on student learning or student functioning as a consequence of their acting.
Domain of practice	Teacher reflected on their own teaching practice and/or tried out a new teaching practice, and/or experienced something new and unexpected.
External domain	The teacher got his/her idea from other teachers, or from assignments during a lesson study meeting, or from reading literature.
Personal domain	The teacher refers to a change in teacher knowledge.

Appendix V

Criteria for IMPG translation processes

Table V1 Criteria used to identify the pathways of change adapted from Justi and Van Driel and Wongsopawiro et al.(2006; 2017)

Pathway	Process	Criterion
1. PD to ED	Enactment	When a specific aspect of teachers' initial content knowledge, general pedagogical knowledge, or PCK influenced what they did or said during one of the learning activities.
2. ED to PD	Reflection	When something that happened during the learning activities modified teachers' initial content knowledge, general pedagogical knowledge, or PCK.
3. ED to DP	Enactment	When something that happened during the learning activities influenced something that occurred in supervising practice.
4. PD to DP	Enactment	When a specific aspect of teachers' content knowledge, general pedagogical knowledge, or PCK influenced something that occurred in supervising practice.
5. DP to PD	Reflection	When something teachers did in their supervising practice modified their content knowledge, general pedagogical knowledge, or PCK.
6. DP to DC	Reflection	When teachers noticed and reflected on something they did in supervising practice that caused specific outcomes.
7. DC to DP	Enactment	When a specific outcome made teachers state how they would modify the associated supervising practice in the future or made teachers change their practice at that moment.
8. DC to PD	Reflection	When teachers reflected on a specific outcome, thus changing a specific aspect of their previous content knowledge, general pedagogical knowledge, or PCK.
9. PD to DC	Reflection	When a specific aspect of teachers' content knowledge, general pedagogical knowledge, or PCK helped them in reflecting on/analysing a specific outcome of their supervising practice.

Note1: PD = personal domain; ED = external domain; DP = domain of practice; DC = domain of consequence.
Note2: learning activities are the activities of the lesson study participation, as well as other supervising activities they conducted after and between the lesson study meetings.

Appendix W

Audit trail report lesson study

Phase: After data gathering and data analysis

Purpose: Summative assessment on final manuscript

Assessment criteria: Visibility; comprehensibility; acceptability according to the article of Akkerman, Admiraal, Brekelmans, and Oost (2008).

Auditor: Junior researcher Educational Sciences

Auditee: First author

Stage 1 and 2 Orientation to audit procedure (1) and to study (2)

Auditee

- The auditee decided which part of the study would be audited. The audited part included the data gathering methods (i.e. learning reports, video observations, and interviews) and the analytic procedure (i.e. the coding procedure for the three data sources).
- The auditee provided all relevant documents regarding the data gathering and analysis and explained the documents verbally in an interview:
    - Start document: participants, informed consents
    - Final document: final manuscript
    - Raw data teacher interviews
    - Raw data student interviews
    - Transcription manual
    - Processed data: coding books, Nvivo files
    - Process document

- The auditee invited the auditor for an initial orientation to the study, and negotiated about the aim and the procedure of the audit trail.
- The auditee discussed with the auditor if this was doable within the given time.
- The information/ description of the auditee to the auditor included not only all the relevant documents, but also the assessment criteria: 1) how things were done (visibility), 2) why things were done (comprehensibility), and 3) what has been done to maintain (or even check and 'proof') the quality (acceptability).

Auditor

- The auditor interviewed the auditee, and made sure the auditor had enough information.
- If necessary, the auditor asked the auditee for additional information to ensure the *visibility* (what) and *comprehensibility* (why).

Stage 3 Determination of the auditability of the study

Auditor and auditee determined together whether the audit trail was complete, and understandable.

Stage 4 Negotiation of the contract

Auditor and auditee agreed to conduct a summative assessment on the documents of the audit trail, assessed within a few weeks.

Sage 5 Assessment

The auditor followed the audit trail as presented by the auditee, trying to verify all links between problem statement, research design, data gathering and analysis plan. For all these methodological actions and decisions the auditor determined whether the criteria of visibility, comprehensibility, and acceptability were met.

Visibility

- Are decisions described and/or communicated?
- Is the procedure (data gathering and data analysis) written down in a transparent way?

Comprehensibility

- Did the researcher provide enough evidence for the decisions that were made?
- Are the decisions explicated?
- Is the procedure (data gathering and data analysis) written down in a
- comprehensible way?
- Are the differences that emerged between the proposed method and the actual
- analysis written down in a comprehensible way?

