



Learning dynamics in doctoral supervision

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Abstract

This doctoral research explores doctoral supervision within life science research in a Danish university. From one angle it investigates doctoral students' experiences with strengthening the relationship with their supervisors through a structured meeting with the supervisor, prepared as part of an introduction course for new doctoral students. This study showed how the course provides an effective way to build supervisee agency and strengthening supervisory relationships through clarification and alignment of expectations and sharing goals about doctoral studies. From the other angle the research investigates learning opportunities in supervision with multiple supervisors. This was investigated through observations and recording of supervision, and subsequent analysis of transcripts. The analyses used different perspectives on learning; learning as participation, positioning theory and variation theory. The research illuminates how learning opportunities are created in the interaction through the scientific discussions. It also shows how multiple supervisors can contribute to supervision by providing new perspectives and opinions that have a potential for creating new understandings. The combination of different theoretical frameworks from the perspectives of learning as individual acquisition and a sociocultural perspective on learning contributed to a nuanced illustration of the otherwise implicit practices of supervision.

Summary

This dissertation reports on five studies into doctoral supervision within life science research in a Danish university. The first study considers personal development planning and alignment of expectations as a means to strengthen supervisory relationships in doctoral education by analysing course assignments and written reflections provided by earlier course participants. As part of an Introduction Course for new PhD students, participants make a personal development plan. They are required to share their plan with their supervisor together with questions to clarify expectations to the supervisory process. The study illustrates how such structured and scaffolded meetings can work as an asset in establishing good working relationships in doctoral education, but also points to the difficulty in reaching those supervisors who appear to be too busy to contribute effectively to the process or are largely indifferent towards doctoral education.

The remainder four studies are based on observations and recording of supervision sessions and subsequent interviews with supervisors and doctoral students. The interaction has been analysed using positioning theory, the notion of variation, learning as participation and the concept of multivoicedness from dialogism. The first two of these four studies was an analysis of a single supervision session, which concerned methodologies to be employed in a PhD study and included the doctoral student and her three supervisors. In the first study the analysis was informed by Anthropological Theory of Didactics, and showed how the supervisory style was dialogical because of the interdisciplinary nature of the research project and the student-focused approach adopted by the supervisors. In the second study the analysis was informed by positioning theory and dialogism. The analysis identified two contrasting storylines about how the researchers in this particular research environment talk about 'scientifically sound' research in contradicting manners. A learning opportunity was created for the doctoral student as a participant in the academic discussion with her supervisors, because of the diverging voices of her

supervisors that allowed for the doctoral student to create her own understandings. The involvement of multiple supervisors appears to enrich the learning environment and help create learning opportunities.

The two last studies were based on observations of four cases of supervision of doctoral students with each their two supervisors. Analytically one of these two studies employed variation theory, whereas the other used two perspectives; a sociocultural perspective on learning as participation and the use of positioning theory, and an individual constructivist perspective seeing variation as key for learning. The use of the notion of variation illustrates how opportunities to learn about subject matter as well as norms and values are created when aspects of phenomena are varied and expand the space of learning. Variation theory is not concerned with the interactional aspects of learning, so another perspective is needed to investigate the influence of having more than one supervisor. Therefore variation theory was used together with positioning theory and learning as participation. Different levels of participation were identified, leading to identification of learning opportunities that are specific to supervision with multiple supervisors as 'supervisors supplementing doctoral student' in presenting, 'engaging in common discussion' as a more complex setting than engaging in dialogue with one supervisor, and 'supervisors' internal dialogue'. The first is an opportunity for the supervisor to scaffold the doctoral student in presenting. The latter is an opportunity for the doctoral student to observe scientists engaging in scientific discussion. The opportunities to construct knowledge are identified as patterns of variation in the scientific discussions, for instance by contrasting different aspects of a concept or phenomenon. The ways that the doctoral students are positioned and position themselves illuminates the dynamics in play in doctoral supervision. Having a co-supervisor participating in the meeting enriches the learning environment for the doctoral students. The combination of different theoretical frameworks from the perspectives of learning as individual acquisition and a sociocultural perspective on learning contributed to a nuanced illustration of the otherwise implicit practices of supervision.

Sammenfatning

Denne afhandling omfatter fem studier om ph.d.-vejledning inden for life science på et dansk universitet. Det første studie afdækker hvordan ph.d.-studerende aktivt kan styrke samarbejdet med deres vejleder. Som en del af et introduktionskursus for nye ph.d.-studerende udarbejder deltagerne en personlig plan for egen læreproces. Efterfølgende diskuterer kursusdeltagerne deres plan med vejleder sammen med en række spørgsmål til at afklare forventningerne til vejledningsprocessen. Studiet viser hvordan en sådan struktureret samtale med vejleder kan fungere som et aktiv i at etablere gode samarbejdsrelationer i vejledningen, men peger også på vanskelighederne ved at nå vejledere, der synes at have for travlt til at bidrage effektivt til processen, eller ikke prioriterer deres ph.d.-studerende.

De resterende fire studier er baseret på observationer og lyd- og videooptagelse af vejledningssessioner og efterfølgende interviews med vejledere og ph.d.-studerende. Sessionerne er transskriberet ordret og analyseret ved hjælp af positioneringsteori, variationsteori, læring som deltagelse og begrebet flerstemmighed fra dialogisme. De første to af disse fire studier var en analyse af en enkelt vejledningssession med en ph.d.-studerende og hendes tre vejledere. Sessionen blev først analyseret gennem Didaktisk Antropologisk Teori, og viste at vejledningsstilen var dialogisk fordi forskningsfeltet var interdisciplinært og fordi vejlederne var studenter-orienterede i deres tilgang til vejledning. Det næste studie analyserede sessionen ved brug af positioneringsteori og dialogisme. Gennem analysen blev to modsigende storylines identificeret, idet vejlederne i dette specifikke forskningsmiljø talte om god videnskabelig praksis ud fra forskellige forståelser. Vejledernes flerstemmighed blev en læringsmulighed for ph.d.-studerende som derigennem kunne skabe sine egne forståelser og på sigt sin egen profil som forsker.

De to sidste studier er baseret på observationer af fire vejledningssessioner med ph.d.-studerende med hver deres to vejledere. Analytisk benytter det første af disse to studier

variationsteori, mens det andet studie tager to perspektiver på læring i brug, et sociokulturelt perspektiv på læring som deltagelse og brug af positioneringsteori, og et individuelt perspektiv på læring som variation. Ved hjælp af begrebet variation illustreres, hvordan der skabes muligheder for at lære både om faget, videnskabelige kompetencer samt videnskabelige normer og værdier. Begrebet variation beskæftiger sig ikke med interaktive aspekter af læring, så der er brug for et andet perspektiv for at kunne sige noget om den betydningen af at have flere vejledere. I det andet studie blev begrebet variation anvendt sammen med positioneringsteori og læring som deltagelse. I dette studie identificeres først niveauer af deltagelse i vejledning med flere vejledere, og blandt disse niveauer ses følgende som læringsmuligheder der forudsætter flere vejledere: 'vejleder supplerer den ph.d.-studerende' i at præsentere, 'fælles diskussion' som mere komplekst end at indgå i dialog med én vejleder, og 'vejlederes interne dialog'. Den første er en mulighed for at vejlederen støtter den ph.d.-studerende i at præsentere. Sidstnævnte er en mulighed for at den ph.d.-studerende kan observere forskere i en videnskabelig diskussion, som en diskursiv praksis i dette praksisfællesskab. Læringsmulighederne set som individuel læring viser sig ved at aspekter af et begreb eller fænomen varieres i mønstre som sammenligning eller kontrastering. De måder de ph.d.-studerende positioneres, og positionerer sig selv illustrerer dynamikken i vejledningen. Vejledning med flere vejledere viser sig at berige læringsmiljøet for de ph.d.-studerende, men det er mere komplekst og krævende for vejlederne.

1. Introduction

I start this thesis with my motivation for going into this doctoral research as an introduction. In chapter 2 I frame the study in the context of previous research in the field. Figure 1 depicts how two foci run through the thesis: The doctoral students' agency and the interaction with multiple supervisors. I start with a general introduction to doctoral education in Denmark, and then I describe relevant literature for the research in this thesis from the perspectives of the doctoral students, the supervisors, and finally the interaction. Chapter 3 is concerned with the theoretical approaches and methods applied in this research, and validity questions and ethics. Chapter 4 gives the reader a brief overview of the four manuscripts and an overview of the findings before moving on to the discussion in chapter 5, and ending with concluding remarks in chapter 6.

The aim of this introduction is first to give the reader an overview of the thesis, and then to introduce myself as a researcher and doctoral student.

1.1 Navigating the thesis

This doctoral research concerns doctoral supervision. The thesis comprises of four manuscripts / papers and an extended abstract associated with a poster that are appended, and an introduction. For easy reference I have given short-hand names to the five studies that each are presented in an appended papers/abstract. The flow diagram in figure 1.1 shows the interconnectedness between the different parts of the thesis.

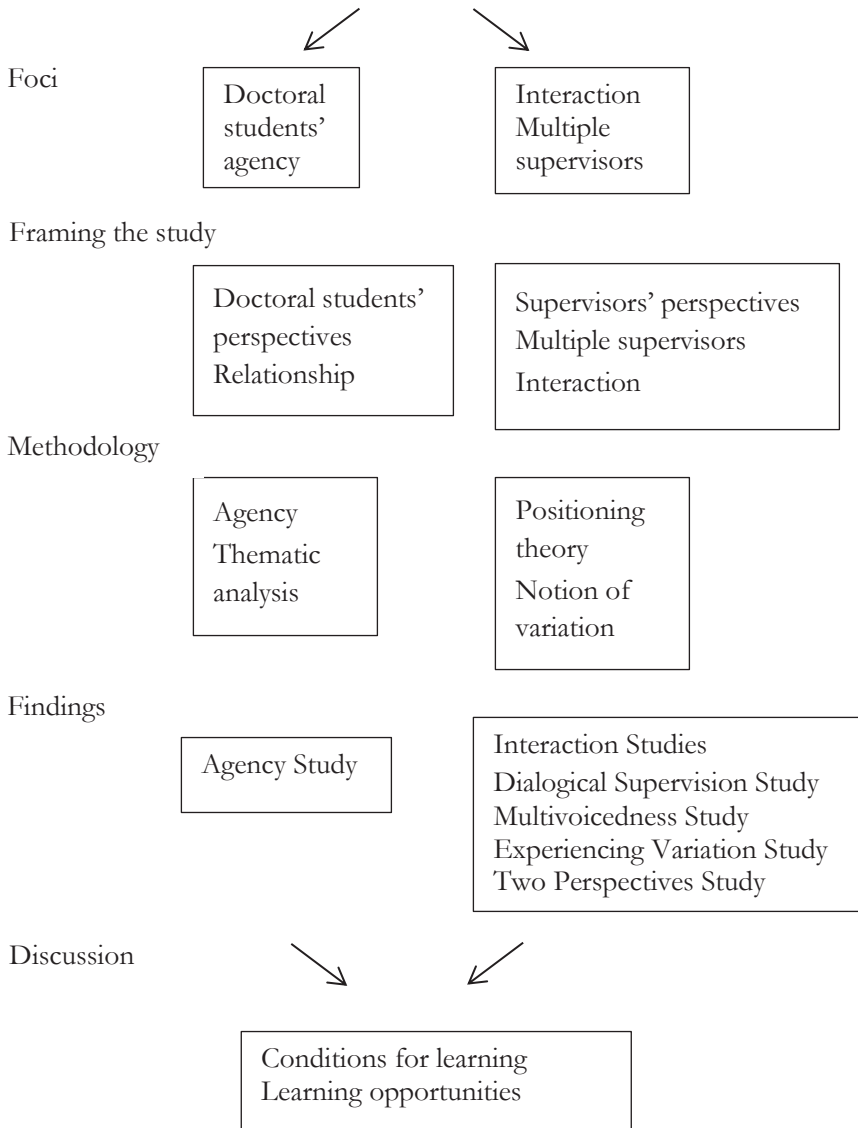


Figure 1.1. Map of the thesis to help navigate.

The five studies that are presented in the appended papers/abstract:

1. **The Agency Study:** Building agency and strengthening supervisory relationships in doctoral education.
2. **The Dialogical Supervision Study:** Supervisors' approaches to supervision and how these relate to conceptions of research.
3. **The Multivoicedness Study:** Interaction and learning in PhD supervision – a qualitative study of supervision with multiple supervisors.
4. **The Experiencing Variation Study:** Experiencing variation - learning opportunities in doctoral supervision.
5. **The Two Perspectives Study:** Learning opportunities in doctoral supervision - viewed from two perspectives.

1.2 Entry to the study

This PhD thesis is the result of two years' full time enrolment as doctoral student and equal to one year's full time work prior to that. The work I did before enrolment comprises 25 ECTS coursework at PhD level and some groundwork for the Agency Study and the Multivoicedness Study in this thesis. My basis for embarking on this PhD study included courses in philosophy of science, action research, soft systems methodology and qualitative methods (mainly ethnography and interview technique). My background is a higher degree in agricultural science and work in university administration, and my interest in the topic of PhD supervision stems from working with doctoral students over the last decade. Hearing about their experiences from the troubled terrain of supervision, and organising workshops for doctoral students and supervisors about supervision has been great inspiration as well as important motivation for me. In 2007 I started our Introduction Course for new PhD Students together with colleagues from the Graduate School of Life Sciences. At this course we attempt to equip the novice researchers to enter

their supervisory relationships in a constructive manner that will help them improve the interaction with their supervisors. My work on the first manuscript started before I started my PhD, out of curiosity about if and how our attempts to improve interaction worked. In 2009 the Graduate School of Life Sciences funded a qualitative evaluation of the course and an external ethnographer, Sine Penthin Grumløse, was employed to interview a cohort of participants who had participated in the course 18 months earlier (Grumløse, Kobayashi & Grout, 2010). The findings of the evaluation were presented at the EARLI conference in Exeter in August 2011. This work has been my main entry into PhD studies, and Paper I is based on further work researching the effects of the course on the supervisory relationship.

At one of the PhD courses I attended in 2008, 'The business of Ethnography' at Copenhagen Business School, I conducted a small fieldwork for the course. I observed supervision sessions at one department at the Faculty of Life Sciences at the University of Copenhagen, and I interviewed some of the supervisors. For the purpose of the course I attempted to make a thick description (Geertz, 1973) across supervision sessions, to describe the themes that supervision was concerned with. I sound-recorded the supervision sessions, and one of these sessions, a doctoral student meeting with her three supervisors, formed the basis for a conference poster presentation in 2012 and the Multivoicedness Study of this thesis.

Another piece of work that has contributed to my basis for undertaking this PhD in two years only is an ethnographic study of supervision across faculties of the University of Copenhagen, funded by the Research Training Council of the University of Copenhagen in 2009. I interviewed seven heads of Graduate Schools and three supervisors together covering the eight faculties of the university with an external ethnographer, Josefine Due, as my teacher/supervisor on interview technique and ethnographic thematic analysis. She in turn interviewed 15 PhD students, and in collaboration with Camilla Rump we published a small booklet on supervision 'To lead the way' (Due, Kobayashi & Rump, 2009). While working on this I attended a PhD course on qualitative research methodologies at Aarhus University. The

study was presented at the EARLI SIG on Higher Education in Helsinki, August 2010. The booklet has since been published by Australia National University, emphasising the general value of the work (Due, Kobayashi & Rump, 2012).

In 2010 I received funding for a small staff development project on PhD supervision from The Centre for Development of Human Resources (Statens Center for Kompetenceudvikling - SCK). I took a bottom-up approach in two different groups, one being a department and the other being a research group within another department, where I consulted the potential participants to learn what they found to be important issues in supervision. On that basis I planned a series of interactive workshops on the themes they had identified. Both supervisors and doctoral students were involved in the planning and took part in the workshops. My approach was rooted in earlier work on action research / action learning using soft systems methodology (Checkland & Scholes, 1990) and inspired by a PhD course I attended in 2010 in Uppsala with the Action Research Action Learning Interest Group (ARALIG is a Nordic network of PhD researchers, academics and others with an interested in Action Research in the context of Social Learning in Nature-Society Relations).

My doctoral studies

When I was enrolled as a doctoral student in October 2011 my interest was circling around PhD supervision and the learning processes involved in PhD education. Methodologically I was mainly grounded in ethnography, but with an urge to make changes through my research and rather keen on the idea of doing action research. My motivation was to improve the learning environment for doctoral student by shedding light on supervision and facilitate change processes for supervisors who wanted to improve their practice. At the same time I saw (and still see) this as an opportunity for me to learn, and to build my theoretical foundations and the methodological understanding in higher education research. As I explored literature on action research I found many of these studies theoretically shallow, and I realized the danger of ending up with a theoretically superficial project, especially with my rather weak theoretical basis within

higher education research. I decided to put my action research ideas into a drawer labelled ‘post doc or later’, and investigate supervisory practices as they are.

I aimed at exploring differences in supervisory style/ approach between different disciplines, and how this changed over the course of PhD studies. Thus I set out to make a quasi-longitudinal study with the aim to ‘investigate how PhD students in a science based faculty construe and experience their learning environment, including their supervisory relationships, and how this relates to the supervisors’ approaches to supervision’. I delimited the scope of the project to natural science research. I had, at some point, considered making a comparative study across faculties, but partly because I am based at and sponsored by a science faculty I decided to investigate supervision in the natural sciences. This means that I can say something about how supervision takes place within natural science, more specifically life sciences, and transferability to social sciences and arts and humanities will need to be researched. The delimitation of data collection to supervision within life sciences has the advantage that I understand the scientific discussions sufficiently well to analyse the interaction, given my background in agricultural sciences. Another, more pragmatic reason was that I had easier access to supervisors and doctoral students at the previous Faculty of Life Sciences, where I had worked for a decade. I come back to recruitment of cases in chapter 3 on Methodologies. I had three specific objectives

- 1) How do PhD students create and use their learning environment?
- 2) How do supervisors support the processes of learning and identity formation?
- 3) How do Supervisors and PhD students interact over time and create learning possibilities?

I focused on learning opportunities in the interaction, seeing learning as participation and identity formation (Lave & Wenger, 1991). Actual learning from a supervision session is near to

impossible to measure, even with pre- and post-tests, because the learning in PhD studies happens in a multitude of spaces that intertwine, and isolating what a doctoral student learns from a one hour meeting cannot be isolated from what she gained from the coffee talk with a colleague, babbling about her research just before the supervision meeting, and how the two learning situations influence each other.

I intended to investigate the first question, how PhD students construe and use their learning environment, through interviews with doctoral students. My interest in this question was inspired by a paper by Boud and Lee (2005) who suggest the need for a new discourse in research education pedagogy to enable research students to make use of the learning opportunities available in their environment and thus take on the role of self-organising agents in their own research learning. This idea resonated with our ideas and intentions with the Introduction Course for New PhD Students. I was hoping to be able to show that doctoral students who had attended the introduction course were more agentive, and to get a better understanding of how we might support them further in this process of building agency. During interviews I asked doctoral students to describe where they would go for help, who they would ask, and how they would describe the research and learning environment. However, I did not pursue this question further in my analyses, partly because I felt that I did only get obvious answers and was only scratching the surface of this question through interviews, and partly because I got more interested in the third question over the course of my data collection and analyses.