Acceptability

- Based on the quality descriptions the auditor evaluates the acceptability.
- Has quality been maintained in terms of reliability and validity throughout all steps undertaken?
- The auditor assesses everything that might ensure vs. harm the quality of the data and analysis.
- With respect to data gathering the auditor could think of the timing of data gathering, the content, and the behavior of the researcher.
- With respect to data analysis the auditor might think of choices in categorization and the way such categories are applied.
- How well is the sample of participants described? Is the sample representative?
- How much tension can be determined between the proposed method of data gathering and the specific circumstances of the teachers and students?
- Did the researcher pay attention to the circumstances of the participants in an acceptable way?
- Is the relationship between researcher and the participants written down in an acceptable way.

Stage 6 Renegotiation

The auditor presented her findings to the auditee. There were some discrepancies in the auditor's claims and what was agreed upon. The auditee did not provide the informed consent forms of the participants. After this renegotiation, the auditor finished the assessment and provided a final written report filling out the assessment scheme.

Stage 7 Final auditor report

In the assessment scheme the auditor can systematically summarize the conclusions on the three criteria for trustworthiness of the study. In this audit trail a formative assessment procedure was conducted in which the planned data gathering and data analysis were assessed.

Table W1. Audit trail assessment scheme

Assessment criteria	Audit trail components
	Data gathering
Visibility	Procedure was visible, every step in the data gathering was written down. The data gathering script was clear. Informed consent forms were checked, and all the raw data transcripts were read.
Comprehensibility	The procedure of data gathering was comprehensible. Sometimes the content of the transcripts did not make sense, because of the specific interactions between the teachers. Another example is the discrepancy analysis which was not mentioned specifically during the transcripts. Teachers worked on this analysis during a meeting, the results were discussed, but it was hard to find at what time this happened. As the transcripts of the video observations existed of 4 or 5 speakers, several teacher utterances were not transcribed, but characterized as "incomprehensible"; sentences and dialogues were therefore sometimes hard to read or to understand. It is hard to understand what the role of the student is in this study.
Acceptability	Only the sentence ´The participating teachers and students were all female; this was representative for the amount of women teaching and attending this bachelor of health program' is about how representative the sample is. It stays unclear why these teachers participated. Was it a purposive (selective) sample? The context in which these teachers work is important as then the reader can draw conclusion to other contexts as well. Do research supervisors in engineering experience the same struggles. And can lesson study provide a solution? In line with the description of the context, the paper still misses a description of the relationship between the first author and the four participating supervisors. The relationship could have influenced the quality of the study, but is now hard to determine.

	Data analysis
	Completely replicable, all the coding is clear. A good example is given of each coding, apart from the learning activities part. An addition could be to provide examples of sentences to the learning activities part as well.
	Adding the 'coding tree' as a figure would give the reader more oversight into the data analysis, however it is not strictly necessary. For every choice in analysis a good source is given. All the methods of analysis (IMPG, pathways of change, etc.) are mentioned in the Introduction. Differences that emerged between the proposed method and the actual analysis are not mentioned.
	Completely replicable, all the coding is clear. However, the raw data can be quite confusing, the content of the transcripts exists of specific interactions between the teachers. The fact that sentences and dialogues are sometimes hard to read can have made the data analysis more difficult.

Nederlandse samenvatting

(Dutch summary)

In het hoger onderwijs hebben studenten veel interacties met hun docent waarin docenten veel feedback geven aan studenten om van te leren. We weten dat feedback een positieve bijdrage levert aan de leerontwikkeling van studenten en dat feedback een sterke invloed heeft op de prestaties van studenten (Black & Wiliam, 1998; Hattie & Timperley, 2007). In verschillende studies rapporteren studenten echter hun frustratie en ontevredenheid over vage en onduidelijke feedback (Ferguson, 2011; Hounsell, McCune, Hounsell, & Litjens, 2008). Feedback zou veel meer dan alleen als overdracht van informatie gezien moeten worden; het zou als communicatie tussen docenten en studenten moeten worden neergezet. Op die manier zijn studenten niet alleen feedback ontvangers, maar krijgen ze ook de gelegenheid om te participeren in een discussie over de feedback met de docent (Nicol & Macfarlane-Dick, 2006). Feedback conversaties, waaraan docenten en studenten samen deelnemen, geven die mogelijkheid. Wanneer feedback niet goed wordt begrepen of geïnterpreteerd, kunnen studenten vragen stellen over de feedback aan de docent of studenten kunnen controleren of ze de feedback goed hebben begrepen (Prins, Sluijsmans, & Kirschner, 2006). Feedback conversaties in het hoger onderwijs zijn een specifiek voorbeeld van student-docent interacties en zijn het onderwerp van deze dissertatie. Student-docent interacties zijn geëxploreerd tijdens feedback conversaties in het hoger onderwijs. Het doel van deze dissertatie was om de complexiteit van feedback conversaties tussen docenten en studenten in het hoger onderwijs te onderzoeken. Specifieker hadden we als doel, om te exploreren hoe deze interacties plaats vonden, waarom ze interacteerden zoals ze deden en om docenten te stimuleren anders te interacteren.

Context

De studies in deze dissertatie zijn allen uitgevoerd in de vierjarige bachelor opleiding Voeding en dietetiek van de Hogeschool van Arnhem en Nijmegen. Het bachelor programma Voeding en diëtetiek leidt studenten op tot diëtisten. De diëtist is de Hbo-opgeleide specialist op het gebied van voeding en gedrag in relatie tot ziekte en gezondheid. De diëtist is de enige professional die gekwalificeerd is om op individueel en groepsniveau dieet- en voedings-problemen te onderzoeken, diagnosticeren en behandelen. Twee grote taken van de opleiding Voeding en diëtetiek stonden centraal in deze dissertatie.

In hoofdstuk 2 stond het rollenspel met een simulatiepatiënt centraal; studenten oefenden hun diëtistische vaardigheden op een patiënt met een welvaartsziekte en pasten klinisch redeneren toe. Op die manier krijgen studenten tijdens de opleiding goede gespreks- en coaching vaardigheden aangeleerd om op een respectvolle en gedegen wijze de patiënt tegemoet te treden. Ook leert de student onder andere de problemen, vragen en behoeften van de patiënt op het gebied van voeding & gezondheid te analyseren, de student leert op basis van deze analyse een conclusie te formuleren en een behandelplan op te stellen. In hoofdstuk 2 was de context van de studie een vaardigheidscursus van zes weken binnen een module welvaartsziekten. Gedurende de cursus kregen de tweedejaars studenten voeding en diëtetiek instructie over het beroep van de diëtist als behandelaar van patiënten met een welvaartsziekte. Aan het einde van deze cursus vond een performance assessment plaats die werd beoordeeld door een docent. Studenten ontvingen feedback op hun performance.

In hoofdstukken 3, 4, 5 en 6 stond de bachelor thesis centraal. De diëtist heeft onderzoekend vermogen nodig om kennis uit onderzoek van anderen toe te passen en zelf onderzoek te doen. De student leert tijdens de opleiding te werken aan de opzet en de uitvoering van praktijkgericht onderzoek, hierover op gedegen wijze te rapporteren en de resultaten te implementeren. De bachelor thesis is in het

hoger onderwijs vaak een laatste proeve van bekwaamheid aan het einde van de opleiding, waarin de student alleen of in een kleine groep zelfstandig een praktijkgericht onderzoek moet uitvoeren. Studenten hebben verschillende kennis en vaardigheden nodig voor het doen van onderzoek, zoals hoe een literatuur onderzoek wordt uitgevoerd, hoe specifieke onderzoeksvragen worden opgesteld, hoe data worden verzameld en geanalyseerd en hoe de resultaten en discussie sectie worden geschreven. In het hoger onderwijs hebben studenten die hun bachelor thesis schrijven regelmatig feedback conversaties met hun docent. Studenten bespreken individueel of met een groepje het proces en (tussen) product van hun onderzoek. Tijdens deze conversaties ontvangen studenten veel feedback op hun onderzoekskennis en -vaardigheden.

Mondelinge feedback tijdens feedback conversaties

In de eerste studie (beschreven in hoofdstuk 2 van dit proefschrift) zijn student percepties en hun motivatie onderzocht vanuit een feedback perspectief. Het effect van mondelinge feedback en het gebruik van feedback voorkeursformulieren op de feedback perceptie, het geloof in eigen kunnen en de motivatie van studenten werd onderzocht. Het geven van schriftelijke feedback wordt veel toegepast in het hoger onderwijs. Schriftelijke feedback die vanuit de docent wordt gedeeld met de student, leidt echter regelmatig tot weinig effectieve feedback (Carless, Salter, Yang, & Lam, 2011). Aangezien schriftelijke feedback voor veel problemen kan zorgen, kan mondelinge feedback hier een oplossing voor zijn. Mondelinge feedback wordt namelijk vaak beter gewaardeerd door studenten omdat het meer lijkt op een natuurlijk gesprek (Merry & Orsmond, 2008). Wanneer studenten de mogelijkheid krijgen om aan te geven op welke delen zij graag feedback ontvangen kan de waardering voor de ontvangen feedback nog meer stijgen (Nicol, 2010). Deze voorkeur voor feedback kan bijvoorbeeld worden geuit via een feedback voorkeurformulier (Bloxham & Campbell, 2010). Een 2 x 2 factoriaal experiment werd uitgevoerd bij 115 studenten. Feedback perceptie enerzijds en motivatie en geloof in eigen kunnen anderzijds werden gemeten met twee verschillende vragenlijsten. Resultaten lieten een significant effect van mondelinge feedback zien op vier van de vijf feedback perceptie schalen en een significant effect op de motivatie schaal van de controle van leren. Studenten waardeerden de mondelinge feedback beter dan de schriftelijke feedback, waarschijnlijk omdat de feedback beter werd begrepen tijdens de feedback conversaties. Deze studie gaf aanleiding om de student-docent interacties tijdens feedback conversaties nader te bestuderen.