With the second question, how supervisors support the learning process, I intended to shed light on the supervisors' experiences and intentions with supervision, as perceived by the supervisors. I also intended to explore the research-supervision nexus (as parallel to teaching-research nexus) by asking supervisors about their research. I expected that I would be able to find differences between disciplines, as reported by Madsen and Winsløw (2009). They studied the research – teaching nexus in two disciplines: Physical Geography and Mathematics, which were their own respective fields. In their study Madsen and Winsløw found a

much closer link between research and teaching in physical geography than in mathematics, and they explained this as differences in the hierarchy of the two disciplines. I did not find such differences from my interviews, probably because all my cases were concerned with applied research and resembled physical geography in that sense. And again, I became preoccupied with the third question, or rather, a modification of the third question.

The third question then, concerns how supervisors and doctoral students create learning opportunities over time. This was intended as a quasi-longitudinal study. I recruited cases so that I would have doctoral students in the beginning of their research, one year into their PhD study, and two years into their studies. By following them over a 10 months' period I would have covered almost the whole period of three years, although not with the same doctoral students. I planned to observe some three to four supervision sessions with each of them over these ten months, and interview both the doctoral students and supervisors in the beginning (after the first observation), in the middle, and at the end of the period. This is still in my plans, but I decided to keep following the doctoral students until they graduate, so the longitudinal study is still continuing. I plan to analyse and publish this at a later stage, and the longitudinal aspect is not a part of this thesis. The core of the question, how learning opportunities are created in the interaction, became the overall research question.

I attended a PhD course named 'Didactics as Design Science' when I started in the Department of Science Education. Through the course I got acquainted with the Anthropological Theory of Didactics (Chevallard, 2006) and as an assignment for the course I analysed a supervision session from my 2008 fieldwork. I used Chevallard's concept of *praxeology* to analyse the research-supervision nexus, to find linkages between the nature of the research and the approaches to supervision. The analysis of the case showed how three supervisors in an interdisciplinary PhD project included the doctoral student in an academic discussion about research methodologies. The interdisciplinary nature of the project seemed to urge the supervisors to go into a dialogue about the research as none of them were an expert on the whole

project, thus in this case interdisciplinary research promotes dialogical supervision. The course paper was presented as a conference poster at the Quality in Postgraduate Research conference in Adelaide, Australia in 2012 (Kobayashi, Grout & Rump, 2012).

The analysis of the supervision session triggered my curiosity about multiple supervisors, and I went on to interview the doctoral student, who had now graduated and was employed as a post doc, and two of her three supervisors. The third had taken up a new job in his home country. Another source of inspiration at the time (spring 2012) was the PhD thesis by Maria Berge (2011) on learning possibilities in physics group work. Berge used three different theoretical frameworks to analyse the learning dynamics in group work, namely phenomenography and variation theory, the sociocultural perspective of positioning theory and conversation analysis. I used positioning theory to analyse the learning opportunities in the supervision session with three supervisors supplemented with the interviews with the participants in the Multivoicedness Study.

From there I went on to analyse the supervision sessions I had observed where two supervisors were present. Because the Graduate School of Life Sciences had a policy of assigning both a principal and a supplementary supervisor to all doctoral students enrolled, all the doctoral students in my study have two or more supervisors. Not all of them meet with all their supervisors simultaneously, though, but four of the twelve cases I had observed were with two supervisors present. I learned from my literature review for the Multivoicedness Study that supervision with multiple supervisors is under-researched although the practice is becoming more and more common. It is often thought of as problematic, but the work by Dysthe, Samara and Westheim (2006) on multiple voices showed learning opportunities specifically availed from having more than one supervisor.

I decided that my third paper in the thesis should be an analysis of these four supervision settings, using the notion of variation and positioning theory to identify learning opportunities in

supervision with multiple supervisors, and I submitted an abstract for the EARLI conference 2013 to frame the paper.

I went to Umeå University in Sweden to collaborate with Maria Berge on this paper, and we decided to start out with a paper only using the notion of variation to analyse learning opportunities. This collaboration resulted in the Experiencing Variation Study. The fourth study then is based on the abstract submitted for and presented at a symposium at EARLI 2013.

When I first embarked on this journey of exploring supervision of doctoral students, I often, informally, posed this question to supervisors I talked with: How do you teach scientific thinking? Most supervisors hesitated to answer this question, they replied in the direction of ‘That is something PhD students learn from doing research’ or ‘I give them this book to read: What is Science’. One supervisor, an associate professor in organic agriculture, had a more concise answer

‘I think that comes from discussing their research project with them and through emphasizing different approaches to scientific quality. It is quite easy to discuss scientific thinking and quality when it is done relative to specific research projects and publications’.

Later, when I was working with my data, looking for learning opportunities in terms of learning space created as variation of a phenomenon offered in the interaction, I realized what this supervisor was talking about. Learning opportunities are created in the discussion about problems in the research, the experiments, the protocols, where variation of scientific phenomena are experienced, brought up by the supervisor, the doctoral student or the research.

The primary question underlying this thesis then is: How are learning opportunities created by the supervisors and doctoral student during supervision sessions with multiple supervisors? While the Agency Study is concerned with students’ agency and the supervisory relationship, the Interaction Studies are

concerned with analysis of actual supervision with multiple supervisors.

1.3 Supervision Philosophy Statement

A Philosophy Statement reflects the basic conception of learning that a person's supervision is based on. This is where the individual supervisor defines her central ambition. In a Danish article in co-authorship with Asbjørn Molly we define how the philosophical grounding is critical for how a supervision style is evoked in practice as the techniques available in the supervisor's mental toolbox are employed in each situation (Molly & Kobayashi, 2014). If, for instance, one has a philosophical grounding in an understanding of learning as transmission and teaching as Teacher-Focused Information Transmission (Prosser & Trigwell, 1999), this will lead to a supervisory style of telling and directing. The supervisory style may become predominantly authoritarian, and this influences the learning space created for the doctoral student. In this section I unfold my own philosophical statement. I am not yet entitled to supervise doctoral students, so this statement builds on my values, my insights gained through research and readings, and my experiences from teaching doctoral students at our Introduction Course for new PhD students at Science, as well as teaching PhD supervisors at the University of Copenhagen.

To me, supervision is to create a space for learning in a certain context. My conception of learning is therefore pivotal for my understanding of supervision. I like to think that I am a constructivist to my bones. This is not only based on my intellectual understanding of how individuals learn gained from my readings, discussions with colleagues, coursework and my teaching. It is also based on my deeply rooted personal values. It matters to me to be able to help others, to understand their starting point and facilitate their development on their own terms. It makes me happy to see people grow, whether it has been my daughter growing up and becoming independent of her parents, or when I coach doctoral students and they find a way forward. In relation to this my ability to empathize with another person is

important because it enables me to better understand their starting point.

Education at doctoral level is shaped around the individual doctoral student and I see the research project as the vehicle for learning. I find it optimal that the learning goals are mutually agreed, since it would help me as a supervisor to know where a doctoral student wants to get to. The research project as a vehicle for learning and the wider doctoral education are interdependent and present simultaneously. One cannot discuss one without the other, but one can be foregrounded. The research thus shapes the content of the education and for me as a supervisor to be, it would have to be sufficiently relevant to my own research interests for me to engage and have a stake in the outcomes, but it remains the background for educating a researcher while I foreground the competence and personal development. This does not mean that I would spend less time discussing the research, but I believe that the way the research is discussed is different if one foregrounds competence development.

As for the goals of doctoral education, generally perceived to produce autonomous scholars, I think that some second thoughts are needed. In the sciences at least, research is carried out by teams of researchers, and being able to collaborate, to listen and take in other people's viewpoints, is fundamental. I think, instead of aiming at independence we should aim at interdependence or mutual dependency. Of course, this also connects well with my personal values as I value sharing, solidarity and co-operation. I believe that collaboration enhances learning, and I prioritize a collaborative environment because I believe that it enhances learning much better than a competitive environment.

This also means that I see Olga Dysthe's 'Partnership model' as the ideal to strive for in dyadic relationships, with elements of her 'Apprenticeship model' to supplement that (Dysthe, 2002b) especially in applied sciences where my research is based. A partnership is not necessarily based on equal partners, and in supervision the relationship is inherently asymmetrical.

The relations of power in play in supervision have advantages and challenges. A possible challenge is the inescapable summative element in supervision, which makes formative feedback an ideal that is difficult to achieve especially in the beginning when the doctoral student is more insecure. Lauvås and Jakobsen (2002) describe formative and summative assessment as:

Formative: It is first of all the incomplete, the unfinished and the bad quality that it is important to identify. However, the one being assessed must feel safe that issues brought out will be treated confidentially and that it will not influence the summative assessment in any way. It is silly if you, as a student, do not accept the invitation of thorough assessment, because then you reject the help offered for your own development. The assessor is a change agent and developer who engages in the process.

Summative: The one being assessed should, and has the right to, show all the best, the successes and the correct and hide what is not as good. It is silly to be open and honest; here it is about showing the positive sides like in a job interview. Assessor is a neutral judge who should not get involved, but keep a distance. (Lauvås & Jakobsen, 2002, p. 90, My translation from Norwegian).

This description in my view explains an important implication of the power in play in supervision and it stresses why trust is essential in the asymmetrical relationship. As a doctoral student one is a legitimate, peripheral participant striving to move towards a more central position, and to be recognised as a worthy full member of the community of scholars. To be recognised as such it can be difficult for a new doctoral student to reveal doubts and weaknesses. One tries to show the best aspects, to perform, and the supervisor can easily be seen as a judge. Of course, much depends on the confidence of the doctoral student, but it is my experience from our introduction courses that many feel rather unconfident in their new role as researchers. Being a good course-taker is not enough - being a researcher requires other competences (Lovitts, 2005). I find the advice from one supervisor in our interview study very valuable to address this

imbalance: 'Personally, I think that the confirmation that their work is both good enough and can be even better – that duality – is critically important' (Due et al., 2009, p. 5). The emphasis that Lauvås and Jakobsen (2002) give the 'incomplete, the unfinished and the bad quality' makes formative feedback difficult, and the definition ought to be more balanced. I think formative feedback must include the positive specific feedback and non-evaluative feedback. I find the non-evaluative techniques provided by Peter Elbow very useful, for instance 'movie of the reader's mind' where you add a meta-voice as comments to paraphrase what you understand from the text (Elbow & Belanoff, 1995). Then it is up to the author to evaluate if she got her message across and what needs to be done to improve the text. Because these techniques are non-evaluative in nature they support the efforts in being formative in spite of the asymmetrical relationship. These are techniques I learned from Sarah Haas, a friend and expert in writing processes. The positive feedback is immensely important to build a person's confidence and self-efficacy believes, but it needs to be specific in order to be constructive and point forward.

In my experience private relationships do not necessarily hinder professionalism. It is not the relationship that is wrong, but the supervisor's competences as a professional, or the ability by either of the two to be open and self-reflective. Being friends in a supervisory relationship makes it more complex, as there is more at stake - the friendship and the research education - and it may be challenging to separate the different roles. It can be difficult to give serious or fundamental criticism if the relationship is very close, because of the anxiety to damage the friendship, and because both may need to be able to withdraw and digest. So I recognise that it is a balancing act, but in my experience it is a great advantage to know each other well enough to understand the nuances of the intonation and body language, the reasons for changes in behaviour if for instance family issues are disturbing daily routines, etc. I believe it makes communication easier and the relationship more robust. But I also think that it demands a strong social contract of the supervisor being an ally, and it demands certain level of self-reflection to receive criticism constructively; an openness to admit mistakes and change one's

opinion. And then it demands that the supervisee sees the supervisor as a rightly authority. Especially young and inexperienced supervisors find it difficult to have an overly friendly relationship with their supervisees. This is perhaps because they do not have the authority of an experienced supervisor and therefore mainly has the institutionally mediated position to back their authority as a supervisor. In Scandinavia at least authority and respect is earned through experience, competence and knowing rather than from the formal institutional position.

This leads me to the next topic: Supervision in cross-cultural settings. I believe that every doctoral student is a unique individual, and culture, like other social positions as ethnicity, gender, age or class are always/already conditions for interaction. An individual's cultural background is not predictive of their behaviour, but culture (as other social positions) is always negotiated in the interaction. A person's cultural and educational background arouses expectations of certain behaviour, but the individual may not live up to the 'stereotype' of her culture. An understanding of a person's cultural background can facilitate mutual understanding as long as one remains curious and does not take anything for granted.

I would like to give an example which I find very illustrative of the situation I believe many international doctoral students find themselves in. At a seminar at the Swedish Agricultural University in Uppsala in 2009 I facilitated a peer supervision of supervision together with Professor Nadarajah Sriskandarajah. A summary of the session was written up immediately after, and below is an excerpt of the summary.

A PhD student and his supervisor (also male) volunteered to make a supervision session with the group as audience. They made pre- and post-supervision sessions moderated by Sri (supervisor group) and Sofie (PhD group). The PhD student perceived himself as quite autonomous even though he started his studies recently. Still he would like his supervisor to reassure him from time to time that he agrees or supports him to

continue in the direction he has set out or suggested. He also said that he would like to go into more detail with some issues and that he felt that the supervision sometimes became superficial. One of his peers was appointed to give feedback, and he especially asked clarifying questions and summarized what the focus PhD wanted feedback on. They staged the supervision. The post-supervision session took place as feedback from the peer groups, but openly so that we all listened. The feedback giver from the PhD group shared his reflections. In a very non-intruding way, he suggested that the PhD student in focus did not get the reassurance he was hoping for or aiming at, and that he could do more himself to get that. The peer suggested that the focus PhD could ask his supervisor not to shift the subject until he was clear about details and decisions regarding current topic. The focus PhD referred to his cultural and educational background to explain his need for reassurance. In his view his educational background from Colombia meant that he was used to very factual feedback: 'This is good'/'this is bad'. Even though he knows that the type of feedback he would get in Sweden is different, it was difficult for him to reassure himself that he was doing OK as long as he would not hear otherwise.

There are two points I would like to make about this case. One point is that cross-cultural supervision is not only about the individuals' national cultures, but their educational background is important, and the two are intertwined. It is my (our) hypothesis that many international students from non-Western schooling systems are used to get much more summative feedback, and this makes it difficult to cope with what they may perceive as lack of feedback in the Scandinavian system. We, my-self and Mie Kobayashi, are currently investigating that in an interview study. The other point is that this doctoral student intellectually knew what he needed and what he wanted to ask his supervisor for, but in the situation he was not able to make requests. This is where power relations come into play, or perceptions of power relations. The doctoral student's perception of his social position

does not allow him to make suggestions to his supervisor. Even if he intellectually knows that he can do that in Sweden, and that he needs to in order to get the kind of supervision he needs, he is not able to cross the line and improvise contrary to his culturally encoded norms in the situation.

As a supervisor I would put much effort into understanding an international doctoral student's educational and cultural background to be able to understand their reaction patterns and needs to the best of my abilities. I would spend time on aligning expectations, because there may be many other things that they assume to be different, and much less can be taken for granted in cross-cultural settings. I would talk about how they need to learn to cope with the insecurity and the unpredictable process of research. I would use a lot of meta-communication and be open about my intentions, as I find this important in all supervision.

In the article I published together with Asbjørn Molly we advocate the use of meta-communication in supervision (Molly & Kobayashi, 2014). The way I understand and use the term meta-communication is as intentional 'talk about the talk' that aims to increase understanding. Meta-communication is to share the motives behind the utterances made and invite the other inside the 'engine room' where communication is construed. Sharing motives and intents has a double function in that the relationship becomes more collaborative and communication becomes clearer. I find meta-communication very useful in connection with text feedback. Being explicit about the kind of feedback I provide, but also asking the author to express what kind of feedback he or she needs or wants can help the process.

The last thing I want to touch on in this philosophy statement – my views on what is good supervision – is the context of life sciences where my research is based, because this context without doubt colours my view of supervision. It is common in life science, as in other applied sciences, that the doctoral student becomes part of a common research project, and publishes papers with other members of the group as co-authors including the supervisors. This has consequences for the power structures that the doctoral student partakes in. There is more at stake for

the supervisor both in terms of research outcomes that often feed into a larger project, and in terms of publications. For the doctoral students to become full members of the Community of Practice they need to work together with the supervisor and the group and show that they are able to collaborate. This is different from much of social science and humanities where the expectation in some contexts may be that to be recognised as a full member of the group you must show that you walk your own path; that you are different, you create your own project, and you rebel against the established researchers. This leaves very few possibilities for the supervisors to scaffold the doctoral student. The supervisor has less at stake when the research is individualised, mainly his or her prestige. In applied science, like life sciences, the mutual dependency is part of the 'contract' and this creates a different balance of power where it might be easier to build trust. Not that everything is harmony, as we shall see from my research, but a trustful relationship comes more natural when the goals are shared.

My understanding of supervision is shaped by my personal values and my experiences from the research and educational environments that I have been part of through my studies and working life. The Faculty of Life Science, where I was educated and spent twelve years with teaching and educational tasks, can largely be characterized by a collaborative spirit. Of course, some environments are more competitive than others, but by and large I have experienced the place as collaborative. It is the predominant spirit I meet when I talk with supervisors about supervision as they signal goodwill and desire to include new doctoral students in their research environments. They generally trust their doctoral students from the outset, and they put effort into maintaining a good supervisory process and a good working relationship. Some may underestimate what it takes, as my Agency study shows, with some doctoral students feeling neglected. And some may underestimate the importance power has in this relationship. The position that the supervisor has carries both a duty and the possibility of showing genuine interest in the doctoral student's wellbeing.

Supervisors hold a powerful position and that places them under an obligation to use that power constructively and reduce the risk of the power differentials becoming unhealthy. This is the reason why I believe that a trustful relationship is essential and why I find the caring element in supervision so important.

2. Situating the study in the extant research literature

2.1 Framing the review

The international literature on research degree supervision is extensive and continuously growing and so, to better reflect and position my own research I have provided a focus to this review steered by the objectives of the study.

Objectives of the study

The research objectives of this doctoral research are to explore doctoral students' agency as a condition for learning, and to explore the interaction with multiple supervisors for learning opportunities.

Research questions that aim to contribute to doctoral students' agency:

Does the discussion with the supervisor about personal development planning and aligning expectations help doctoral students build their agency in managing collaboration with the supervisor, and strengthen the supervisory relationship as perceived by the doctoral students?

Research question that aims to contribute to the interaction with multiple supervisors:

How are learning opportunities created by supervisors and PhD students during supervision with multiple supervisors?

Focus of the literature review

Steered by these objectives the main focus of the review is on contemporary research into the supervisory relationship, and the conditions for learning opportunities created in the interaction.

Selection has focused mainly on primary research rather than, for example, handbooks for practice, although I include such secondary literature where it points to gaps between practice and research. Being fully aware of such insightful handbooks on supervision and doctoral education, I use a number of these in my own teaching practice, including (Delamont, Atkinson and Parry (1998); Handal and Lauvås (2006); E. Phillips and Pugh (1994); Taylor and Beasley (2005)). I believe that in order to place my own contribution in the landscape of research into doctoral supervision the appropriate way to set the boundaries is to focus on publications that describe research in the field. In an inclusive view of what it means to be a scholar Boyer (1991) noted: ‘a recognition that knowledge is acquired through research, through synthesis, through practice, and through teaching ... these four categories – the scholarship of discovery, of integration, of application, and of teaching – divide intellectual functions that are tied inseparably to each other’ (p. 11). The focus of this review is on the scholarship of discovery, acknowledging that it is inseparable to my scholarship of practice and teaching.

There are no formal requirements regarding the format of the thesis under the Danish PhD Order, nor in the PhD regulations of the University of Copenhagen. However, it is stated in the regulations of the Faculty of Science, University of Copenhagen that the thesis should preferably be written in English. Given the focus on internationalisation in the Danish PhD Order and the tradition in the Science Faculty of the University of Copenhagen, I have decided to target my thesis at an international audience and deliberately avoided literature in local languages that the readers cannot pursue, unless it adds something that the English language literature does not cover.