Diagnose als voorwaarde tijdens feedback conversaties

In de tweede studie (beschreven in hoofdstuk 3 van dit proefschrift) zijn student-docent interacties onderzocht vanuit een docentperspectief; het diagnostisch gedrag van scriptiebegeleiders werd onderzocht. Om een scriptie te kunnen schrijven hebben studenten specifieke kennis en vaardigheden over onderzoek nodig waar docenten met hun begeleiding bij kunnen helpen. Wanneer docenten adaptief begeleiden, stemmen zij hun interventie af op het huidige niveau van de kennis en vaardigheden die de student heeft. Om adaptieve begeleiding te kunnen geven, dienen docenten wel te weten wat hun studenten al kennen en kunnen. De docent kan dit in kaart brengen door te diagnosticeren welke kennis en vaardigheden over onderzoek een student al beheerst. Wanneer het niveau van kennis en vaardigheden over onderzoek van de student is gediagnosticeerd, kunnen docenten hun begeleiding afstemmen op deze diagnose. In de studie van hoofdstuk 3 hebben we een model gebruikt met vier diagnose fases: diagnostische vragen stellen, diagnose stellen, diagnose checken en interventies toepassen. Met dit model is het diagnostische gedrag van scriptiebegeleiders onderzocht. In een multipele casestudie zijn van vier scriptiebegeleiders 16 feedback conversaties met hun studenten geobserveerd en getranscribeerd. Elke docentuitspraak werd gecodeerd op een van de vier fases. Resultaten lieten zien dat de scriptie begeleiders het niveau van de student vaak niet expliciet diagnosticeerden, maar vaak intervenieerden met bijvoorbeeld uitleg en instructie. We beargumenteerden dat de diagnose over wat

de student al weet veelal impliciet plaats vindt. Door geen expliciete diagnoses te gebruiken, deelden docenten hun conclusie over de kennis en vaardigheden niet met de student. We concludeerden dat het diagnosticeren van het niveau van de student een belangrijke voorwaarde is voor het adaptief begeleiden van studenten en dat meer onderzoek nodig is om deze diagnose te ontrafelen.

Co-regulatie van het leerproces tijdens feedback conversaties

In de derde studie (beschreven in hoofdstuk 4 van dit proefschrift) zijn student-docent interacties onderzocht vanuit het perspectief van de student en van de docent; de interacties werden opnieuw onderzocht in de context van een onderzoeksproject en scriptiebegeleiding. De theorieën van scaffolding en co-regulatie werden gecombineerd om een verschuiving in de docentbegeleiding en in de student verantwoordelijkheid te meten. Co-regulatie werd gedefinieerd als de sociale regulatie van het leerproces van de student waarin studenten tijdelijk hun kennis, gedrag, motivatie en emoties reguleren samen met hun docent (Räisänen, Postareff, & Lindblom-Ylänne, 2016). Docenten werden verwacht om feedback conversaties te domineren wanneer studenten net zijn begonnen aan hun scriptie. Na een tijdje, als de onderzoekskennis en -vaardigheden van de student zijn toegenomen, kan de docent meer verantwoordelijkheid aan de student geven. In een mixed methode multipele casestudy werden twintig feedback conversaties geobserveerd, met video opgenomen en getranscribeerd op twee verschillende momenten: aan het begin van het onderzoeksproject en tegen het einde als de scriptie bijna af was. De transcripten werden geanalyseerd met een zogenaamd 'dialogue act coding' procedure. Resultaten lieten zien dat de co-regulatie tussen studenten en docenten geen verschuiving liet zien over de periode van de onderzoekscursus. Sommige student-docent interacties lieten scriptiebegeleiders zien die met veel enthousiasme begeleiding gaven, ze gaven zo veel feedback en uitleg dat studenten vrij passief deelnamen aan de feedback conversatie. Andere scriptiebegeleiders leken meer autonomie van de student te ondersteunen, deze studenten namen ook meer initiatief tijdens de conversaties. Deze balans van samenwerking waarin studenten en docenten samen het leerproces van de studenten reguleerden werd gezien als werkelijke co-regulatie. We concludeerden dat sommige scriptiebegeleiders wellicht verder moeten reiken dan hun eigen repertoire biedt; zij dienen niet alleen hun eigen script te volgen, maar hun studenten de gelegenheid te geven om een actieve rol op te pakken.

De impliciete diagnose tijdens feedback conversaties ontrafeld

In de vierde studie (beschreven in hoofdstuk 5 van dit proefschrift) zijn de interactieve beslissingen van scriptiebegeleiders onderzocht om het proces van diagnosticeren te ontrafelen. We stelden vast dat docenten diagnosticeren moeilijk vinden, omdat ze geen diagnose stellen (Graesser, Person, & Magliano, 1995), omdat de diagnose ver van perfect zijn (Südkamp, Kaiser, & Möller, 2012), of omdat docenten direct interveniëren (Ruiz-Primo & Furtak, 2007). Doordat de diagnoses in hoofdstuk 3 voornamelijk impliciet en niet te observeren bleven, wilden we de diagnoses verder onderzoeken. Dit hebben we gedaan door data te verzamelen over de interactieve beslissingen van de scriptiebegeleiders en de percepties van de studenten. Interactieve beslissingen zijn de beslissingen die docenten nemen wanneer ze lesgeven en interacteren met hun studenten. We hebben een cyclisch model voorgesteld waarin de diagnoses en lesgevende acties van de docent, als ook de percepties van de student op die lesgevende acties en hun eigen acties zijn opgenomen. Een multipele casestudie werd uitgevoerd waarin zeven feedback conversaties werden geobserveerd en met video zijn opgenomen met een actiecamera op het hoofd van de docent en een camera op statief. De video van de actiecamera is toen gebruikt als stimulus tijdens de stimulated recall interviews met zeven scriptiebegeleiders; de video van de camera op statief werd gebruikt als stimulus tijdens de stimulated recall interviews met zes studenten. Alle interviews werden met video opgenomen, getranscribeerd en geanalyseerd. De resultaten lieten zien dat de scriptiebegeleiders interactieve beslissingen maakten, die een sterke

focus op het leren van de student hadden. Scriptiebegeleiders stelden bijvoorbeeld veel vragen om de studenten te stimuleren voor zich zelf na te denken of om hun kennis en inzicht te vergroten. De percepties van de studenten neigden positiever te zijn, wanneer controle van de studenten op hun eigen leerproces toenam of wanneer ze werden gestimuleerd om voor zich zelf na te denken. Echter andere studenten voelden zich nog onvoorbereid voor zulke interacties en vonden dat ze te weinig duidelijke begeleiding kregen. We concludeerden dat scriptiebegeleiders gevoelig moeten blijven voor de behoeften van de student en dat ze hun begeleiding moeten blijven aanpassen aan deze behoeften.

De kracht van lesson study om feedback conversaties te herontwerpen

In de vijfde studie (beschreven in hoofdstuk 6 van dit proefschrift) hebben we een lesson study project uitgevoerd. Het doel was om aan te tonen dat lesson study als programma voor professionele ontwikkeling van docenten een bijdrage kon leveren aan veranderingen in de pedagogical content knowledge (PCK) van scriptiebegeleiders. Tijdens het vier maanden durende project participeerden vier scriptiebegeleiders en een procesbegeleider in een lesson study team. De lesson study aanpak werd in detail beschreven met alle materialen die ter beschikking werden gesteld of werden ontworpen door de deelnemende docenten. De scriptiebegeleiders waren gefocust op het leerproces van de student. Wij waren gefocust op het leerproces van de scriptiebegeleiders. Data werden verzameld over de leeractiviteiten die de scriptiebegeleiders ontplooiden en over hun PCK. Negen lesson study bijeenkomsten werden geobserveerd, met video opgenomen en getranscribeerd, de scriptiebegeleiders werden gevraagd om vier leerrapporten bij te houden en tot slot werd er een interview gehouden met elk van de scriptiebegeleiders. Resultaten lieten na analyse zien dat lesson study een krachtig programma voor de professionele ontwikkeling van scriptiebegeleiders kan zijn. Lesson study bevat waardevolle leeractiviteiten die een toename van de PCK van scriptiebegeleiders stimuleren. Vooral de PCK componenten kennis van didactische strategieën en kennis van het leren van studenten werden beïnvloed. Het stellen van open vragen was een van de strategieën waarmee de scriptiebegeleiders hadden geëxperimenteerd; deze strategie gaf de scriptiebegeleiders waardevolle informatie om de kennis en vaardigheden van studenten te diagnosticeren. We beargumenteerden dat in dit geval een toename van kennis in didactische strategieën heeft geleid tot een toename van diagnostische vaardigheden. De scriptiebegeleiders rapporteerden dat vooral de beschouwing op het eigen handelen en de beschouwing op het handelen van de student heeft geleid tot deze groei. We concludeerden dat deelname aan een lesson study project het scriptiebegeleiders heeft mogelijk gemaakt hun feedback conversatie te herontwerpen en hun eigen scriptiebegeleiding te veranderen.