Literature on doctoral supervision research is extensive, and the PhD has changed so much over the last two decades that

literature more than 15-20 years old is no longer relevant as the accepted norms for supervisors were very different 20 years ago. It is always good to take a look backwards, but since I am not doing a historical doctorate but a contemporary study, I limit my view to research over the past 10 years, or at least past 2000. There are aspects of supervision that I have not touched on in my research as it is a time and resource limited study. In line with current university practice the thesis format is based on a compilation of published or publishable manuscripts targeted at specific journals with a specific scope and a word limit ranging between 5-8000 words. Consequently the introduction to the manuscripts, i.e. the chapters 1 to 6 of this thesis, is steered by the manuscripts, meaning that the thesis, and this review, does not exhaust the topic of doctoral supervision. I am not researching the writing process and feedback, which is clearly a significant element in supervision, and there are work such as Handal and Lauvås (2005), Haas (2010), Parry (2007), van Rensburg and Danaher (2009), Scott and Coate (2003), and a lot of other interesting literature about the writing process and feedback in doctoral studies that has been left out of consideration. It also lies beyond the scope of this thesis to explore issues of: training of supervisors, evaluation of supervision, recruitment of doctoral students, complementary skills, assessment and examination, distance supervision, supervision of specific groups like minorities, disabled people, part time and industry based doctoral students, nor is the professional doctorate covered in this review. I touch on topics like completion rate and time, the wider learning environment, and satisfaction and wellbeing, as context for my research. I briefly touch on research into cross-cultural supervision and gender. I did not research cross-cultural supervision, but the Agency study is discussed in this light in the Discussion of the thesis (Chapter 5).

The starting point of my study is that there is a need to improve supervisory practices, so I start with a brief overview of researcher education in Denmark, the institutional perspective, so as to provide international readers with the political and structural context of the study, and to substantiate the perception that there is room for improvement in the practices of doctoral supervision in Denmark like elsewhere. I then take three different

perspectives on doctoral supervision, as three different starting points to understand doctoral supervision. First I explore the research on doctoral supervision from the perspectives of the doctoral students. After that I focus on supervision as pedagogy from the supervisors' perspective and lastly considering supervision as interaction, the shared point of view of the relationship.

2.2 Researcher education in Denmark

The view from society and the institution frames the changes in doctoral education and the increasing pressure on supervisors and doctoral students for timely completion. Society and governments see a need to educate more at a higher level to increase competitiveness in the global knowledge society. There is a need to improve completion rates and reduce completion time. This demands more structure to be able to measure performance, better support structures (graduate schools) and better supervisor competences. In this study I focus on supervision.

Research education in Denmark has been streamlined to allow an increase in production of PhD graduates over the past two decades. Enrolment has increased from around 1200 in the early nineties to 2600 in 2010. As elsewhere, the purpose is to prepare the country for the knowledge economy by educating more people at a higher level, especially in the domains of health, natural sciences and technical sciences. Through reforms in 1993 and 2002 research education changed from individual master-apprenticeship to a formalised education under structured programs with external quality criteria aimed to ensure that employers outside academia could know what skills and competences a PhD degree leads to (Mejlgaard et al., 2012). As a result of the increased number of PhD graduates, a smaller share of graduates continues in a research career in academia. In Denmark only one third of the PhD graduates stay in academia after being awarded their degree, one third finds employment in the private sector, one fourth in public sector outside education, and the rest in other educational institutions or in private non-profit organisations (Langberg, Ladefoged & Graversen, 2008). Unemployment rates are lower (1-2%) among PhD graduates

than academics in general (3.6%) in Denmark, but as many as 43% report that they are over-qualified in their jobs (Mejlgaard et al., 2012). As of July 2013 the unemployment rate for academics was 4.8% according to The Danish Confederation of Professional Associations (Akademikerne, 2013). Internationalisation of research education has also been on the agenda as part of the reform process of making the Danish research environments internationally competitive with large (internationally significant) research groups and recruitment of the best candidates internationally to enhance quality (Mejlgaard et al., 2012). This strategy is associated with an increase in diversity of educational and cultural backgrounds among doctoral students. The public investments in research education also set demands for higher completion rates and shorter completion time. The Danish reform process is not unlike what is seen in many other countries both in Europe under the Bologna process and the Lisbon Strategy (Bitusikova, 2009; Kehm, 2007), and beyond, since reforming research education and training seems to be a global trend (Cyranoski et al., 2011; Humphrey, Marshall & Leonardo, 2012; Kehm, 2007). A Norwegian study showed that improved supervision together with other factors like structured programmes and common regulations, has resulted in increased completion rates (Kyvik & Olsen, 2013).

Surveys in Denmark have shown that the research environment and the supervisory relationship are the two single most important factors in mitigating drop-out, and funding has been channelled for supervisor development initiatives aimed to improve quality of supervision. A national survey from 2005 among doctoral students enrolled in Danish universities in 1998 and 2002 (N = 1726, response rate 70%) indicated that supervision was the most important factor for the doctoral students, whether it was referring to good supervision leading to success, or unsatisfactory supervision leading to difficulties or even drop-out (Vestergaard, 2006). Another Danish survey collected data from 442 individuals who had dropped out from PhD studies and 600 who had graduated, using a questionnaire followed up with focus group interviews with smaller groups. This survey found that drop-out was linked with dissatisfaction with supervision first and foremost and secondly with

dissatisfaction with the research environment (Epinion Capacent, 2007). The authors point out that the results are based on self-reports, and that especially the drop-outs may seek an explanation for their non-completion. The group of drop-outs reported less contact with the supervisor than the group of graduates. These findings are in line with surveys in other countries. For example the Higher Education Academy in UK found that research students considered supervision to be the most important aspect in successful completion (Park, Hanbury & Kulej, 2007). From the institutional perspective the interest in doctoral education focuses on providing the right support structures to increase completion rates, especially supervisor training and rich research environments, as is the case in most countries (Deem & Brehony, 2000; Golde et al., 2006; Sinclair, 2004). However, some initiatives also strive to support the doctoral students as supervisees, and it is therefore also relevant to view supervision from the perspective of the doctoral students (Boud & Lee, 2005; Grant & Graham, 1999; Kiley & Liljegren, 1999). An important difference in PhD – supervisor matching lies in the general perception in research literature that the doctoral student selects a supervisor (Ives & Rowley, 2005), while the current practice in Denmark, at least in the sciences, is that the supervisor employs a doctoral student with funding from a larger research project. It is a prerequisite for enrolment that funding is available to sustain the project and the living expenses of the doctoral student for the whole three years' study period, whether from research funding or from scholarships. This recruitment practice leaves little choice to the doctoral students, except for the growing number of international doctoral students with scholarships from their home countries.

Statistically completion rates are mainly related to disciplines with higher completion rates in health, natural and technical sciences and lower completion rates in social sciences and humanities (Golde, 2005; Jiranek, 2010; Rodwell & Neumann, 2008; T. Wright & Cochrane, 2000). The causal relationships point to the research environment, which is experienced as more supportive in the natural sciences (Golde, 2005). Frischer and Larsson (2000) point to lack of supervision and leadership in social science in a Swedish university. A new survey at a Danish university, Aarhus

University, revealed that doctoral students in social sciences and humanities more often feel isolated, they are more often unsure about the quality of their work, they more often report that they meet a very harsh and closed environment, and the prevalence of exhaustion and stress is significantly higher than in science, technology and health (Hermann, Wichmann-Hansen & Jensen, 2013). In the Danish context it may also be connected to a mutual dependency in the natural sciences, where it is the norm to publish together and the thesis is a compilation of publishable or published manuscripts. The PhD project is an individual affair nested in a collective project. Because the supervisors in the sciences are also dependent on their doctoral students for research outcomes and publications, they have more incentive to put effort into the supervisory process and the working relationship. This is the kind of environment that this doctoral study is embedded in, both my own doctoral education and the cases I research.

Danish universities offer courses in transferable skills to varying degrees, and it is an ongoing discussion how much the general attributes should be weighed in doctoral education. However, the Danish Ministerial Order on the PhD Programme defines the purpose of the PhD degree as wider than academic career, and includes research, development and teaching in both private and public sectors as employment opportunities for PhD graduates. International research investigating graduate attributes and generic or complementary skills to fulfil demands from the private sector as employers of doctoral (Denicolo & Reeves, 2013; Gilbert et al., 2004) is relevant in relation to my teaching at the 'Introduction Course for New PhD students' as well as courses for supervisors, but it lies beyond the scope of this thesis.

2.3 Doctoral student perspective

Typically, doctoral students in Denmark are full-time students employed as university staff members with a formally-recognised status as working colleagues with respect to their supervisors. Additionally, a relatively high degree of autonomy is expected of doctoral students in the Danish system as they have to rapidly take a very high level of responsibility for their project, its

development, direction and management. This places a significant pressure on the students, particularly those who are not familiar with the Danish system. The supervisor has power to terminate a doctoral study through the quality control system: Supervisors sign progress reports, and if the student does not live up to requirements there are rules to protect both parties, but eventually unproductive students will be terminated on initiative by the supervisor (Ministry of Science, 2008; University of Copenhagen, 2012). However, unlike for instance the German system, the supervisor is not part of the examining committee. The doctoral students are dependent on their supervisors for support and quality criteria, both in terms of becoming a member of the scientific community of their field, as an identity project, and to learn how to produce valid results, to build the needed competences. It is a complex relationship between a novice and an experienced researcher, and in the natural sciences often involving more than one supervisor, so relationships and collaboration becomes even more complex. Especially in the sciences where the supervisor often has the research funding from external sources, doctoral students do not have an opportunity to select a supervisor, but the position is advertised and the supervisor selects the candidate they find most appropriate in terms of competences and personality.

From the doctoral students' perspective doctoral education is a learning process leading to a formal qualification. Stubb, Pyhältö and Lonka (2012) found that perceiving the PhD study as a learning process correlated positively with well-being and persistence, while doctoral students who perceive doctoral studies as a means to get a qualification reported significantly lower interest and motivation, and this finding reinforces the relevance of investigating doctoral studies as a learning process. This learning process is complex and context dependent, but a commonly perceived duality is expressed by Green (2005, p. 162) "Doctoral pedagogy is as much about the production of *identity*, then, as it is the production of *knowledge*." [original emphasis]. L. Gerholm and Gerholm (1992) investigated the culture of research education in six disciplines in a Swedish university, and describe how doctoral students acquire the tacit knowledge of the discipline and form their identity as researchers, also reported in

T. Gerholm (1990) and in L. Gerholm (2003). Kärreman (2003) describes the identity work (his own) in the work with the doctoral project. Doctoral students form their identity as researchers through the process, and they acquire the needed skills, competences and subject matter knowledge.

The outcomes of the process are a researcher and the research, which underpins the learning process. Because research is unpredictable the learning process cannot be planned as in undergraduate teaching where the curriculum and learning objectives are decided in advance. Learning in doctoral education is a continuing negotiation between the research (or thesis), the supervisor (or supervisors) and the doctoral student. As stated by Meyer, Shanahan and Laughksch (2007) learning to think like a scientist is not ‘some indefinable osmotic process that “just happens” in the process of supervisor/ candidate interactions and with the passage of time.’ (p. 432). Research into doctoral learning attempts to shed light on how doctoral students learn from the wider environment, and how supervisors might support the learning process.

Doctoral learning is nested in a context that can be very complex, with many layers and stakeholders. McAlpine and Norton (2006) developed a framework that integrates the factors influencing the doctoral student experience, depicting three layers; the department/ disciplinary context, the institutional context and the societal context. Lovitts (2005) developed a similar model, but in addition to the layers suggested by McAlpine and Norton, she describes the individual resources influencing degree completion and creative performance: intelligence, knowledge, thinking styles, personality and motivation. Self-direction was one of a set of specific factors that Lovitts (2005) identified as critical, others included perseverance, willingness to take risks and intrinsic motivation, which I would argue are related to agency. The context provides a multitude of learning opportunities, and making use of these opportunities requires agency (Boud & Lee, 2005; Hopwood, 2010b; Hum, 2013).

Supervision is an interaction between two (or more) parties, and both parties bring something to the supervisory process. Grant

(2003) describes how the relations between the doctoral student, the supervisor and the thesis is constituted of many layers, from the institutional to the unconscious. What the doctoral student brings to the interaction and the relationship is influenced by their previous experiences, including earlier relations with teachers, parents or other figures of authority. Grant (2000) suggests that we can do more to assist and support doctoral students in taking a more active role in the supervisory relationship: 'I think students need to reposition themselves from dependence and passive gratitude. ... They need to reposition themselves as active players in supervision, as negotiators of the terms' (p. 33). Goode (2010) uses the concept of 'doing supervision' to discuss doctoral students' need for a proactive role in supervision, both with regards to managing their own time, tasks, identity and career development, but also their supervisory relationships. Not only would doctoral students gain more from a more proactive role, but this would also support and reinforce their development towards autonomous researchers with high research self-efficacy.

Overall, Deane and Peterson (2011) found that doctoral students with supervisors who encourage them to think and act autonomously while still guiding them on research tasks, termed academic support, reported higher research self-efficacy. A supervision style with low autonomy support predicted low research self-efficacy, independently of the level of personal support. Autonomy support is described as 'acknowledging the student's perspective, encouraging the student to be open with their ideas and providing opportunities for students to make their own decisions' (p. 794), much in line with Grant's suggestion to support doctoral students as active players in supervision (Grant, 2000). Grant and Graham (1994) report on the use of 'Guidelines for Discussion' as a tool for doctoral students to discuss goals and expectations with their supervisor, and later Grant and Graham (1999) attempted to empower doctoral students to approach their work and their supervisors in new ways by introducing strategies for more effective self-management. They suggest working with students and supervisors together as a more sustainable strategy to address supervision problems.

The question about autonomy, self-management and agency in doctoral education has been studied and discussed by a number of researchers. Hopwood (2010b) emphasizes the importance of relationships and relational agency in doctoral research and learning, for example in making a difference to students' conceptual understanding and to their affective response to the challenges they face. Relational agency is the ability to act on or interpret the world by seeking the help of others, involving the capacity to offer support and ask for support from others (Hopwood, 2010a). In a survey of 669 doctoral students in a Finnish university Pyhältö and Keskinen (2012) found that a majority of 70% considered themselves as passive objects in their scholarly community, lacking relational agency with respect to the scholarly community. Lack of relational agency was connected to lack of interest in their studies and other negative emotions like anxiety and exhaustion, and more frequent considerations of interrupting studies. Although the overall focus of her research is broader, the research undertaken by T. Wright (2003) shows that postgraduate students who successfully completed their PhD within four years in spite of personal or supervisory difficulties often mentioned support from their broader network that they used in their negotiations of the difficulties they faced. In contrast, postgraduate students who had not completed their PhD within four years seemed to have lower capability in negotiating their difficulties with the help of others.

Building confidence and identity through academic activities was also evidenced by Dunlap (2006), here through online journal editing, which supported doctoral students in identifying themselves as contributing members of the scholarly community. Räsänen and Korpiaho (2011) report on a course that supported doctoral students in their professional 'identity projects'. Jazvac-Martek, Chen and McAlpine (2011) analysed progress logs from doctoral students, collected monthly over two and a half years. Their study highlights students' agency in negotiating with others in order to achieve their intentions and in navigating difficulties (termed negotiated agency). They found that many doctoral students engage in activities that represent academic work that does not directly progress their research or thesis, but that these interactions have an impact on the students' sense of progress

and thus contribute to their development of an academic identity and establishing themselves as academics. The learning in doctoral education is also about developing a professional identity within the discipline. The multiplicity of identities in doctoral education is described in detail by Colbeck (2008). McAlpine and Amundsen (2009) found that doctoral students engaged in activities to bring about change in their faculty developed important collective identity and agency that facilitated their identity building within the discipline. They also found that supervisors explicitly model students' agency through text feedback and discussion of thesis work. van Rensburg et al. (2012) investigated university academics' recollections of their doctoral journeys, and their sense of agency and identity building, through the lens of agency and identity as defined by McAlpine and Amundsen (2009). They found the framework useful to look beyond the superficial accounts of practices and identify some of the underlying patterns of interactions. Yet, they find that the issue of agency and identity in the doctoral student-supervisor relationship needs further investigation.

It is against this background of research into doctoral students' agency that I set out to study the possible effects of our own initiative. Previous research indicates a need for initiatives to support doctoral students' agency, but few initiatives have been reported that significantly succeed in this. In their review John and Dencolo (2013) call for research into how negotiated agency can be promoted in an increasingly diversified research environment. I investigate if the discussion that course participants in our Introduction Course have with their supervisor about personal development planning and aligning expectations has a potential in building their agency, so that they feel able to collaborate effectively with their supervisors, and thereby strengthen the supervisory relationship in the longer term, as perceived by the doctoral students.

2.4 Supervisor perspective

Doctoral supervision can be viewed and described from different angles. In essence, I view supervision as providing the frames and conditions for learning. One way to focus is to explore 'what is

good supervision', and from that follows a range of studies focusing on 'good' in terms of (timely) completion (cf. Humphrey et al., 2012; Kyvik & Olsen, 2013; Seagram, Gould & Pyke, 1998), satisfied students (cf. Barnes, Williams & Stassen, 2011; Harman, 2002), educating self-efficacious researchers (cf. Dunlap, 2006; Harsch, 2008; Overall et al., 2011), or other measures of success. Another focus is on supervision as a pedagogy (or thinking tools to understand supervision), mental models, styles, roles, and tasks involved (cf. Gatfield, 2005; A. Lee, 2008a; Lindén & Helin, 1998). Other studies again focus on specific models or set-ups of supervisory practice, for instance group or collective supervision (cf. Borders et al., 2012; Fenge, 2011; Nordentoft, Thomsen & Wichmann-Hansen, 2012), team or joint supervision (multiple supervisors) (cf. Guerin, Green & Bastalich, 2011; Manathunga, 2012), distance supervision (de Beer & Mason, 2009), and different types of support mechanisms provided by graduate schools, research training centres, or peer support (cf. Boud & Lee, 2005; Buissink-Smith, Hart & van der Meer, 2013). Some studies focus on issues related to specific groups of doctoral students, like cross-cultural supervision (cf. Goode, 2007; Kiley, 2006), interdisciplinary supervision (Manathunga, Lant & Mellick, 2006), minorities (Grant, 2010b), less advantaged students, supervising professionals (Malfroy, 2005) or colleagues (Denicolo, 2004), and gender issues (Brown & Watson, 2010). And a number of studies focus on the supervisory relationship (with some overlap to the focus on roles) (Grant, 2003, 2005; Hockey, 1995; Sambrook, Stewart & Roberts, 2008), and lastly some studies focus on training of supervisors (cf. Emilsson & Johnsson, 2007; Kiley, 2011) and on evaluation of supervision (Aspland et al., 1999; A. Lee & McKenzie, 2011). All these studies use a wealth of different theoretical frameworks and methods, dependent on research question being asked, and the researchers' interests and backgrounds.

For the purpose of this thesis I review the research on supervision at a general level as context for my research, and I go into supervision as teaching or pedagogy, since this has relevance for the exploration of learning opportunities in supervision. The relationship, including power differentials and closeness of the relationship, will be covered in section 2.4 below. I touch on

topics like completion, satisfaction and self-efficacy, but that is not the focus. Issues related to specific groups lies beyond the scope of this thesis, as does supervisor training.