Implicaties voor de praktijk

De studies in deze dissertatie hebben verschillende implicaties voor de praktijk. We hebben aangetoond dat mondelinge feedback een grote impact heeft op de feedback perceptie van studenten. We hebben laten zien dat het communiceren van mondelinge feedback tussen student en docent heeft geleid tot deze positieve percepties. Wanneer docenten een feedback conversatie met hun studenten hebben, dan is het aanbevolen dat docenten met een indirecte regulatie strategie starten. Wanneer bijvoorbeeld met het stellen van open vragen wordt begonnen, geeft dit enerzijds de gelegenheid voor studenten om de leiding in de conversatie te nemen; studenten kunnen de verantwoordelijkheid voor hun leerproces laten zien als ze daar klaar voor zijn en ze kunnen laten zien wat ze al weten. Anderzijds geeft deze indirecte strategie docenten de gelegenheid om de kennis en vaardigheden van de student te diagnosticeren en hun begeleiding vervolgens af te stemmen op dit niveau. Tot slot, wanneer docenten niet de beschikking hebben over de juiste diagnostische vaardigheden, dan kan lesson study het programma zijn om de professionele ontwikkeling hiervan te stimuleren.

Conclusie

De vele feedback conversaties die we hebben geobserveerd, lieten student-docent interacties zien die vooral gekarakteriseerd werden door een docent centrale aanpak met veel interventies en directe regulatie richting het leerproces van de student. Vanuit een scaffolding perspectief lijkt dit een heel acceptabele strategie, zeker als studenten net zijn gestart aan een nieuwe taak. Verschillende docenten lieten geen afname in hun begeleiding zien, op het moment dat te verwachten was dat studenten onafhankelijker zouden functioneren aan hun taak. Alhoewel het onduidelijk is gebleven in deze dissertatie of docenten niet in staat waren om hun begeleiding te laten afnemen, hebben we wel kunnen aantonen dat docenten effectieve scaffolding technieken kunnen toepassen en zo de rol van de studenten kunnen versterken. Ons toegepaste lesson study project bleek een effectieve methode om de PCK van didactische strategieën voor scriptiebegeleiders te verrijken. We hebben empirisch bewijs kunnen leveren over de manier hoe docenten de rol van studenten kunnen versterken tijdens feedback conversaties en hoe zij hun studenten kunnen stimuleren om verantwoordelijkheid te nemen op hun eigen leerproces. We hopen dat de studies in deze dissertatie docenten en onderzoekers inspireren, om de balans te vinden in student-docent interacties en dat ook zij zullen concluderen zoals wij hebben gedaan: zowel studenten als docenten zouden de controle moeten hebben.

About the author

Bas Agricola (1974) received a bachelor's degree in Nutrition and Dietetics at the Hague University of Applied Sciences in Den Haag, the Netherlands (2000). From 2000-2008, Bas worked as a dietitian in several medical centres in Amsterdam, Leiden, Rotterdam, and Nijmegen. In 2006, he started working as a lecturer at the bachelor program of Nutrition and Dietetics at the HAN University of Applied Science in Nijmegen. He lectured students in clinical nutrition courses and supervised students in their internships and undergraduate theses. His membership of the assessment committee and work as assessor increased his interest in feedback and assessment. In 2009, Bas obtained a teacher grant (OCW) and started with the premaster program of educational sciences at Utrecht University. In 2013, he received his master's degree in Educational Sciences at Utrecht University. In 2012, Bas applied and obtained a doctoral grant for teachers from the Netherlands Organisation for Scientific Research (NWO). In 2013, Bas started his PhD research on feedback conversations and student-teacher interactions in higher education at the Utrecht University. He presented his research at several national (ORD, HGZO) and international conferences (EARLI). During his PhD, he also worked as a lecturer in the bachelor program in Nutrition and Dietetics at HAN University of Applied Science. Since February 2019, Bas is appointed as a lecturer-researcher at the faculty of education of the Amsterdam University of Applied Sciences. At the centre for applied research in education he will continue his practice-oriented research with a focus on study success during the school careers of students in higher education.