Supervision as pedagogy

It can easily be agreed that the doctoral students are learners. The changes in the way the concept of supervision is perceived and framed lies in the changes in the perceptions of the role and responsibilities of the supervisor. Johnson, Lee and Green (2000) vividly describe what they term ‘the pedagogy of indifference’, which bears similarities with the *laissez-faire* supervision and leadership described by Frischer and Larsson (2000). It is possible to become a researcher with minimal supervisory support and guidance, but both for ethical reasons and in the light of the growth and diversification of doctoral education is no longer considered optimal. The emergence of structured programmes, the increasing emphasis on the learning environment and culture, and an expansion of actors, spaces and practices of doctoral work characterise the view of doctoral work as education and supervision as pedagogy (A. Lee & Boud, 2008).

A focus on supervision as pedagogy makes it possible to draw from elements of teaching, but it also requires a critical reflection on the differences between supervision, teaching and research. While traditional teaching can be planned following a curriculum, with intended learning outcomes, learning in doctoral education depends on the individual doctoral student’s starting point with regards to skills, knowledge and competences, the research project, and individual ambitions and goals. Supervision is co-created by supervisors and doctoral students involved, and cannot be planned according to learning objectives because research in itself is a learning process for all involved, also the supervisors. Bowden and Marton (1998) describe the connection between learning, teaching and research as forming knowledge: teaching contributes to the individual student’s learning and research is about finding out new things. Research is about forming pristine knowledge, which makes it a joint learning process between doctoral student and supervisors. Not only does a doctoral student’s research connect with her individual learning

process, but the doctoral student's research is also connected with a collective learning process, where the scholarly community and humanity learn. Maxwell and Smyth (2011) emphasize the production of new knowledge in doctoral education, the contribution to the discipline, which makes doctoral supervision different from teaching, which is reproduction of existing knowledge. Instead of an intended curriculum, the research project plays a central role in determining the goals and learning needs in the process. The outcomes of doctoral education then become an autonomous researcher and knowledge (or a contribution to the specific scientific discipline). 'What has to be learned is the research process leading to the research product' (Maxwell & Smyth, 2011, p. 224), and that learning process can be supported by competent supervisors who are also experienced researchers.

There is a wealth of research investigating supervisory pedagogy and the supervisory process. Some of this research outlines different models of supervision that can be useful mental frameworks for discussing supervision or frameworks that can structure an analysis of supervisors' conceptions of supervision. These include Gatfield (2005), Gurr (2001), A. Lee (2008a), Pearson and Brew (2002), Pearson and Kayrooz (2004), Vilkinas (2002), Lindén and Helin (1998), Lönn Svensson (2007) and A. Wright, Murray and Geale (2007). Based on life history interviews with supervisors at an Australian university Halse and Malfroy (2009) suggest a description of doctoral supervision as professional work comprising five facets, as a model for understanding and developing doctoral supervision. Lindén and Helin (1998) describe a conceptualisation that is also used in much Danish supervision, namely the distinction between product and process oriented supervision. However, while Lindén and Helin see process oriented supervision as holistic, the Danish version originating from Tofteskov (1996) makes the point that pure process oriented supervision focuses so much on students' learning that there can be a danger of losing sight of the assessment criteria. Through a phenomenographic study from Sweden Franke and Arvidsson (2011) depict two structures of supervision; the research practice-oriented and the research relation oriented supervision. The research practice-oriented

supervision is mainly found in the technology and health faculties and is characterized by a well-developed common research project. The advantage they see for doctoral students' learning in the practice-oriented supervision may contribute to explain the relative success seen in completion time and satisfaction in technology and natural sciences.

Brew and Peseta (2008) stress the importance of whether supervisors think of supervision as research or as teaching for how they supervise. However, they take this a step further in considering the supervisors' approaches to supervision as teaching, drawing on the Approaches to Teaching Inventory by Prosser and Trigwell (1999). If a supervisor has a 'teacher-focused information transmission' approach to teaching then they might be more directive in their supervision. The outcome of a 'student-focused conceptual change' approach to teaching would be that the student's views on both the supervisory process and the subject-matter or research project will be taken into account. Bruce and Stoodley (2011) investigated supervisors' experiences of supervision as teaching, and they described nine categories ranging from very supervisor-focused to very student-focused and further focusing on the wider community and society.

A common characteristic of that literature, though, is that most of it addresses generic questions that are discipline neutral and focus on the process rather than exploring *how* supervisors 'guide' or 'direct' doctoral students to acquire specific understanding or build specific competences. An explanation for this gap in research might be that most research into doctoral supervision is based on interviews, as described in section 2.4. In order to address this issue there is a need for a finer grained analysis of the actual interaction within specific disciplines. I found some studies that get behind the general terms of guiding and directing. Manathunga (2005b) found, based on interviews with successful supervisors, that a common strategy is to *show* students how to e.g. write a methods chapter or analyse data. In another study she found that strategies to develop critical thinking skills include feedback on students' writing, engaging in critical conversations, explicating assessment criteria, and peer-to-peer collaborative learning (Manathunga & Goozée, 2007). There are studies on text

feedback that describe the actual interaction, for instance Handal and Lauvås (2005). In this thesis, however, I choose to focus on how doctoral students can learn to conduct research - how they can learn to produce valid results. I delimit the disciplinary field to life sciences, a choice that is explained and discussed in chapter 3 on methodologies.

At the end of the day, doctoral students are assessed on their production of publishable research, as demonstrated by the following quotation from Denicolo (2003)

In essence, the QAA states that the student should demonstrate the creation and interpretation of new knowledge (through original research, sufficient to satisfy peer review) that extends the forefront of the discipline and merits publication (p. 86).

In the realm of natural science, research is judged in terms of validity, reliability and replicability, and thus learning to conduct research in life sciences is associated with learning how to produce valid, reliable and replicable results, for readability I write in short 'valid results'. The understanding of what valid results imply is associated with conceptions of research, and this has been studied from different angles. Meyer, Shanahan and Laugksch (2005) report on research into students' conceptions of research, and in their later publication (2007) they compare students' conceptions with supervisors' conceptions of research. Bills (2004) and Kiley and Mullins (2005) investigated supervisors' conceptions of research, and Brew (2001) investigated experienced researchers' conceptions of research. Pitcher (2011) and Pitcher and Åkerlind (2009) investigated post-doctoral researchers conceptions of research. Meyer et al. (2007) raise the issue of contrasting or mismatching conceptions of research between doctoral students and supervisors, and how this may increase the risk of failure, including withdrawal from postgraduate programmes. These studies into conceptions of research do not explore *how* doctoral students gain insights into conceptions of research. Kiley (2009) suggested that PhD students gain this insight through their research under skilful supervision, where supervisors help candidates recognize the

development they go through as novice researchers. She quotes two supervisors from her focus group interviews discussing how candidates learn to conduct research:

Marian: I think you can talk at them [candidates] till the cows come home... how many of those programmes have you been to with beginning PhD students where other students have told them the facts of life, but words are words, they cannot convey experience?

Jack: It comes from working.

Marian: You bet. (p. 173)

Kiley adds an active role of the supervisor to this perception, as conveyer of second order learning as an explication of the 'osmotic process' that Meyer et al. (2007) oppose. Investigating this further would require a workplace learning perspective and investigations into doctoral students' learning from the wider environment and the supervisors' active role in that setting. What I investigate is learning opportunities created in the interaction with supervisors during supervision sessions. As becomes apparent from above this is an under-researched area.

Multiple supervisors

Literature on doctoral supervision most often addresses supervision as a one-to-one relationship, although educating new researchers is increasingly a shared responsibility among multiple (two or more) supervisors (Hopwood, 2010b; A. Lee & Green, 2009) and thus it becomes increasingly relevant to focus research on these more complex supervisory settings. The interdisciplinary nature of many doctoral research projects makes it relevant, and even necessary, to have more than one supervisor (Manathunga, 2012; E. Phillips & Pugh, 1994). Joint supervision can also be an institutional strategy to provide elbow training for new supervisors. Manathunga (2012) also notes that team supervision can be a way to share the burden of sole supervision and to provide better support to the doctoral students. In an evaluation of the Carnegie initiative on the doctorate in USA Golde et al. (2006) advocate that 'Today's students are best served by having several mentors' (p. 8). In an SRHE guide, A. Lee (2008b)

provides discussion sheets and advice for supervisory teams with reference to her framework of approaches to supervision. Taylor and Beasley (2005) devote a chapter of their handbook to relationships with co-supervisors. E. Phillips and Pugh (1994) warns against some pitfalls in joint supervision, but also state that it can work very well, and they advise doctoral students about how to manage multiple supervisors (pp. 116-118). Rehn (2006) strongly advises against having more than one supervisor, and Wellington (2010) argues that the disadvantages of having two or more supervisors is that they may not agree, and that they might discuss the research between themselves.

While the handbooks and guides on supervision and doctoral education deal with multiple supervisors, and policy generally moves towards assigning more than one supervisor, like supervisory panels in Australia, or one or more co-supervisors especially in the sciences in many countries research is still limited. Bourner and Hughes (1991) state that joint supervision is the norm in polytechnics and colleges of higher education in Britain. They distinguish between joint supervision and multiple supervision, in that joint supervision in their view means that the supervisors collaborate closely about supervision, while multiple supervision just means that the student has multiple supervisors. Their case study of joint supervision shows clear benefits of this in more publications and supervisors learning from each other. Pole (1998) questions joint supervision as a safety-net for doctoral students and points to problems in managing a team of supervisors who may not collaborate well with each other. Humphrey et al. (2012) found that organising supervision in teams rather than appointing a single supervisor is an important factor in increasing completion rates and reducing time to completion in UK. Through interviews with doctoral students in a Finnish university Lahenius and Ikävalko (2012) arrive at three different approaches to joint supervision depending of roles and responsibilities among the involved supervisors. In what they term 'substitutive supervision practice' the doctoral student mainly relies on support from an additional supervisor, which makes this a de facto dyadic relationship. In what they termed 'complementary' and 'diversified' supervision, the doctoral student benefits from the expertise of both the principal and the

additional supervisor. Research into joint or team supervision – supervision with two or more supervisors – recurrently emphasize the need for clear roles and responsibilities, and aligned expectations between all participants.

In an interview study with 21 doctoral students in Australia, Ives and Rowley (2005) found that those who were categorised as more satisfied and had completed their thesis were more likely to have two active supervisors compared to those who were dissatisfied and those who had not yet completed or had discontinued their studies. Watts (2010) reports on her own experiences with team supervision, and she finds that team supervision has added value for the doctoral students when expectations and responsibilities are aligned and a student-centred approach to supervision is adopted. Spooner-Lane et al. (2007) suggest a model where the experienced supervisor takes on the role as co-supervisor plus mentor for the novice (less experienced) supervisor, to allow for both supervisors to improve their practice from explicit professional development. Manathunga (2012) investigated power relations and peer regulation among supervisors in supervisory teams, which again emphasizes the increased complexity of multiple supervisors and the need for good collaboration and clear ground rules. Guerin and Green (2013) found that it can be confusing for students when the supervisors have different opinions, and supervisors need to be alert to this and to the power relations between team members. However, they also see team supervision as a way to induct students into the norms of academic debate.

Dysthe builds on the concept of multivoicedness based on dialogism (Bakhtin, cf. Holquist, 1990) to explain the learning potential in experiencing conflicting opinions or perspectives. As argued by Lillejord and Dysthe (2008) learning is often caused by disturbance, conflicting perspectives, or tensions that the students have to relate to and choose between in order to make sense of the world. Dysthe et al. (2006) studied supervision in groups of two supervisors and their master's students. They found that the supervision groups provided both enculturation and multivoiced discussion. The tension between diverging voices of the supervisors creates a potential for new understandings.

Research into doctoral supervision with multiple supervisors is thus still limited, but a very common practice in the context of life science research in Denmark and an increasing practice generally speaking. This makes it relevant to focus on the learning opportunities created in the interaction with multiple supervisors in the present study.

2.5 Interaction perspective

The last perspective is a focus on the interaction in supervision. In this section I first look into literature about the supervisory relationship. Lastly I go through studies focusing on the interaction by empirically investigating interaction.

Relationship

Both supervisors and doctoral students bring something to this interaction, and in the preceding sections I have focused on what each side may bring to the interaction. From the doctoral students' side an important attribute is agency, and from the supervisors' side it is a range of competences that can be gathered under the umbrella of supervision pedagogy in addition to disciplinary knowledge and competences. The space of interaction that I want to focus on here is the relationship between the supervisor(s) and the doctoral student. Many studies have emphasized the supervisory relationship as important for doctoral education (Ives & Rowley, 2005), so it is relevant to look into what a 'good' relationship is.

Cullen et al. (1994) list the 'desirable features' of a good supervisor from the students' perspective as approachable and friendly; supportive, positive attitude; open minded, prepared to acknowledge error; organised and thorough; and stimulating and conveys enthusiasm for research (p. 101). Based on their evaluation of the Carnegie Initiative on the Doctorate in the United States, Golde et al. (2006) advocate that reciprocity, trust and respect are qualities of a relationship that fosters learning. Trust, they state, builds on respect, and reciprocity counterbalances power differentials because both gain from a

learning-centered relationship where supervisors learn from the research as well as satisfaction of educating new researchers. McPhail and Erwee (2000) point to three preconditions to establish a robust relationship that can endure difficulties: setting mutual goals and objectives, the emergence of social bonding, and the development of trust (p. 85). Mutual goals and objectives require that both parties have a stake in the common project, such as publications, research findings or competence building. Mitkidis et al. (2013) have shown that ascribing mutual and explicit goals is associated with increased cooperation. Trust is generally viewed as essential for students to be able to engage in dialogue given the asymmetry of the supervisory relationship (Boucher & Smyth, 2004; Engebretson et al., 2008; Sambrook et al., 2008).

The expectations that supervisors and doctoral students have to the relationship are important for how this relationship develops, and conflicting or just unaligned expectations can lead to difficulties or even breakdown of the relationship (Hockey, 1996; Kiley, 2003, 2006; Wichmann-Hansen, Eika & Mørcke, 2007; T. Wright, 2003), and tools for aligning expectations in the supervisory relationship are recommended in handbooks, courses and graduate school websites (cf. Aspland et al., 1999; Moltschaniwskyj & Moltschaniwskyj, 2007; Taylor & Beasley, 2005; Wisker, 2005).

The relationship is often referred to as the roles the (usually) two parties take on, or expect each other to take on. Handal and Lauvås (2006) discuss the complementarity of these roles, which are often expressed in metaphors like expert – novice, guide – explorer, etc. If the supervisor acts in the role of the expert, then the doctoral student becomes the novice, since the doctoral student cannot easily challenge the expert role of the supervisor. These metaphors are useful because they have immediate associations about the dimensions in the relationship, especially the power distance, but also the closeness vs. distance dimension, and this can be a good way to open discussions about expectations to the relationship (Pearson & Brew, 2002). Bartlett and Mercer (2000) deliberately use metaphors to negotiate their own supervisory relationship and the embedded power structures.

In literature about doctoral supervision there are opposing views on the use of metaphors. While Pearson (2001) finds that metaphors tend to blur the understandings of supervision, A. Lee and Green (2009) find metaphors useful and with their point of departure in language and discourse ‘metaphor may well be all there is’ (p. 618). Metaphors can be very strong and evoke unintended interpretations, like is seen in the articles by Manathunga (2006), Manathunga (2007b), Firth and Martens (2008) and Manathunga (2009), where Manathunga’s use of post-colonial metaphors are seen as provocative and humiliating by Firth and Martens.

The role of the supervisor is complex and situated, it changes over time, in relation to tasks at hand, and with the individual needs of the doctoral student. A focus on roles can lead to stagnant and inflexible perceptions of supervision, while learning in doctoral education in reality is situated and distributed in the wider environment beyond the supervisor(s). Pearson and Brew (2002) suggest that ‘A more productive approach is to focus on what supervisors are doing and why’ (p. 139). The roles that supervisors and doctoral students take on can be determining for the style of supervision, see Deuchar (2008), and further lead to development of models of supervision, for instance Gatfield (2005), A. Lee (2008a), and Dysthe (2002b). These models were discussed in section 2.3 above, under Supervision as pedagogy.

The supervisory relationship is usually described as a one-to-one relationship. As shown in section 2.3 it is increasingly relevant to expand this to multiple supervisors, and also to take the broader environment into account, as learning takes place in a workplace situation and nested in contexts of different scales.

Grant (2003) describes the complexity of the supervisory relationship with the research or thesis as the third vertex of the triangular relationship. In Grant’s description the institutionally mediated supervisor – student relationship is the first layer. The second layer includes the thesis (or the research project) in a pedagogical triangle, which bears resemblances of the didactic triangle in mathematics teaching (Brousseau, 1999). The supervisor does not have all the power in the relationship, as both

the student and the supervisor have the capacity to act, and the thesis carries the power of the (usually implicit) assessment criteria of the discipline. The third layer is constituted by the social positions of the individuals behind the student and supervisor labels, like gender, class and age, which influence the way they take up their positions as supervisor and student. The fourth layer in Grant's description is made up of the unconscious responses that student and supervisor make to each other. An example of such transference is given by Bartlett and Mercer (2000). Grant shows how irrational factors influence the relationship including previous supervisory relationships. This detailed description of the complex triangular relationship can be a useful reference for discussing research into doctoral supervision, and I get back to this in the Discussion of this thesis.

Literature about the supervisory relationship witnesses how two different dimensions of the relationship, power and closeness, are intertwined and influence each other, at times perceived as conflicting dimensions. Power relations are determined by factors like the formal power involved, difference in status and positions, difference in age and experience, as well as attitudes (cf. Grant, 2005; Manathunga, 2005a), while the question of closeness versus distance (how well you know each other) in the relationship may rather be determined by factors like emotion, sympathy, personality, and preference (Sambrook et al., 2008). Other factors like gender (Brown & Watson, 2010), culture (cf. Goode, 2007; Kumar & Lee, 2011) and transference (Grant, 2003) influence both the power and the closeness dimensions of the relationship. In the following sections I focus on the closeness dimension first, then the power dimension of supervision, and after that I briefly explore research into cross-cultural supervision.

The closeness dimension

Sambrook et al. (2008) suggest a typology of supervisory relationships based on different emotional domains, detachment vs. involvement, and professional vs. social, later validated through focus group interviews (Sambrook et al., 2009). They state that 'neither one is the 'best' type of relationship, as this depends on the two individuals involved, and the extent to which they may wish to demonstrate, and are able to manage, emotion'

(p. 81). This typology is associated with the closeness vs. distance dimension of the relationship, rather than the power distance in the relationship. A relationship between two equal colleagues can still be distanced and formal, and a relationship between an experienced and renowned professor and a novice doctoral student can be friendly in spite of the power distance. The question at stake is whether the relationship can become too close and impede on the supervisor's ability to use the power distance constructively.

Books about PhD studies advise doctoral students to put efforts into maintaining a good relationship with their supervisors. E. Phillips and Pugh (1994) note that 'rapport' and good communication between students and their supervisors are the most important elements of supervision (p. 10). Wisker (2001) emphasises the importance of striking a balance between friendship and a professional working relationship. The danger of a too close relationship is, according to Wisker, that both parties tend to relax too much and forget timing and management of the research. A very close relationship can undermine the potential for using the power distance constructively to support students in their development as scientists within the discipline. Doctoral students need both freedom and regulation to develop their identity (Manathunga, 2007a). Hockey (1995) found that some supervisors tend to get too emotionally involved because of the pastoral care component of supervision and they feel that this affects their academic judgement. Moreover, he found that over-involvement can have severe emotional costs for supervisors, and he suggests a pastoral skills component of in training programmes for doctoral supervisors. Sambrook et al. (2008) also point to the danger that an overly friendly relationship can make it difficult to give and receive critical feedback. Sullivan and Ogloff (1998) compare the supervisory relationship in doctoral education with the therapeutic relationship between psychologists and their clients, and refer to codes of conduct and ethical principles for psychologists. They warn against too close relationships between supervisors and doctoral students, because of the power relation and the dependency that the student finds themselves in. D. Lee (1998) describes the risk of misuse of power relations leading to sexual harassment.

In the other end of this scale, Boucher and Smyth (2004) discuss the benefits and difficulties in supervising professionals who are also, or become friends of the supervisor. A close relationship can be more demanding in terms of clarifying roles and responsibilities, setting boundaries and explicitly reflecting on the supervisory practice for example in discussions with likeminded colleagues to avoid that the friendship adversely impact on the supervisor's ability to advise and the supervisee's consent to a relationship, which is asymmetrical in certain aspects. Boucher and Smyth (2004) find that the higher level of trust from the outset makes it easier to establish a good work relationship, and that the supervisor is in a better position to identify and understand personal issues that impinge on the student's work. Supervision of colleagues adds complexity to the supervisory process, but as shown by Denicolo (2004) the closer relationship can also have advantages of a deeper, more respectful relationship. Bartlett and Mercer (2000) describe their own supervisory relationship as 'a productive and supportive friendship' (p. 196).

Emergence of social bonding requires some level of acquaintance beyond the formal and professional relationship. McPhail and Erwee (2000) state that trust develops over time, through sharing information, ideas and feelings, accountability from both sides, and appropriate feedback and recognition. Hemer (2012) explores supervision over coffee in 'third places' as a means to strengthen the relationship. Third places like coffee shops can be neutral and informal, which will improve the quality of supervision according to Kam (1997). Unsworth et al. (2010) show how the expression of gratitude can improve work relationships in doctoral supervision. The role of humour has not, to our knowledge, been investigated, but might well be an important element in supervisory relationships. There is general agreement that supervisors' responsibilities include psychosocial functions and pastoral care, like supporting students with the emotional dimension of their experience and demonstrating genuine interest in well-being (Hockey, 1995; Pearson & Brew, 2002; Pearson & Kayrooz, 2004). Pastoral care also includes demonstrating care and respect, being sensitive to the emotional stages of the student, and understanding the complexities of students' lives and

the factors outside their studies that have impact on achievements (Engebretson et al., 2008). Our own interview study suggests that trust and mutual respect is of uttermost importance for doctoral students to use their supervisors, and that building a robust and trustful relationship is seen, at least by some supervisors, as an investment to withstand crisis that may arise later in the process (Due et al., 2009).

The power dimension

Manathunga (2007a) argues against a perception of supervision as innocent and collegial and discusses ‘the very real and inescapable role that power plays within supervision’ (p. 208). Manathunga claims that for instance Pearson and Brew (2002) and Wisker et al. (2003) believe that the hierarchical aspects of supervision can be removed by a supervision pedagogy where supervision is perceived as mentoring. As Manathunga (2007a) describes it, supervisors are generally assumed to be more experienced and wiser than their supervisees, and expected to assist their supervisees in developing competences and become autonomous researchers. Guiding and mentoring has a certain direction defined by the discipline in question and the genre of the thesis, and thus supervision is invested with power dynamics. She draws on Foucault’s sites of governmentality and technologies of the self to describe how the power relations are productive for the doctoral student to develop in a certain direction defined by the discipline and the supervisor. Hence power relations become supportive of the learning process. The inherent asymmetry in the supervisor being in a position to judge and give feedback enables the doctoral student to direct her learning in the desired (by both presumably) direction.

Grant (2008) analyses an episode in supervision of a Master’s students in humanities, using a Master-slave metaphor. In this study she shows how power is in play as the supervisor gives the student feedback on a text. In line with Manathunga’s argument above, Grant states that ‘a submission to the norms and values of the discipline is the price the student pays for the privileges and freedoms of academic mastery’ (p. 23). However, as Grant shows in another study, the power relation depicted in the Master-slave metaphor is not the only option for supervisors. Here she

analyses a sequence of supervision that resembles the partnership model described by Dysthe (2002b), as a supervisor and student pair improvises in a more mutual, creative and playful mode of supervision (Grant, 2010a).

In her Master and slave-study, Grant (2008) describes the student's desire not to reveal her-self, but rather 'to listen and improve' (p. 21). This is an example of the summative element in supervision I discussed in my philosophy statement. Because the doctoral student strives for recognition there will always be an element of performance and judgement embedded in the asymmetrical relationship, and this can be a barrier to formative feedback. Formative feedback requires a high level of trust (Lauvås & Jakobsen, 2002); it requires that the doctoral student sees the supervisor as an ally who facilitates the learning and development process. But the supervisor is both the coach and the goalkeeper at the same time, to use a metaphor from A. Lee and Green (2009). The power in play makes trust and aligned expectations fundamental to a good working relationship (Brockman, Colbert & Hass, 2011).

The power structures are shaped by the social positions, like cultural background, age, gender, class, but also on the ways that supervisors and doctoral students may depend on each other. Brockman et al. (2011) describe the power differentials as one-sided, with the supervisor holding all the cards. However, in science and technology that is not necessarily the case, since the supervisors depend on their doctoral students for publications and research outcomes to fulfil the requirements of their funding bodies.

Cross-cultural supervision

Understanding the informal expectations is important for completion (Lovitts, 2001), and these are usually tacit and may be very different from what the international doctoral students have experienced in their home countries. International doctoral students are commonly characterized as problematic and often seen as dependent and demanding (Goode, 2007), and this depicts international students as in deficit. Clearly, the

collaboration across cultures adds a layer of complexity and possibilities for miscommunication, but there is a wealth of studies that go behind the superficial understanding of deficit, and that can inform our understanding of issues in play in cross-cultural supervision. There is an overweight of studies involving East Asian students as also noted by Signorini, Wiesemes and Murphy (2009). Research regarding international students from African, South American or Eastern European countries is scarce, although for instance the study by Winchester-Seeto et al. (2013) includes candidates from Africa and South America.

The study by Winchester-Seeto et al. (2013) showed that issues reported by international doctoral students are mainly the same as domestic students raise, but the authors identified eight intensifiers that make the situation more difficult for international students. Some of these intensifiers are rooted in circumstances like language problems and distance to supportive networks, while others are rooted in cultural differences, the latter being in focus here.

In discussing the cross-cultural skills needed for global virtual teams Parkinson, Zaugg and Tateishi (2011) distinguish between cultural values and communication. Understanding differences in cultural values is important to avoid ethnocentrism – feeling that one’s own culture is superior. While acknowledging that the frameworks they present, partly based on Hofstede (1984), are simplifications, they can be useful to help understand how culture affects collaboration. They present five dimensions of cultural values: collective vs. individual; equality vs. hierarchy; precise vs. loose reckoning of time; tolerance of risk and uncertainty; and doing vs. being orientation. For the cross-cultural skills in communication they go into detail with three dimensions: high context vs. low context communication; saving face; and equality vs. hierarchy and communication. They mention other communication issues like how much emotion is acceptable in a conversation and how to deal with silence.

The understanding of and expectations to the relationship often seem to be mismatched in cross-cultural supervision, with differences rooted in both educational philosophies and cultural

norms (Adrian-Taylor, Noels & Tischler, 2007; Wang & Li, 2011). In particular dealing with the cultural differences in perception of hierarchy is recognised as an issue (Ingleby & Chung, 2009; Kiley, 2006; Winchester-Seeto et al., 2013). The doctoral student's perceptions of their role can prevent them from taking initiative, and then the conception of the hierarchy becomes a barrier, as showed by Cargill (2000). Some authors refer to students' expectations to the supervisor as the one who sets direction and formulates the project, which is contrary to the supervisors' expectations in most Western universities (Cargill, 2000; McClure, 2007). Wang (2006) describes the Chinese tradition where teachers should be respected for their wisdom and knowledge, which should not be questioned. At the same time, Chinese teachers and students are assumed to think of each other as extended family, and it is not unusual with personal and casual relationships outside the classroom. The power differentials and the cultural norms that the students may assign to these can result in difficulties in approaching the supervisor for help and guidance, or reluctance to disagree openly with the supervisor (Wang & Li, 2011; Winchester-Seeto et al., 2013).

In a Canadian study regarding conflict management in cross-cultural supervision Adrian-Taylor et al. (2007) listed a number of sources of conflict reported by supervisors and graduate students, with some overlap. For example, from the international graduate students the most commonly reported (32%) source of conflict was lack of openness, defined as the student unwilling to disagree with or confront supervisor because he or she is afraid of the supervisor's power to make things worse for him or her. 23.6% of the students reported lack of support and guidance from the supervisor as a source of conflict, while 37.7% of the supervisors reported that the student is too dependent as a source of conflict. This study does not investigate the possible explanations for the findings as it is based on a quantitative survey. Qualitative studies are required to increase our understanding of the perceptions of power relations in cross-cultural supervision especially studies that include African, South American and Eastern European international students in Western universities, and Western international students in, to them, foreign universities.

The way that Parkinson et al. (2011) describe the dimension of equality vs. hierarchy indicates that cultures that value strong hierarchical structures for example as having respect for titles and expecting social relations to be rather formal, while cultures valuing weak hierarchies expect delegation of authority and informal social relationships. This can explain why some doctoral students may wait for the initiative of the supervisor as they do not expect the supervisor to delegate authority, and in communication they may feel uncomfortable if expected to talk openly and challenge the ideas of the supervisor.

Another explanation for some international students' reluctance to seek help may be rooted in a feeling that revealing their weaknesses to others leads to a loss of face and feeling of shame (B. Lee, Farruggia & Brown, 2013). Parkinson et al. (2011) describe an issue in cross-cultural communication as the desire to protect an individual's reputation – saving face – that can result in people avoiding to give feedback, not discussing conflict and avoiding to say no. With reference to Indonesian students in Australia Kiley (2006) reports that, according to her respondents, when a student does not contact the supervisor in Indonesia then everything is wrong, but the supervisor takes it as 'everything is ok'.

Kiley (2006) also found that some cross-cultural issues were related to communication and doubts about how to approach the supervisor in the appropriate way. This may relate to what Walsh (2010) terms pragmatic competence; the ability understand and respond to the complex sociocultural issues such as social distance and indirectness. Parkinson et al. (2011) use the term 'cultural intelligence' to signify 'the ability to interpret the actions of team members in terms of their own culture' (p. 1224), and understand this as the opposite of ethnocentrism.

Indirectness in communication is a concept that also gives rise to misunderstandings. When it comes to writing, the direct writing-style in Western academia may be considered rude and insulting by East Asian academics, while an indirect style, circling around the main argument, is considered elegant and polite (Adrian-Taylor et al., 2007; Wisker, Robinson & Jones, 2011). Singh and

Fu (2008) explain the differences in writing style through different argumentative approaches students are taught in Western countries vs. China. Parkinson et al. (2011) refer to the dimension of high context vs. low context communication. In high context cultures it is considered as good communication to express negative comments in abstract and round-about ways in order to keep good relations, while low context cultures tend to focus on getting the message across by using direct language.

Some studies reveal a perception of international students being weaker in critical thinking, critical reflection or questioning (Wang, 2006; Wisker et al., 2011). Kember (2000) and B. Lee et al. (2013) depict the common stereotype of East Asian international students as rote-learners with a surface approach to learning by memorising. However, they argue, memorisation and understanding are not opposites, but mutually supportive. Wang (2006) challenges this understanding and states that in Confusian tradition 'Memorizing, understanding, reflecting and questioning are the basic components of learning' (p. 3). On the other hand teaching of critical reflection in higher education is discussed by for instance Smith (2011) with no reference to culture as this is an issue in higher education in general.

The understanding of the Chinese learner as memorising may be boiled down to a question of learning strategies. Wang (2006) states 'Westerners believe in exploring first, then in the development of skill; the Chinese believe in skill development first, which typically involves repetitive learning (as opposed to rote learning), after which there is something to be creative with' (p. 9). Wang's account of Chinese culture and learning takes us behind many stereotypes of the Chinese learner, and that Chinese learning and teaching is more complex than many studies express. In her doctoral work Yang (2005) found that Chinese doctoral students in Australia adopt a range of different learning strategies dependent on personal qualities, and perceptions of context and demands.

Winchester-Seeto et al. (2013) identified stereotyping as an intensifier, for example doctoral students experiencing how supervisors assume that they needed extra help. Goode (2007)

recommends that supervisors need to avoid stereotyping and to become aware of what they take for granted, as the doctoral students in her study were able to adjust to the local culture when they got to know the rules of the game. Kiley (2003) reports on three different strategies adopted by Indonesian doctoral students in Australia. One group termed 'transformers' reported that they had changed their world view and their way of learning during their studies. The 'strategists' group strategically acquired certain skills and attitudes in order to complete, while the third group, the 'conservers', reported that they did not want to change, but they were keen to acquire knowledge and skills. Grimshaw (2007) advocates against the stereotype of the Chinese learner as passive, uncritical and over-reliant, and suggests that 'we should seek to relate to them first and foremost as people, with all the complexity that entails' (p. 308).

I find the frameworks presented by Parkinson et al. (2011) useful as background understanding to increase one's 'cultural intelligence' or 'pragmatic competence', to avoid ethnocentrism the best we can, avoid stereotyping by not taking things for granted, and keep being curious about the individual person's background and values.

Gender

Research into gender perspectives in doctoral education is quite limited. The Danish survey from 2007 showed that women statistically have higher completion rates than men (Epinion Capacent, 2007). Work by Rodwell and Neumann (2008), Kyvik and Olsen (2013), Seagram et al. (1998) and T. Wright and Cochrane (2000) did not find significant differences between men and women in time to completion. This may indicate that the social position and the power differentials that gender entails does not work to the disadvantage of women. Unlike research into cultural differences in values and communication, studies on gender differences are almost non-existent. However, Bell-Ellison and Detric (2008) found that female doctoral students tended to rate acceptance and confirmation (believe in me) higher than male doctoral students, but otherwise they found that male and female doctoral students were more alike than different in

their preferences of the 'ideal mentor'. In an interview study with eight female PhD graduates Brown and Watson (2010) found no indication of gender impacting the supervisory relationship, but the qualitative nature of this study limits this aspect of their study. In a survey with 63 female doctoral students Maher, Ford and Thompson (2004) found that factors helping or hindering progress and timely completion in their survey were similar to factors identified in earlier research on progress of all students, regardless of gender. In her doctoral research into gender and doctoral physics education Gonsalves (2010) shows how women (and men) construct their subject positions, i.e. the possible identities available, in ways that are compatible with the discourse of physics. 'while almost all of the female and male participants in this study describes physicists in normative masculine terms, all of them saw a place for themselves in physics and, moreover, saw no contradiction between their own gender performance and the practice of physics' (Gonsalves, 2011, p. 125). This illustrates how gender is constructed in situations rather than being a predictor of behaviour.

Interaction

Research into doctoral supervision is mainly based on interviews, which gives an understanding of how supervisors and doctoral students understand supervision, their lived experiences. There is much less research on the actual dynamics of supervision as pedagogy based on observations of supervision (Delamont, Parry & Atkinson, 1998; Goode, 2010; Grant, 2008; A. Lee, 2008a; A. Lee & Green, 2009). McAlpine and Amundsen (2009) analyse actual supervision in their study of doctoral students' agency. Although they have not observed supervision they have gained access from audio-recording. Similarly Paré, Starke-Meyerring and McAlpine (2007) base their analysis of supervision of the writing process on audio-recorded supervision sessions. Vehviläinen (2009) analysed actual interaction in master level supervision in terms of student-initiated advice. She found that responding to students questions is a central pedagogical activity in supervision, and that supervisors cautiously avoided straight answers. Supervisors at master's level sometimes withhold their answers for pedagogical reasons, to encourage students' independent

thought. Such approach to supervision has not, to my knowledge, been described in literature on doctoral supervision. Here the difference in degree level may play an important role, but Vehviläinen's theoretical framework and her background in psychology and counselling can also explain that she sees this in her data. The doctoral work undertaken by Barbara Grant (2005) is based on analyses of actual supervision of Master's students. She has contributed with very valuable insights into the supervisory relationship – the *and* in student *and* supervisor, as she coins it. As described earlier, her research has contributed to a better understanding of the complexity of power in play in supervision, and she published her work as peer reviewed articles as well (Grant, 2003, 2008, 2010a). A study by Florence and Yore (2004) used a case study design and multiple sources of data collection including observation and audio-recording of interaction in research students and supervisors co-authoring scientific papers.

While the focus on the writing process is slightly different from my focus, their research is relevant as they show how the students (graduate and postgraduate) are at the same time students of science and producers of science, and they illuminate how the students become acculturated as science writers through healthy tension and a supportive environment. This bears connotations to the findings of Dysthe et al. (2006) in terms of learning opportunities in the tension between diverging voices of multiple supervisors. (Li and Seale (2007a), 2007b), 2008)) have written about their experiences with supervision as supervisor and supervisee, and base their account on audio-recordings of actual interaction. The advantage of this kind of research is that the actual supervision can be discussed and reflected upon by participants in hindsight. This hindsight is only possible after the PhD has been finished, and thus not an option for a PhD research project. Cargill (2000) uses conversation analysis to explore issues in actual supervision across cultures, and describes how international students in Australia can be reluctant to take up turns in the interaction.

The limitation in interviewing is that respondents may not possess the language and theoretical frameworks to reflect on

how they do, and usually describe their activities in general terms like 'discussion', 'critical conversations', or 'feedback'. Observational studies that uncover what supervision looks like in practice are still scarce. Observation and recording actual supervision can give new insights into the finer grains of the interaction that interviews do not reveal.

3. Methodology

This chapter is divided into two parts dealing with the Agency Study first and then the Interaction Studies. Before that I describe my own theoretical position in constructivism, and in the end of the chapter I discuss validity and ethical issues.

Gibbs (2007) describes a divide in qualitative research between realism and constructivism, although he also argues that few qualitative researchers purely subscribe to one or the other view. My position in this divide is coloured by my background in life science, and I do believe that there is a real world out there, independent of me as an observer. However, in qualitative research about the interaction among people it makes little sense for me to refer to an objective truth. Gibbs (2007) writes in his description of constructivism that 'People used to believe witches had supernatural powers and that the Earth was flat. Now very few believe either and consequently the world *for us* is different.' (p. 7, my emphasis). To me, the world itself is not different, but the world as we perceive it has changed. And in qualitative research of human activity the world per se is not the object of study, but the perceived world that humans construct their understanding of is what this research concerns. I elaborate on different perspectives on learning within constructivism in section 3.2 below.

3.1 Relating to the Agency Study

The objectives for this part of the thesis are to investigate if the working relationship doctoral students establish with their supervisors can be improved through a structured meeting about aligning mutual expectations and sharing the doctoral students' personal development plan. The research questions are

Does the discussion with the supervisor about personal development planning and aligning expectations

- 1) help doctoral students build their agency in managing collaboration with the supervisor, and

- 2) strengthen the supervisory relationship as perceived by the doctoral student.

Identity and Agency as theoretical framework

The Agency Study was started as further investigations into the issues pointed out in the qualitative evaluation of the Introduction Course (Grumløse et al., 2010). These were issues in establishing a good working relationship with the supervisor and understanding how the course apparently worked to engender self-management and forming identity. This led me to search for a theoretical framework of agency which included identity. Also my first analyses of the reflective notes in my data supported me in this choice as a prevalent theme was gaining understanding of one-self, and this I understand as a first step in building agency – being aware of one’s needs. With this understanding I explored the concept of agency in order to find an understanding of agency that embraced identity.