Publications

International publication

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2018). Teachers' diagnosis of students' research skills during the mentoring of the undergraduate thesis. *Mentoring & Tutoring: Partnership in Learning, doi:*https://doi.org/10.1080/13611267.2018.1561015

Submitted international publications

Agricola, B. T., Prins, F. J., & Sluijsmans, D. M. A. (Submitted). Impact of feedback request forms and verbal feedback on students' perception, self-efficacy, and motivation.

Agricola, B. T., van der Schaaf, M. F., Prins, F. J., & van Tartwijk, J. (Submitted). Shifting patterns in co-regulation, feedback perception, and motivation during research supervision meetings.

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (Submitted). Teacher-student perspectives on teaching: A multiple case study about teachers' in-the-moment decisions and students' perceptions.

Agricola, B. T., van der Schaaf, M. F., Prins, F. J., & van Tartwijk, J. (Submitted). Research supervisors' professional development in a lesson study approach: Redesigning research supervision meetings.

International conference contributions

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2017). *Analysing teachers' in-the-moment decisions and students' feedback perception during research supervision meetings about the undergraduate dissertation.* Round table presented at EARLI ASC2017, October 2-6, Utrecht, The Netherlands.

Agricola, B. T., van der Schaaf, M. F., Prins, F. J., & van Tartwijk, J. (2017). *Teachers' decision-making and reasoning: how consistent are their planned and interactive decisions? Poster presented at EARLI2017, August 29-September 2, Tampere, Finland.*

Agricola, Bas, Prins, F. J., van der Schaaf, M. F. & van Tartwijk, J. (2016). *Changes in students' self-regulated learning, feedback perception and motivation during undergraduate research projects.* Paper presented at EARLI SIG1 2016, august 24-26, Munich, Germany.

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2015). *Diagnosing students' understanding: Exploring teacher behaviour during teacher-student dialogues.* Paper presented during symposium at EARLI2015, august 25-29, Limassol, Cyprus.

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2014). *Diagnosing students' understanding: Exploring teacher behaviour during teacher-student dialogues.* Paper presented at International Fall School of Interuniversity Centre of Educational Sciences (ICO), November 10-14, Blankeberge, Belgium.

National conference contributions

Agricola, B. T., van der Schaaf, M.F., Prins, F. J., & van Tartwijk, J. (2015). *Zelfregulerend leren en feedbackpercepties van studenten tijdens begeleidingsgesprekken van de bachelorthesis.* Paper gepresenteerd op de Onderwijs Research Dagen (ORD), 17-19 juni, Leiden, Nederland.

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2015). *Diagnosticeer keer op keer. Hoe ziet de scriptiebegeleiding van studenten er uit?.* Paper gepresenteerd op Hoger Gezondheids Zorg Onderwijs (HGZO) congres, 19-20 maart, Lunteren, Nederland.

Agricola, B. T., Prins, F. J., van der Schaaf, M. F., & van Tartwijk, J. (2014). *Diagnosticeer keer op keer: Hoe contingent is de scriptiebegeleiding van studenten?.* Paper gepresenteerd tijdens symposium op de Onderwijs Research Dagen (ORD), 11-13 juni, Groningen, Nederland.

Agricola, B. T., Prins, F. J., & Sluijsmans, D. M. A. (2013). *Communiceren van assessment feedback. De impact van mondelinge feedback en interactieformulieren op de perceptie, motivatie en self-efficacy van studenten.* Paper gepresenteerd op de Onderwijs Research Dagen (ORD), 29-31 mei, Brussel, Belgie.

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Begeleiding

How to manage Jan en Frans? En een beetje Marieke? ICO bood veel workshops aan met tips en ik heb er veel geprobeerd. Het plannen van afspraken met vier druk bezette mensen is niet gemakkelijk geweest. Worstenbroodjes en appelflappen leken uiteindelijk te helpen; dat had ik eerder moeten weten. Zonder jullie hulp, feedback en correcties had de inhoud van dit proefschrift er niet zo mooi uitgezien. Zelfs familie heeft nog een Cambridge Engels bijdrage geleverd.

Congrestijgers

Alle UU collega's die mee waren tijdens EARLI2015, 2016 en 2017; samen met jullie waren deze congresbezoeken onvergetelijk. Natuurlijk door de inspirerende sessies die we hebben bijgewoond. Maar netwerken kan overal: op het strand van Limasol of in het zwembad van het Ajax hotel. In de biergarten van München kun je heerlijke pretzels en sauerkraut eten tijdens een intercollegiaal overleg. En team builden met de liedjes van Timo's live karaoke band in Henry's pub van Tampere is ook een aanrader.