A doctoral student will have different ways of expressing her or his identity in different contexts. At work, as for example in a meeting in the department, they may present themselves as ‘I’m *just* a PhD student’, as they compare their status with professors attending the meeting. At a family gathering they may proudly say ‘I am a PhD student in so-and-so university!’ sharing their enthusiasm about their endeavour. Holland et al. (1998) refer to identity as self-understanding: ‘People tell others who they are, but even more important, they tell themselves and even try to act as though they are who they say they are.’ (p. 3). When a doctoral student says ‘I am *just* a PhD student’ then she positions herself as lower in the hierarchy, with less responsibility and less voice. A person’s positional and relational identity is shaped by her perception of her access to spaces, resources, activities and voices, i.e. her perception of her social position in the lived world. This is the third layer in the multi-layered description of the supervisory relationship by Grant (2003) as described in chapter 2. An individual’s identity is rather stable because we choose to act in ways that are consistent with our self-understanding to ensure that we are recognised over time and space. Yet identity is continuously constructed in situations and relations as people

author their professional selves. Individuals craft their responses in the situation by improvising in response to particular situations. Holland et al. (1998) see this art of improvisation as one type of human agency. For their second type of human agency they draw on Bourdieu, Bakhtin and Vygotsky to define their understanding. They see the power structures as necessary but changeable. If the cultural and social structures that inform the situation are neglected there would be no need for agency for humans to act. On the other hand if the structural social constraints are viewed as deterministic rules there would be no room for improvisation. But ‘action takes place within an always present, partially durable construction of stratified social differences’ (p. 279).

Within the same understanding of identity and agency Sfar and Prusak (2005) pointed out that identity is linked with communication; individuals build their identity through the communication they engage in with others. People do not just describe who they are, as if their identity is static and unchangeable through time and space, but identity is constantly negotiated and collectively shaped. Sfar and Prusak (2005, p. 16) suggest the following narrative definition of identity as ‘collections of stories about persons or, more specifically, as those narratives about individuals that are *reifying*, *endorsable*, and *significant*.’ [original emphasis]. Narrating oneself as *just* a PhD student can become a self-fulfilling prophecy, especially if endorsed by others, and a doctoral student subscribing to this narrative could be disadvantaged in her journey to becoming a scientist. Storytelling as identity building has advantages in that stories are changeable according to needs and intentions, they have authors and receivers, and they are operational in terms of data-collection and analysis. McAlpine and Amundsen (2009, p. 112) describe agency as an evocation of identity: as the capacity to construct narratives in terms of personal intentions and the ability to influence one’s experiences, or ‘acting to shape and not just be shaped by the contexts in which they [are] acting’ (p. 109).

The concept of *relational agency* is also in play in studies concerning doctoral students’ agency for instance by Hopwood (2010b), as mentioned in section 2.2 regarding the doctoral student

perspective (Chapter 2, Framing the study). This work is based on work by Anne Edwards (Edwards, 2005, 2009; Edwards & D'arcy, 2004), who defined relational agency as “a capability to work with others to expand the object that one is working on and trying to transform by recognizing and accessing the resources that others bring to bear as they interpret and respond to the object” (Edwards, 2005, p. 172). However, relational agency as defined by Edwards is based on Engeström’s activity theory and is less concerned with identity formation, and because I am interested in identity formation I build on Holland et al. (1998), since their socio-cultural understanding of agency is closely linked with identity formation. Therefore I will use the understanding of agency and the approach to analyse transcripts described by Holland et al. (1998) in this thesis. Agency is the evocation of identity, the capacity to act intentionally, to construct narratives in terms of personal intentions and the ability to influence one’s experiences in spite of social and relational positions.

Data collection

The early data of my PhD study included the raw data from the qualitative evaluation (2009) of the Introduction Course: twelve interviews with doctoral students who had attended the course some eighteen months earlier. I also had personal development plans (PDP) corresponding to nine of these interviews with their reflective notes on the meeting these doctoral students had with their supervisors about the PDP. And then I had the report from the qualitative evaluation (Grumløse et al., 2010). The interviews were conducted by an ethnographer, who had been hired for the purpose, so an external researcher who did not know the course participants. The interviews did not focus on the relationship with the supervisors, but some of the interviewees emphasised the effect that sharing the PDP with the supervisor had on their supervisory relationship. All together I found the data too weak to say anything significant about the effect that the meeting with the supervisor may have on doctoral students’ agency and supervisory relationships, and I decided to collect more data.

Stimulated reflection. I invented this term to signify that the respondents were reminded of their earlier reflections when

asking them to reflect further. In teacher training the term stimulated recall is used when a teaching session is video-recorded and the recording is subsequently used to help the teacher recall what he or she was thinking when making choices in the teaching situation (c.f. Schepens, Aelterman & Van Keer, 2007; Stough, 2001). An email was sent to the selected course participants personally. In the email I included for each their reflective note as a means to stimulate their reflection and remind them of how they thought about the meeting at the time. For example, if a course participant wrote in the reflective note: *'it was a nice opportunity to get to know each other more'*, then a further reflection might reveal what impact the respondent perceived this to have on a longer term. I could make an online survey, but then I would not be able to send them their reflective note from the course assignment as stimulation, nor match the reflective note with the follow-up reflection. Another reason for sending individual emails to the respondents is that I expected a higher response rate from that approach. Another alternative would be to interview respondents. Interviews give the possibility of asking supplementing questions to get more into depth with a topic or to rephrase questions that seemingly have been understood differently than intended. The number of respondents and the number of questions or the complexity of the topic are usually pivotal in deciding the method of data collection. Here the complexity of the topic was judged to be rather low, and balancing that with the number of respondents that could be reached with either method made me choose the email with one question, and with their reflective note included.

I selected doctoral students who had attended the course during 2009 through 2011. The total number of assignments during 2009-2011 adds up to 302, and from those I selected the reflective notes with some substance, those who had indicated that the meeting with the supervisor mattered to them, either by pointing to some difficulties, pointing to decisions taken about supervision, or giving an indication of expectations for an improved relationship. An example of how the stimulated reflection approach might work is illustrated in this reply from a doctoral student

I am in my third year now, and naturally quite packed with work. In a way, it feels like I don't have time any more to think and or worry about things like supervision. This may sound a bit negative, or maybe like someone who wants to show off with how busy he is.

It took me a while, pondering about this.

When trying to answer your mail I felt like I completely lost touch with my supervisors. I felt like I had missed everything I expected from a good supervision during the first two years of my PhD. When I read my reflective notes from the first meetings all I thought was: "Oh my God, how naive was I!"

But suddenly I realized something: I felt like a child that suddenly realizes it had grown up. I see my supervisors as colleagues now, we work (almost) on equal ground. All the time I was expecting them to take me by my hand, and guide me through my PhD. And like the child that is being angry at its parents for not holding its hand anymore, and over its anger does not realize it can walk on its own, I guess I am surprised at how my relationship with my supervisors gradually changed, without me consciously realizing the change.

So, to sum it all up: my relationship with my supervisors has changed from a student-supervisor relationship to a relationship among colleagues. Of course I am the one asking them more often than they ask me, and they know more and have more experience, but there are also areas where I can see I am "overtaking", areas where I specialize and acquire more knowledge than they have. And that boosts self-esteem.

This also illustrates how any intervention influences how the respondents think about a situation, including methods like observations and interviews. In a stimulated reflection like this, the idea is to make the respondent think. In interview situations this effect seldom manifests itself so clearly, because the respondent would not have the time to 'ponder' about the answer. An email may give better reflections than online surveys or interviews because of the time lapse.

Data analysis

The data was merged into a single file with the reflective notes paired with the follow-up reflections from the same respondent. Each respondent was given a code and all names removed from the document to make them anonymous. I used Atlas.ti for coding the document. As a first step I coded the data for content, asking ‘what is going on?’ just to familiarize myself with the data. This coding has not been used directly, but made it easier to develop coding schemes for the successive deductive coding. In order to say something about the supervisory relationships I started coding with regards to terms and expressions that the respondents used to describe the relationship with their supervisors. The question to respondents was worded as

‘In hindsight, how did the meeting with your supervisor(s) about the PDP influence your collaboration and relation with your supervisor(s)?’

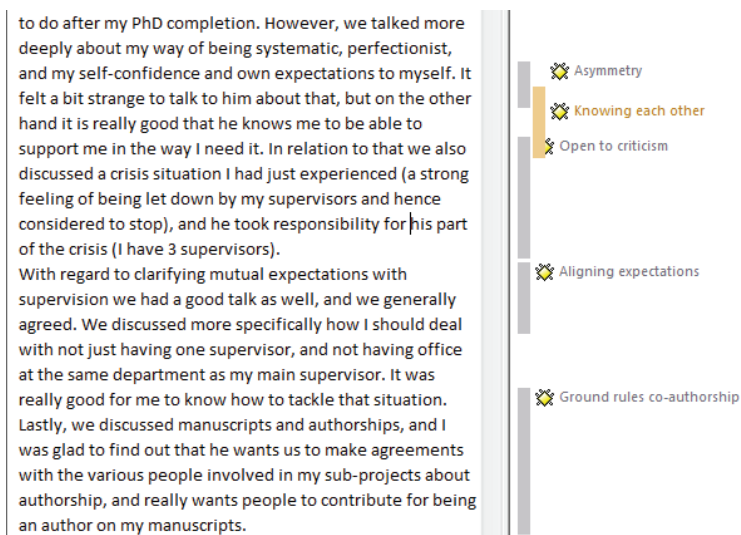


Figure 3.1. Example of coding a reflective note.

The coding scheme was developed as a recursive process of working with the data, but with a clear question in mind, that is

characterizing the supervisory relationship in terms of what the doctoral students gained (e.g. aligning expectations) or what distressed them (e.g. asymmetry, see figure 3.1). This makes it a theory driven (deductive) analysis in the terms used by Braun and Clarke (2006).

All qualitatively different ways of characterizing the relationship were coded irrespective of frequency to avoid quasi-quantification as described by Bryman (2008, pp. 596-598). This analysis did not directly serve to answer the research questions, but aimed to provide a description of how doctoral students perceived supervisory relationships as positive or negative.

To answer the first research question ‘Does the discussion with the supervisor about personal development planning and aligning expectations help doctoral students build their confidence in managing collaboration with the supervisor’ I analysed the reflective notes from the course assignments for expressions of agency, for example

She told me that they consider PhD students as a part of staff and colleague not student. So, it gave me a feeling of confidence that it is my project and I should handle it.

was coded as ‘PhD building self-confidence’.

Finally, to answer the second research question about strengthening the relationship, I coded the follow-up reflections for identity formation and agency. When seeing agency as an evocation of identity as described by McAlpine and Amundsen (2009), awareness in itself contributes to building agency because it contributes to the story-telling that shapes identity. The coding for identity and agency therefore included expressions from how the course or the course material worked to scaffold the meeting, over becoming aware or gain understanding, and supervisors building agency through autonomy support, to doctoral students making suggestions or taking charge. Against the background of this coding the paired reflective notes and follow-up reflections were grouped in qualitatively different perceived effects of the meeting.

3.2 Relating to the Interaction Studies

The initial research question formed the basis for the selection of cases and deciding on the methods of interviewing and observation. The initial research question was

How do supervisors and PhD students interact over time and create learning possibilities?

The research question I ended up with is slightly different

How are learning opportunities created by supervisors and doctoral students during supervision with multiple supervisors?

I have specified that I explore interaction during supervision, I focus on multiple supervisors, and I have omitted the longitudinal aspect. As I explained in the Introduction, section 1.2, the longitudinal aspect of the research is not part of this thesis, but I continue the observations of three cases and will report on this study after the observations and interviews have been completed. The focus on multiple supervisors is a result of my literature search for the Multivoicedness Study. As I have described in chapter 2 little research has been reported to date on doctoral supervision with multiple supervisors.

The Interaction Studies focus on learning opportunities, and I begin with an introduction to the theoretical frameworks to analyse learning opportunities in these studies. First I describe the broader perspectives on learning, and then I go into the theoretical frameworks that I use for my analyses, participation, positioning theory and the notion of variation, and how I understand learning opportunities in each of these theoretical frames.

Packer and Goicoechea (2000) discuss the relation between sociocultural and constructivist perspectives on learning. Sfard (1998) uses the 'Acquisition metaphor' and the 'Participation metaphor' for the two perspectives on learning. In my understanding of constructivism this covers both the individual,

cognitivist perspective and the sociocultural perspective, so I will not use the word constructivist to mean something different from sociocultural. In this thesis I use the terms acquisition or individual acquisition perspective and the sociocultural perspective on learning. In this thesis I use participation more specifically to signify the perspective on learning that is associated with Communities of Practice (Lave & Wenger, 1991; Wenger, 1998). The acquisition perspective on learning in this thesis is concerned with the act of learning or the mechanism of learning for the individual. The individual learning happens in a social context, but the individual's act of learning is foregrounded in this perspective. With the sociocultural perspective on learning the social context is foregrounded. Here learning is seen as happening in the interaction before it is internalised by the individual. Packer and Goicoechea (2000) argue that the two perspectives on learning are not simply supplementary. They argue that the acquisition perspective (what they call constructivist) presumes a dualist ontology, a divide between the knower and the known, the subject and an independent world. The sociocultural perspective assumes a non-dualist ontology where learning is a process of becoming when the person as an acting being engages in activities in the world. The individual and the social world are mutually constituting and internally related to one another.

These perspectives on learning come into play when I study learning opportunities in the Interaction Studies. The Multivoicedness Study is informed by a sociocultural perspective on learning, using positioning theory and dialogism, while the Experiencing Variation Study uses the acquisition perspective on learning with the use of the notion of variation. In the fourth study, the Two Perspectives Study, I combine the two perspectives on learning, and in the discussion consider the value of combining the two perspectives.

The three Interaction Studies are concerned with learning opportunities during supervision with multiple supervisors. The Multivoicedness Study is informed by a sociocultural perspective on learning using positioning theory (Harré & van Langenhove, 1999) combined with dialogism and diverging perspectives (cf.

Dysthe, 2002a; Dysthe et al., 2006; Holquist, 1990). In the Experiencing Variation Study I use of the notion of variation as key for learning (Marton & Tsui, 2004). And the Two Perspectives Study combines the sociocultural and the acquisition perspectives on learning.

Bikner-Ahsbabs and Prediger (2010) argue that diversity of theories should be seen as a resource rather than a challenge, but they emphasize that '[p]lurality can only become fruitful, when different approaches and traditions *come into interaction*.' (p. 490, original emphasis). They present a gradient of strategies to connect theoretical approaches ranging from 'ignoring other theories' to 'unifying globally' as the two extremes with respect to degree of integration. Between the extremes they place pairs of strategies to integrate theories: 'understanding and making understandable, comparing and contrasting, combining and coordinating, and integrating locally and synthesizing' (p. 492). They use the term *coordinating* for building a conceptual framework with elements from different theories, while *combining* theories means to use different theories side by side in analysing an empirical phenomenon. Even theories with conflicting basic assumptions can be combined in order to get a multi-faceted insight into the empirical phenomenon in view. According to Bikner-Ahsbabs and Prediger (2010) only theories that have the same core assumptions can be used in coordination to build a conceptual framework, and the acquisition and sociocultural perspectives have different ontological assumptions. In my Two Perspectives Study I combine the two theoretical perspectives on learning, the acquisition and the sociocultural perspective.

Participation

From the sociocultural perspective learning is viewed as culturally mediated and founded in purposive activity, and Vygotsky is generally seen as one of the founders of the sociocultural perspective (c.f. Packer & Goicoechea, 2000). Learning as participation implies that learning is seen as a socially situated activity, and as such learning is an aspect of all activity (Lave & Wenger, 1991). Wenger (1998) sees knowledge as competence and knowing as active engagement. Learning as participation is

ultimately about creating meaning so that we experience the world and our engagement with it as meaningful. Learning involves the construction of identity, and through learning the individual is transformed or developed. The learning process is what it takes to become competent and capable of participating actively and meaningfully in the practices of a particular community of practice. Lave and Wenger's concept of *Legitimate, Peripheral Participation* entails a learning trajectory from novice to full member of a community of practice. As a novice in a community of practice participation must be legitimate in order to be treated as a potential full member. Doctoral students are legitimate participants because they are enrolled in a graduate school and have a supervisor. They are sponsored from somewhere, they have been formally accepted to pursue doctoral studies, and the supervisor has accepted to take them on board. As a new member the novice needs access to on-going activities and mutual engagement with more experienced members. Being peripheral means that there are not the same demands and expectations to one's performance, and peripheral participation involves special assistance, explanations, supervision and observation. Observation of a practice can be useful before actual engagement, but is not enough in itself. Scaffolding is a specific form of assistance tailored to the needs of the novice. Supervision here may have the connotation of overseeing and rectifying or giving feedback. Lave and Wenger based their first book on anthropological studies in the context of apprenticeships and in that context supervision has this specific connotation which is very different from the general use of the word supervision in education.

This socio-cultural perspective on learning as participation means that learning opportunities in the context of supervision meetings are opportunities to participate in the practice, for instance in scientific discussion, with more or less support from the supervisors.

Positioning theory

Positioning theory was originally developed as an alternative to the concept of roles (Davies & Harré, 1990). While roles are

static and formal, and something we 'take on', the dynamic concept of positioning enables us to make a fine grained analysis of interaction. In positioning theory conversations are viewed as a tri-polar structure of *speech-act*, *positions* and *storylines*. Positioning is the act of assigning rights and duties to oneself and to others, and storylines are the personal use of the cultural context (Harré & van Langenhove, 1999).

A *speech-act* is a meaningful social action. The action of a handshake becomes an act when it is attributed social meaning as a farewell, sealing an agreement, a congratulation or otherwise (Harré & Moghaddam, 2003). A gesture or an utterance becomes an act when others are attributing it social meaning (Davies & Harré, 1990). An action may be interpreted differently depending on the positions of the speaker and the hearer, and there is a tight interrelationship between acts and positions. When an act is interpreted within a social episode, it is subject to normative assessment of correctness, and these norms depend on the cultural context.

Positioning is the act of assigning rights and duties to oneself and to others to perform significant, intentional acts. Positions can be assigned and negotiated from moment to moment, challenged and changed, as the conversation unfolds in a storyline. Positions are both relatively determined by and determining the unfolding storyline and the social forces in play.

Storylines are the implicit references to the cultural context, and thus the cultural meanings are produced and understood through the processes of discursive practice. In an episode the actors may refer to more than one storyline, and these storylines may be contradictory. An example of contradicting storylines, that I find very illustrative, is described by Svend Brinkmann (2010)

If a man is opening a door for a woman, the man may interpret the event according to a storyline of gentlemanship and civility, whereas the woman may interpret the event as one involving male chauvinism that positions the woman as weak and in need of male protection. (p. 258)

The two people involved in this episode interpret the situation differently because they draw on different cultural contexts. The storylines are not an analysis of the power relations in play in the interaction, but they are social constructions that we can hypothesize. Harré and Moghaddam (2003, p. 9) suggest to first hypothesize storylines for each episode. The identification of positioning and storylines is then the iterative process of engaging with the data, as the three concepts of act, positions and storylines are mutually determining. With a tentative storyline the researcher can then code the speech-acts of the episode for positioning, and revisit the storyline in an iterative process to see how far it can be used to make sense of the interaction. Positioning theory enables us to analyse the ambiguous and negotiable nature of social reality. In the Multivoicedness study the supervisors referred to contradicting storylines while the storylines identified in the Two Perspectives study (see figure 1 in the manuscript) are intertwined and coexist without conflict, but they illustrate the complexity of the power relations and positioning in the interaction.

In positioning theory learning is seen as becoming, but rather than the formation of personal identity positioning theory is concerned with the multiplicity of selves we develop in different discursive practices. The learning process is described by Davies and Harré (1999) as

- 1) Learning of the discursive categories which partition human beings into dichotomies or subgroups, e.g. student/ supervisor; lab technician/ doctoral student.
- 2) Participating in the various discursive practices through which meanings are allocated to those categories (see Participation above).
- 3) Positioning oneself in terms of these categories, including imaginatively positioning oneself as if one belongs in one category and not in the other (e.g. as an insecure doctoral student needy of direction, or as fully capable of running this experiment)
- 4) Recognition of oneself as having the characteristics that locate oneself as a member of one subgroup and not of others. This recognition involves the

development of a moral system organised around the belonging, and may entail an emotional commitment to the category of membership. (Recognising oneself as a mature doctoral student in the group may carry with it a moral obligation to include new doctoral students in the group)

Recognising oneself as belonging to certain subgroup can be supported and reinforced by the recognition by others. When a supervisor recognises the doctoral student as expert in a (sub-) field the doctoral student can easier recognise herself as such. Harré (2004) refers to Vygotsky's conception of development of a human being and states that all higher order mental processes exist first in the interpersonal relations of the relevant group, and then it is internalised by the individual. Vygotsky used the phrase *Zone of Proximal Development* to designate the difference between the actual developmental level and the potential developmental level. The actual developmental level is determined by the actual capability in individual problem-solving, whereas the potential developmental level is determined through problem-solving under guidance (Howie, 1999). The guidance may be in the form of hands-on showing or it may be explanations. In this scaffolding the distribution and acknowledgement of rights and duties are of paramount importance. The power relations in the group are closely linked with the assignments of rights and duties, i.e. how the participants are positioned by others and how they position themselves.

In terms of learning opportunities the supervision sessions offer discursive practices that doctoral students can observe and engage in and thereby expand their repertoire (Davies & Harré, 1990). But the learning opportunities are influenced by the way the doctoral students are positioned in the interaction. Doctoral students who often are positioned, or position themselves, as 'in need of help' may avoid the effort of thinking and engaging, and then miss the opportunity to learn. But on the other hand, students who position themselves as experts may lose the opportunity to get new perspectives and feedback on their thinking.

Positioning also influences the doctoral student's capacity beliefs or self-efficacy beliefs. Self-efficacy refers to a person's beliefs that she is capable of attaining desired goals through her action (Bandura, 1997). The confidence in itself that she has the required competences to perform certain task, regardless of actual abilities, leads to more successful performance. Self-efficacy beliefs promote further skills development and are associated with persistence in challenging situations. When a supervisor positions a doctoral student as capable to, say, carry out an analysis in the laboratory, she is more likely to persist on the task and performs better (verbal persuasion). As described by Bandura (1997, pp. 79-115) self-efficacy beliefs can be changed through

- 1) Enactive mastery experience that serve as indicators of capability
- 2) Vicarious (second hand) experience that change efficacy beliefs through comparison with the attainments of others
- 3) Verbal persuasion that one possesses certain capabilities
- 4) Physiological and affective states from which people partly judge their capableness, strength and vulnerability to dysfunction

The way doctoral students are positioned by their supervisor can work as verbal persuasion, and it can influence their affective states, and thereby alter their self-efficacy beliefs. Self-efficacy beliefs are conditions for learning and as such influence the quality of learning opportunities.

Variation theory

The other perspective on learning that I use in this thesis is concerned with the individual person's acquisition of knowledge, understanding and competences. By acquisition in this context I understand learning as constructing meaning. As described by Packer and Goicoechea (2000) this perspective on learning dates back to Piaget, and further back to Kant. Ontologically this perspective takes dualist view, a divide between the knower and the independent world.

In this thesis I use variation theory as the theoretical framework to analyse my data from this perspective. Variation theory is a theory of learning that has been developed from, and is grounded in phenomenography (Marton, 1981; Marton & Pang, 2013; Pang, 2003). The fundamental argument in this theory is, as described by Marton and Booth (1997) that the learner can only notice or *discern* what is varied, and experiencing variation provides opportunities for learning. As stated by Pang (2003) ‘variation is the *sine qua non* of learning’ (p. 150). Learning is defined as a change in the way something is seen. It is central to this theory of learning that there is no learning without something being learned – the object of learning (Marton, Runesson & Tsui, 2004; Runesson, 2005). In a teaching situation the teacher can define an object of learning that she intends the students should learn, and she can use the notion of variation to ensure that the students experience variation that enables them to discern the critical features of the object of learning. There is no guarantee that the students will learn, but variation is a necessary condition for them to learn. What the teacher intends the students to learn is the *intended object of learning* in contrast to the *lived object of learning*, which is what they actually learn. As the teaching unfolds through lecturing, discussion or problem-solving dimensions of the object of learning are varied. What it is possible for the students to learn depends on the variation brought out in the teaching, and the patterns of variation and invariance. What it is possible to learn is termed the *enacted object of learning*, and this can be described by the researcher through analysis of the teaching or interaction.

When something is varied it comes into *focal awareness* and is noticed in a way that it was not seen before, it is discerned. Marton and Tsui (2004) have identified four patterns of variation, each describing what varies and what is invariant in a learning situation. The pattern of variation defines what it is possible to learn in that situation. These are presented below. To make it easy to grasp these patterns I have included examples of learning what a geometric square is given by Fraser and Linder (2009) and Kullberg (2010).

Recognition of contrasts (to know what a square is, you must discern what it is not, in order to distinguish it - if you vary the angles it is no longer a square)

Generalising across aspects (the concept of a square is invariant, but instances of the concept square varies, e.g. different sizes or colours of squares)

Separating critical aspects. In order to discern certain aspects of a phenomenon, that aspect must vary while others remain invariant (you could vary the length of the sides and show that it is still a square)

Fusing critical aspects (being able to discern several features simultaneously, not just one by one)

The pattern of variation defines the space of learning. When dimensions of a phenomenon are varied in a pattern of variation the space of learning is expanded. Experiencing variation in each of these four patterns constitutes an opportunity for learning. Marton et al. (2004) state that ‘separating aspects first and then fusing them together is more efficient than never taking the critical aspects apart’ (p. 17).

The patterns of variation described by Marton et al. (2004) take some effort to grasp, and they are usually described together with simple examples like learning what a square is (Kullberg, 2010) or what a dog is (Bussey, Orgill & Crippen, 2013). I think that the terms used can also confuse the understanding, for instance ‘fusing’ awakes associations of two atoms being fused and a new and different atom is the product together with energy. This is not the intended understanding of fusing as a pattern of variation, but instead a holistic view, seeing everything in one picture. I am not suggesting another term to replace fusion, but it is important to be clear about what it covers.

Recruitment of cases

The case analysed in the Multivoicedness Study was observed as part of a doctoral course about ethnography in 2008, and I used this case in another doctoral course on didactics in 2011 and presented the analysis at a conference (Kobayashi et al., 2012). Here the observation was supplemented with interviews, where I shared my analysis of the session with the respondents and gain insights into their experience of the supervisory process in hindsight. The interviews also served to investigate the supervisors' understanding of research and supervision, and their connections in the research-supervision nexus, with the help of anthropological theory of didactics (Chevallard, 2006; Madsen & Winsløw, 2009).

In selecting the cases for observation I contacted supervisors and doctoral students at the previous Faculty of Life Sciences, University of Copenhagen. A case in this context is a doctoral student and his or her supervisor(s). I selected the respondents from life sciences for different reasons, some being more pragmatic: I have a big network of researchers and doctoral students there, which gave me certain 'street credibility'; because they know that I understand what their job entails it made it easier for me to gain access to observe their practice (Smyth & Holian, 2008). And because the previous Faculty of Life Sciences had funded parts of my studies it seemed fair to let them 'benefit'. However, life sciences was also selected because I have a degree in that field and therefore have the capabilities of understanding the research sufficiently well to analyse the supervision sessions. This opens for questions about my role as researcher within my own field – the advantages and disadvantages of being an insider as described by Adriansen and Madsen (2009). I discuss the risks of insider research in section 3.3.

Selecting cases from life sciences was thus partly out of convenience, accessibility and 'street credibility', and partly purposive due to my knowledge of the discipline, its history and culture. The latter turned out to be very important when using the notion of variation to analyse learning opportunities: In order

to understand when a concept is varied I needed to understand the subject matter to some extent.

The strategy I used in recruiting cases was to ensure as much variety in the resulting sample of cases as possible, so that the cases differ from each other in terms of key characteristics. By selecting a variety of cases I expect to get richer material (Brinkmann & Tanggaard, 2010; Bryman, 2008; Kvale & Brinkmann, 2009). The key characteristics were: disciplines within life sciences, time into doctoral studies, experiences of supervisors, gender, and educational/national background of doctoral students (home vs. international). I used different strategies to contact potential cases. I started with a notice in the faculty newsletter, and this gave a response from a supervisor I did not know, but I knew his doctoral student from our introduction course. I also asked previous colleagues to ask around in their groups, as a snowballing strategy, and this again gave a response from supervisors I did not know, but I knew the doctoral student. When I contacted supervisors directly, I avoided people I knew too well and I avoided supervisors that I had heard complaints about, both out of ethical considerations. Although the interviews have come to play a minor role in this research interviewing is still a part. In interviews the interviewer herself is the main instrument for data-collection and this magnifies the importance of the interviewer's integrity (Kvale & Brinkmann, 2009). My sympathy or antipathy for the respondents may impede my professional distance in the interviewing as well as in analysing data from interviews as well as observations. From those I asked directly two supervisors declined. One said that she thought that this would put too much burden on her doctoral students, and the other stated that he only had ad hoc meetings with his doctoral students, so logistically it would be too complicated. Only in one case did I ask a doctoral student rather than approaching supervisors. This was because I had difficulties in finding supervisors with newly recruited doctoral students, but the doctoral students at our introduction course are usually newly recruited. In this case I asked a doctoral student who seemed confident enough to ask his supervisor. I discuss the issues in selecting respondents further in section 3.3 about validity.

I ended up with sixteen cases, and then realized that I was not able to observe and interview this many. I reduced the number to twelve, on basis of ensuring variety of the characteristics mentioned above. Of these twelve cases, four were interactions with two supervisors present simultaneously, while the other eight cases were one-to-one interactions between the doctoral student and one of that person's supervisors.

Because my initial idea was to have a longitudinal aspect of the study I decided to follow three cases over longer time. I selected one doctoral student in her first year, one in her second year, and the last in his final year. My intention was to make a quasi-longitudinal study by putting together the observations from these three cases. I abandoned this idea mainly because I realised the potential in focusing on multiple supervisors. I have observed the three cases anyway, and continue to follow them till they graduate, to enhance the quality of the longitudinal aspect. This will be data for future research.

Observations

In this study I set the boundaries for exploring learning to the space of scheduled supervision meetings, which are feasible to explore through observation. A total of twelve cases have been observed in the overall study. After each observation I interviewed the doctoral student and the supervisor(s).

Any intervention will alter how a respondent thinks and acts. My presence as observer at the supervision sessions has an effect on the interaction during that session, even if observing entails less active intervention than interviews. When asking a question in an interview situation I affect how the respondent thinks about his or her situation, as my email question altered the way doctoral students think about their supervisory process (section 3.1).

The observations of supervision sessions happened either in the usual space, meaning the supervisor's office, or in a meeting room if the supervisors or the doctoral student judged that more space was needed. While the 'usual place' is more naturalistic, a meeting room of their choice can still be seen as their own

setting, so the respondents are on home ground so to speak. Alan Bryman (2008, pp. 410-411) describes a classification of observer roles based on Gold (1958). The classification describes degrees of involvement vs. detachment, and in this classification my observations fall within the category of complete observer where the researcher does not interact with the people. I am not a participant, and the respondents do not have to take the researcher into account. I gathered the material that respondents were using for the meeting, like the PhD plan, protocol for an experiment or agenda for the meeting. This helped me understand the details of the scientific discussions. And I interviewed respondents after the supervision session, because I intended to record a session as naturalistic as possible, without the influence of a prior interview.

I introduced the idea of my research in a supplement to an email that they had received in advance, I explicitly informed them of the confidentiality of the data I produced, and I informed them when I switched on the sound and the video-recorder. Myself, I found a place to sit in the background and take notes. When asking participants about how the recording and my presence affected the supervision, they said that they tended to forget about it when engaging in the scientific discussions, although they were reminded when they caught sight of me. One doctoral student said that she found her supervisor a bit more formal than usual in the beginning of the session, but that the 'normal' atmosphere returned after some time. In one of the sessions the main supervisor ensured that insider information was explained for my sake, and in another session I was included in the supervision in questions about learning theory. My presence has affected the supervision to some degree. On the other hand I find it ethically sound that the participants are aware that they are being recorded during their supervision session, to avoid putting them in a situation where they regret utterances or feel they need to ask me to exclude episodes. This has not happened, although there are episodes where they discuss conflicts with other groups that I would not include in my study. One might have considered to ask the respondents to video-record their session as a viable and less intervening alternative, rather than observing the sessions personally. What I gain from being there are my experience and

my field notes about the situation, the atmosphere, little things I might notice about the context which a video camera would not catch, and also the reminder for the respondents about the data-collection situation mentioned above.

Interviews

I intended to investigate the first question, how doctoral students construe and use their learning environment, through interviews with doctoral students. During interviews I asked doctoral students to describe where they would go for help, who they would ask, and how they would describe the research and learning environment. The kind of answers I got were descriptions of a bigger research project they might have been part of and mention of other doctoral students in their group, adjacent research groups, or external collaboration partners. I had the sense that they reported the obvious, nothing really surprised me, except perhaps, different opinions on how group supervision worked. The explanation for this apparently shallow outcome of the interviews might very well be due to the interviews being the only way I explored the broader learning environment. The interviews worked very well when it came to gaining insights into the supervision issues, and here the interviews were not the sole data collection method, but gave further insights into an observed practice. I did not explore their learning environment in a broader sense, and it is probably necessary to adopt a variety of research approaches and data collection methods to achieve good insight into that as studies by Hum (2013) and McAlpine and McKinnon (2012).

For the Interaction Studies I mainly use interviews for the Multivoicedness Study, where the interviews served to gain insight into respondents' understanding of power issues in supervision, and in the Two Perspectives Study the interviews are used to gain further insight into respondents' perception of specific issues, but all interviews serve as a background for the analysis of observed interaction. The interviews were semi-structured using an interview guide prepared for supervisors and doctoral students separately. The interview guides were divided into themes with headings that helped me as interviewer to cover

all intended aspects without being locked into a fixed structure. The reason for a loose structure is to promote a positive interaction through a more dynamic interview style (Kvale & Brinkmann, 2009).

Data preparation

The supervision sessions that have been used in my research have all been transcribed. For the fine grained analyses using the notion of variation and positioning theory this is necessary. It also makes it easier to work in a team and allow for double rating and common discussion and agreement on interpretation (Gibbs, 2007). The interviews used for the Multivoicedness Study have been transcribed verbatim. For verbatim transcriptions I used the legend below. In my transcripts I have used first letter of the person's name, but in the papers, and here, I have changed that to Main supervisor, PhD student and Co-supervisor.

...	Short pause
..	Is continued while someone else interrupts
/	Interruption
(text)	Comments in brackets are comments by the transcriber, e.g. mumbling or laughing
(?)	Unclear
☺	Laughing
!	Emphasis
hmmm	Confirming sound
mhhm	Confirming sound
hm	Matter-of-fact sound

Below I have given an example from a transcription.

Main supervisor:	☺ yeah, I think they are also very much on that side, ja
PhD student:	ok,
Main supervisor:	but that didn't answer your question, I can see/
PhD student:	☺ no
Main supervisor:	I can see that from your face ☺
Co-supervisor:	☺ (all laughing)

PhD student: that's the idea/
Main supervisor: then you are sitting there: 'oh, what are they talking about?, I, I, '/
Co-supervisor: but we agree very much
Main supervisor: yes, sure!
Co-supervisor: OK, so what's the question again?
(all laughing)

Coding

In the analyses I used different coding for different analyses. In the following I give a couple of examples of pieces of coding to showcase how I engage with the data. The first example is descriptive coding that I used to familiarize myself with the data. In example 2 ash and biochar are contrasted with regards to solubility. The patterns of variation that I coded for were contrasting, generalisation, fusion and separation. I also coded the first transcript for re-contextualisation (viewing a phenomenon in a different context) and relevance (statements indicating relevance of decisions). After coding the first transcript we decided to focus on the four patterns of variation described by Marton et al. (2004). The code 'focal awareness' is used as a basic code to signify anything that the participants bring into focal awareness and that might be varied following one of the four patterns. Ingerman, Berge and Booth (2009) used both re-contextualisation and relevance in her own analysis of physics group work. However, in the present context relevance gets very close to judging actual learning, and the aim was to look for learning opportunities rather than actual learning, or enacted learning rather than lived learning in the terminology of Marton and Tsui (2004). The third example shows the use of positioning theory to code how rights and duties are taken and given to selves and others. Further descriptions of analyses are available in the manuscripts.

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1. Descriptive coding: What is going on?

Participant	Phrase	Coding
PhD student:	that pH is not really for	PhD asks clarifying
Main	combustion pyrolysis, is it?	question
supervisor:	no I'm just asking, because I	Meta-
	can't remember, I always, just	communication
PhD student:	remind me, basically..	
Main	ok ☺	
supervisor:	.. in your objectives it says there	Meta-
	is only one statement about pH,	communication
PhD student:	and then you say, and I	
Main	remember we discussed it, but	
supervisor:	hmm	Meta-
PhD student:	not what we concluded	communication
Main	ehm, yes, we decided on the	PhD explains
supervisor:	one hand we vary the	Supervisor
PhD student:	temperature	supplementing
Main	ja, that we want to be a	PhD explains
supervisor:	continuous variable	
PhD student:	yes, so to see what kind of	PhD explains
	effect this has on extractability	
Main	of the P	Sup. asks leading
supervisor:	ja, yes	question
PhD student:	and on the other hand to take	PhD responds
	the fresh solids and adjust it to	
	a certain pH range and to see	
	changes in P	
	just for the fresh solid	
	that's how I understood it	

2. Analytic coding: Experiencing variation

Participant	Phrase	Coding for variation
PhD student:	no, last time the ash settled	Focal awareness
Main	perfectly well,	
supervisor:	yes	
PhD student:	in the centrifuge	Focal awareness
Main	but what about the biochar?	Contrasting
supervisor:	(fuish-sound) floating!	
PhD student:	yes	Contrasting
Main	not, not, hardly settling	
supervisor:	so there you have the problem,	
PhD student:	of course	
Main		
supervisor:		

3. Analytic coding: Two perspectives, coding for positioning

Participant	Phrase	Coding for positioning
PhD student:	but what I thought, it was better to look at that than for instance	
Co-supervisor:	soil types	takes the right to support
PhD student:	I think you are right about that because FAO's are defined according to a biological response, you can say, a plant says something about something complex, it says something about humidity and season and soil type and so on. So I used them as, as	takes the right to request the doctoral student to act. At the same time
Co-supervisor:	interpreter, you can say I would like if you, next time, would demonstrate this for	acknowledging the value of the work
Main supervisor:	[name of co-supervisor] and me,	accepts the duty to act
PhD student:	because then we are better prepared when we arrive, that we have kind of, eh, right? Yes, that's a good idea that we also feel that we have good insight in the map, actually Yes	

3.3 Validity

The term validity is sometimes used as an overall term that refers to the quality of the research, and sometimes as a separate quality criterion. Bryman (2008) adapts the criteria of validity and reliability from quantitative research to be used in qualitative research. In this process the external criteria become irrelevant: external reliability is about replication, which is not relevant in qualitative research. External validity is about generalization, which he also dismisses due to the small sample sizes and non-probability (representative) selection of samples in qualitative research. This means that only the internal criteria of reliability (consistency between researchers within the team) and validity (good match between theory and observations) are relevant. Like Bryman, Gibbs (2007) also takes departure in the quality criteria of quantitative research. Gibbs emphasises ensuring validity, reliability and generalizability, and to these three criteria Gibbs adds reflexivity. Reflexivity is the recognition that researchers cannot claim to be objective. This also holds for pure science, for instance in selection and formulation of research questions, even if the experimental design is fully transparent and replicable. If following Kvale and Brinkmann (2009) then the validity criteria in quantitative research question whether the results are accurate and correctly measure what the research set out to capture. In qualitative research the question can be reformulated into whether I investigate what I intended to investigate. Kvale and Brinkmann (2009) divide the validity question into three; correspondence, coherence and pragmatic utility. Correspondence refers to whether results correspond to the objective world, but this criterion makes little sense from a constructivist viewpoint as there is no objective reality to compare with. Instead Kvale and Brinkmann (2009) introduce validity as quality of craftsmanship and credibility of the researcher. Coherence refers to consistency and internal logic of the research and by the pragmatic criterion the results are judged through their utility value or effectiveness in application. The latter two terms they 'translate' into communicative validity and pragmatic validity. Kvale and Brinkmann (2009) also state that 'Validity is ascertained by examining the sources of invalidity' (p. 249).