Studeren

Wanneer ben je met je studie klaar? Nu dus. Ralph en Bart, jullie waren met mij de enige mannen tijdens de ICO introductie cursus. Een mooie start van een vriendschap. Tijdens onze gezamenlijke PhD periode hebben we afwisselend in Den Haag, Utrecht en Amsterdam geborreld en bespraken we onze voortgang, of niet. Jeroen en Rob, jullie oude en recente promotie ervaringen wisselden we uit in proeflokaal de Olofspoort tijdens onze borrels van de wilde wallen wandeling.

Roomies

Motivatie haalde ik uit de collega's om me heen die ook hard aan het werken waren aan hun promotie onderzoek op LV3. Ellie en Thomas dachten altijd met me mee, als ik door een interne verhuizing weer eens van kamer moest wisselen. Martine, Bjorn en Femke en Els die altijd even binnen liep, drie jaar lang op kamer E332 hebben we naast onze promotie uitdagingen, lief en leed kunnen delen. Met Jeroen en Marloes op kamer E334, van wie ik altijd een antwoord kreeg op al mijn statistische vragen.

Tot slot met Eva, Renée, Monika, Esther en geen afscheid kunnen nemende Steven op kamer E336. Toen voelde ik me echt oud. Gelukkig kon ik dan altijd bij overbuurvrouw Ineke terecht.

Helpdesk

Jos jij stond altijd klaar wanneer het printen weer eens niet lukte, of mijn data package toegang was verdwenen, de SPSS licentiecode weer eens was verlopen, je had altijd raad. Gijsbert jij hebt me in je laatste jaar op LV3 nog de kneepjes van de sequentie analyse in MEPA en het DAC filter geleerd. Sophie, Pien en Aline dank voor het uren transcriberen van alle video observaties en interviews. Zonder jullie hulp was ik nu nog met twee vingers aan het typen. Eva en Else dank voor het kritisch meedenken van studies 4 en 5. Door jullie feedback zijn de studies heel erg verbeterd.

Paranimfen

Luce en Eva. Jullie hebben je meer dan een jaar gewillig aangeboden, waardoor ik echt niet meer om jullie heen kon. Ik ben blij dat jullie een mooie jurk hebben aangetrokken.

Participanten

Susanne, Mirjams, Marieke, Sonja, Jenneke, Janneke, Karen, Dorris, Jacqueline, Suzan, Hanny, Danielle, Gerda, Nienke, Inge en alle studenten Voeding en Diëtetiek. Zonder deelnemers, geen onderzoek. Jullie hebben mijn onderzoek gemaakt. Dank dat jullie altijd enthousiast wilden deelnemen, als ik je feedback conversatie wilde opnemen, ik een go pro camera op je hoofd zette, of je vroeg om vier maanden deel te nemen aan de lesson study.

Ouders

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Thuis

Mees en Roef, jullie hebben me al die jaren heerlijk afgeleid, door samen alle Star Wars en Avengers films te kijken, door de hockey en door de drum- en pianoles. Ik vind jullie heel lief. José, door jou bleef ik met beide benen op de grond ("Is er nu al een studie gepubliceerd?"), ik waardeer je relativeringsvermogen ("Wat heb je eigenlijk aangetoond met je onderzoek?") en ik weet dat je heel erg blij bent met mijn rokkostuum. Ik hou van je.

Who's in Control?

In higher education students have many interactions with their teacher in which teachers provide support for students' learning. Feedback conversations in higher education are specific examples of student-teacher interactions and are the objects of this dissertation. Feedback conversations can help students to acquire the essential skills for the task they are working on. In five empirical studies, we aimed to unravel the complexity of face-to-face feedback conversations between teachers and students in higher education. We explored how these student-teacher interactions take place, why they interact the way they do, and we stimulated teachers to interact differently. In many of the feedback conversations we observed student-teacher interactions that were characterized by a teacher-centred approach. From a scaffolding perspective, this seems to be an acceptable teaching strategy when students are starting with a new task. We have provided the empirical evidence about how teachers can strengthen the role of students and how they can stimulate students to take on responsibility for their own learning process. Our teachers were able to apply indirect regulation strategies, such as asking questions and prompting, to stimulate students to think for themselves. We hope that this dissertation will inspire teachers, as well as researchers, to find the balance in student-teacher interactions, and conclude as we did: both students and teachers should be in control.