I organise the discussion of validity of my research into four sections that deal with issues I recognise as potential sources of invalidity. The craftsmanship I attempted to showcase in the sections above under data preparation, coding and data analysis.

Insider research

The background and pre-understandings of the researcher have implications for the choices made throughout the research process. Instead of trying to eliminate the effects of the researcher, which is not possible, we should report them (Gibbs, 2007). An important question in this regard is my role as insider researcher, as mentioned in section 3.2. I can be an insider of different communities in relation to the cases I research, and not all are equally relevant. While I do have an MSc degree from the Agricultural University I have not conducted research in this area since my Master's dissertation, and I would not consider myself an insider in the agricultural or veterinary research community. Adriansen and Madsen (2009) define an insider as 'someone who is considered an insider by the other members of a given community and/or who participates on a par with other members of that community' (p. 147). The difficulty of being an insider is that it may become difficult to ask naïve questions and to get beyond 'you know' answers, if one is too close. In this sense I did not experience being positioned as an insider by my interviewees with regards to their research projects. Another experience that Adriansen and Madsen (2009) describe is when respondents comment on the researcher's methods, for instance the interview guide. In that sense there was no overlapping in research communities as the research I engage in now is qualitative and very far from the kind of research most life science researchers are engaged in.

Adriansen and Madsen (2009) also point to the issue of being colleague with the interviewees. While I am not formally employed in the same department as any of my respondents any longer, I have been employed in some of the departments in question, although not as a researcher (nor doctoral student). Being a doctoral student myself I find myself in the same academic category as the doctoral students in my study. This on

one hand puts us in the same boat – the troubled terrain of researcher education and supervision. There are two things though, that position me in a different category from the doctoral students in my study. I am in a different age category, them being around thirty and me being fifty. And secondly, I know many of them from the Introduction Course for new PhD students, where I am part of the teaching team, and this influences the interview situation. As described by Kvale and Brinkmann (2009) an interview is an asymmetrical power relation. The interview follows a structure of a one-way dialogue where the interviewer asks the questions, and the interviewee answers. The interviewer has the power to define the topic, take initiatives, deciding which answers to follow up on, and to terminate the dialogue. My role as member of the teaching team at the Introduction Course could influence the interviews in different ways. Because I am in charge of a session about ‘Collaborating with your supervisor(s)’ at the course they know that I know about supervision, and they can refer to common knowledge. On the other hand they may expect that I can advise them on issues, which would be beyond the intention of an interview. I have some few times broken the interview format explicitly and given advice. As for the supervisors in my study none of them have attended my courses for supervisors. When comparing with the challenges that Adriansen and Madsen (2009) report, an important difference is that my respondents are not familiar with qualitative research and interview techniques. The interviews all followed the ‘script’, the interviewees adhered to the storyline of a research interview, and they answered my questions as thoroughly as they could. I wasn’t challenged when steering the interviews.

I have been an insider in the community of agricultural researchers, and my educational background and previous employment in the faculty is important for both interviews and analysis of data. The advantage is that I am familiar with the history and the culture of the people and the institution (Smyth & Holian, 2008), and this enables me to notice nuances that outsiders may not see. The danger is that I take things for granted that may not be obvious to an outsider, so the analyses of an insider and an outsider may emphasise different aspects.

Reliability

Reliability concerns the consistency and trustworthiness of findings (Kvale & Brinkmann, 2009). A way to enhance reliability is to use double rating where two or more researchers independently analyse the data, and findings are compared and negotiated (Gibbs, 2007). I did this for samples of data throughout by involving my supervisors.

Agency Study. Two researchers (my-self and my co-supervisor) independently of each other categorized the follow-up reflections. When comparing the categorization we found good consistency between researchers as only eight of 71 follow-up reflections were re-categorized. In the process we also renegotiated the categories and merged two, so the number of categories was reduced from five to four categories to make them qualitatively more distinct.

Interaction Studies. In general I adopted a double rating strategy for samples of my analyses to ensure internal reliability (Bryman, 2008). For the *Experiencing Variation Study* we were two persons engaged in the analysis at once. Through constant comparison and negotiation we ensured a common understanding and consistency in the analysis.

My presence during the supervision sessions may have had impact on the interpretation of the data. Making field notes after the sessions were helpful to become aware of otherwise unconscious interpretations of the sessions, like how the atmosphere may have affected me personally and thereby as a researcher. If I had encountered unpleasant episodes of supervisors arguing, or a supervisor scolding a doctoral student, I might have found it very difficult to distance myself from such incidents during the analysis, and this would impact reliability of the analysis. I might get to know things about named colleagues in the university that should not be public, and any sensitive issues have been left aside in my analyses. In the *Two Perspectives* study I analyse an episode where the doctoral student may feel let down by her supervisor. In this case I emphasise that my interpretation may or may not hold, and I

suggest an alternative interpretation of inclusion. Because it can be ethically problematic to judge and showcase 'failure' I am very cautious to emphasise the hypothetical status of the storylines, and to offer alternative storylines. The same would be the case if I was not present to observe supervision, but only received their recorded video- and sound-files, so it is not the observation as such that creates the ethical and reliability questions although I might feel slightly more distanced if I was not present personally. The observations and the video-recording support my analysis by adding a dimension of the positioning taking place during interaction. An analysis using only variation theory can be carried out from a transcript, but it has added much value to the analysis that I could actually see what happens during pauses, who is looking at who or what. An example of that is from the analysis for the Two Perspectives study. The co-supervisor explains something, and in the video it becomes obvious that the main supervisor carefully studies the mimic of the doctoral student, and from that he interprets that she did not catch what the co-supervisor explained. So I believe that the observations add important information to the analysis that outweighs the possible negative impact.

Selection of cases – what is left un-researched

Agency Study. I selected 110 out of 302 reflective notes from 2009-2011. This means that two thirds of the assignments did not express any substantial outcome of the meeting with the supervisor. There can be different explanations for this, for example that the doctoral student did not prioritize the assignment and did not put much effort into writing, the student was not very 'reflective' or had difficulties expressing reflections, the meeting was not important because they already have a good relationship with their supervisor, or the supervisor did not take this meeting seriously. The interviews from the qualitative evaluation (Grumløse et al., 2010) and the corresponding nine reflective notes there is an example of someone already having a good relationship, and someone experiencing that the supervisor did not take the meeting seriously, both resulting in very shallow reflective notes that we would not have selected in the present investigation. In general there was very good alignment between

what the respondents had written in the course assignment and their response in the interview situation, indicating trustworthiness of the reflective notes. Exactly what is left un-researched when using this approach to selecting cases can be difficult to establish. To get further into this I would need to investigate the reasons for shallow reflective notes further.

Interaction Studies. In my recruitment of respondents I contacted supervisors who are in my network and by using a snowballing method, their colleagues. As I wrote in section 3.2 I avoided contacting supervisors I had heard complaints about. Often complaints are about supervisors not being available, and such situations would make logistics very difficult. As it is not my aim to judge supervision practices by any quality criteria, any bias in recruitment here is not important. I believe that all supervisors have areas they are good at and other areas they are less competent in, and if I were to judge the supervision that I observed I would most probably be able to find many examples of interactions that could be critically discussed. However, that has not been the aim of the study. It would be interesting to investigate how new supervisors learn the ‘craft’ of supervision, but that is a different study. The two supervisors who declined to participate represented other segments. I am not sure what lies behind the decline from one who said that her PhD students would be unnecessarily burdened. The other supervisor though, who does not have scheduled meetings with his doctoral students is not unique; that is a rather common practice when working closely together. With the present study I do not capture that practice at all. I do not know if this type of meeting is different or similar to the ones I observed, and it would take a different kind of study to investigate that, like ethnographic or anthropological field work with participant observations over a period of time.

Transferability

This relates to the question about sample and population. The cases in this research are not selected to be representative of life science doctoral supervision. Even though I use the term ‘cases’ in my manuscripts, I am not taking a case-study approach in my research, and the cases are not selected with generalisation in

mind, like for example extreme or critical cases (Flyvbjerg, 2006). The strategies for case selection that Flyvbjerg sets up have the purpose of enabling the researcher to generalise from the research. However, qualitative research does not have to be generalizable. The discussion and attempts to establish validity criteria for qualitative research is reviewed by Whittemore, Chase and Mandle (2001), who place Guba and Lincoln (1989) as central contributors. Guba (1981) describes four aspects of validity: truth value, applicability, consistency and neutrality. In science the aspect of applicability is termed generalizability or external validity. In naturalistic research (ethnography, anthropology, qualitative inquiry) he suggests to use transferability as a criteria. In Schwandt, Lincoln and Guba (2007) Lincoln and Guba describe how transferability should be judged: 'Thick descriptive data - narrative developed about the context so that judgments about the degree of fit or similarity may be made by others who may wish to apply all or part of the findings elsewhere' (p. 19). My intent is that the analyses and findings of my research should be read and reflected upon, and maybe the reader will recognise situations, and then make their own judgements about what is transferable and applicable to their own situations.

My findings from the Interaction Studies are illuminations. I explicate otherwise implicit practices of supervision and with the use of different theories I interpret the mechanisms that may be in play in the interaction. Doctoral education and supervision is always situated within specific cultural and institutional contexts, and supervision could look very different in other contexts than this study is situated in. On the other hand, the practices and issues discussed in this thesis have resonance in literature about doctoral supervision, and assume that the insights revealed here can be recognized and serve to inspire research and practice across disciplines, educational levels and countries.

3.4 Ethics

Respondents received a brief description of my research project prior to data collection. They were informed that all data will be anonymised and I was very cautious to say clearly when I turned

on and off the sound and video recording. When I have used larger episodes from transcripts I have shared these and my description and interpretation with the respondents to allow for objections. I did this for ethical reasons, to ensure that the respondents find the excerpts properly anonymised, and not as an attempt to make the research more 'objective' or closer to any 'truth'. When analysing the data there were some things I decided not to report because of the risk of violating anonymity. I was present as observer during supervision sessions that were recorded for my research, and this has to some extent influenced the interaction although when asked, respondents said they quickly forgot about my presence. In some cases I was referred to or even involved during the session, so obviously the respondents were aware of my presence. However, I also believe that this awareness is ethically sound, that the respondents are reminded that they are being recorded and researched, and thereby less likely to lose themselves in talk they would rather not have recorded and documented.

As I described in section 3.2 under reliability I could have witnessed episodes that were unpleasant for different reasons, and would influence my view of the respondents to a degree where it impacts reliability of my analyses. I would definitely have chosen not to include such episodes in my analyses and manuscripts. Not because bad practice should not be criticised, but ethically it would not be right to showcase bad practice when these respondents have agreed to open their doors to me as observer, and moreover, it is not the purpose of this research to assess supervisory practices. The purpose is to explore the creation of learning opportunities, and it would not affect the reliability of the study to avoid certain episodes if I had observed anything that I would judge as problematic (but that was not the case). Furthermore, I would say with Connell and Manathunga (2012) that 'the main enemy of bad practice is good practice' (p. 7). It is of course important not to share any insights with others, and to maintain the analyses anonymous.

In Denmark it is not required to obtain an ethical clearance of the proposed research as long as data collection does not include

questions about ethnicity and registration of personal identity numbers.

4. Findings

The aim of this chapter is to present in summary the four studies that make up this thesis. Since the four papers present the findings of this work they will not be thoroughly repeated here, but to prepare the reader for the discussion to follow in chapter 5 the main findings are described in the last section of this chapter.

4.1 The Agency Study

Building agency and strengthening supervisory relationships in doctoral education: Using a structured meeting about personal development planning and aligning expectations.

This paper reports on a qualitative study of an initiative at the University of Copenhagen that aimed to support new doctoral students in building agency and establish good working relationships with their supervisors, in view of the power differentials in doctoral supervision. As part of the course the doctoral students set up a meeting with their supervisor to discuss their personal development planning and to clarify mutual expectations for the supervisory process. Further they submit a reflective note about this meeting as part of the assignment for the course.

The theoretical framework used in this paper is an understanding of agency as an evocation of identity (Holland et al., 1998). Understanding one-self and creating a narrative about one-self is seen as a prerequisite for personal intentions. Agency refers to acts done intentionally (Bandura, 1997). It is the intention and ability to act to shape one's context, here in relation to the collaboration with supervisors.

From the reflective notes submitted during 2009 – 2011 we selected 110 out of 302. We sent an email to these course participants asking them to reflect further on the influence the

meeting with the supervisor had on their collaboration and relationship. The 71 replies (response rate 65%) were paired with the reflective notes, and analysed thematically (Braun & Clarke, 2006) and for expressions of agency (Holland et al., 1998).

The analysis of the data yielded three main categories in terms of building agency: Scaffolding, Shared understanding, and Repositioning. The first, Scaffolding, refers to the supportive effects of the course and the course material that enable the respondents to lead the meeting in spite of the power differentials. The second, Shared understanding, points to the importance in getting to know each other better and thereby lowering the power distance. This can be seen as a stepping stone to Repositioning. The third category refers to respondents changing their perception of their identity in practice into a more resourceful position.

Further, the analysis of the follow-up reflections yielded four distinct categories of the perceived effect of the meeting

- 1) No effect. The doctoral students describe this as a lost cause, as their supervisor was too busy or indifferent
- 2) No effect. This group already know their supervisor well and/or perceive that they would get good supervision anyway
- 3) For this group the meeting helped the doctoral student, but the supervision as such did not change
- 4) The last group experienced that the meeting resulted in changes in the supervisory process and/or a stronger supervisory relationship

The follow-up reflections were quantified to look for any possible trend. This showed that almost half of the respondents (34/71) perceived the meeting as an asset in strengthening the relationship and improving collaboration with their supervisors, and this is especially true for international doctoral students as almost two thirds (21/33) of them fall into this category. The sample is too small to say anything meaningful about the effect of gender. The results are shown in Table 4.1 below.

Table 4.1. Frequency of responses in each category.

Category	F*/ DK	F / Int	M / DK	M / Int	Total
1. No effect – insufficient supervision	6	2	0	2	10
2. No effect – good supervision	8	4	3	3	18
3. Supported the doctoral student	5	1	3	0	9
4. Strengthened relationship/ collaboration	13	11	0	10	34
Total	32	18	6	15	71

*F: Female, M: Male, DK: Danish, Int: International

This research illustrates a way in which doctoral students can be supported to build agency and strengthen collaboration with their supervisors, including those finding themselves in cross cultural settings. The structured meeting they have with their supervisors as part of the introduction course is a way of scaffolding the doctoral students in positioning themselves for the next three years as a doctoral student and a supervisee.

4.2 The Dialogical Supervision Study

Supervisors' approaches to supervision and how these relate to conceptions of research

This extended abstract was presented at the 10th Quality in Postgraduate Research Conference, 17-19 April 2012 in Adelaide, Australia. It was developed from a course assignment at the PhD course named Didactics as Design Science offered at our department by Professor Carl Winsløw. The extended abstract and poster are based on an analysis of the same single supervision session as the Multivoicedness Study and it inspired me to use the concept of multivoicedness.

This study aimed to shed light on the relations between supervisors' conceptions of research and their approaches to

supervision. It is based on observation and sound recording of a single supervision session. The doctoral student and her three supervisors discussed the methodology of the research. The research project was interdisciplinary in nature, and none of the supervisors were an expert in the whole project as they came from different scientific disciplines. The doctoral student's contributions to the discussion were of decisive importance for the outcome, although much of the discussion took place between the supervisors who had different understandings of the project and what they viewed as scientifically sound. The doctoral student and two of her supervisors were interviewed.

For the analysis of this session and interviews we used Chevallard's Anthropological Theory of Didactics (Chevallard, 2006). In accordance with Madsen and Winsløw (2009) we have merged the theory with technology, which makes the framework very operational for interviews. For the supervision practice, the techniques and the tasks, we used the framework developed by Pearson and Kayrooz (2004), and to uncover the justifications we used the supervisory models by Dysthe (2002b).

The supervision was mainly concerned with helping plan and refine the project (the topic of supervision), and how they supervised can be characterized as dialogical in Dysthe's terms, including aspects like respecting the expertise of the doctoral student and being open to different research approaches (Pearson & Kayrooz, 2004). In the interviews one explanation for the dialogical style was the interdisciplinary nature of the research project. Landscape architecture is an inherited iterative and interdisciplinary process and to this supervisor, this is the explanation for the supervisory approach: When the research process is interdisciplinary, supervision necessarily has to be dialogical in his view. Another supervisor described interdisciplinary supervision as a dialogue with the aim to find a focus that the PhD student wishes to pursue.

The interdisciplinary nature of the project seemed to urge the supervisors to go into a dialogue about the research as none of them were an expert on the whole project, thus in this case interdisciplinary research promotes dialogical supervision.

4.3 The Multivoicedness Study

Interaction and learning in PhD supervision – a qualitative study of supervision with multiple supervisors

This paper reports on an analysis of a single supervision session, undertaken with the aim of identifying how learning opportunities are created for a doctoral student with multiple supervisors. The supervision session concerned methodologies to be employed in a PhD study related to storm water management and included the doctoral student, her principal supervisor and two co-supervisors. The supervisors were colleagues in the same department, but their scientific backgrounds were as different as life sciences (applied hard), planning (applied soft) and creative arts (pure soft), and this resulted in different perceptions of ‘good research’ (the brackets refer to terms defined by Becher (1994) and Biglan (1973)). The session was observed and audio-recorded to provide for verbatim transcript. Furthermore, the doctoral student and the two supervisors were interviewed after the doctoral student had graduated.

The transcript was first analysed thematically (Braun & Clarke, 2006) and from this analysis a theme, discussion of the research approach, was selected for analysis using positioning theory (Harré & van Langenhove, 1999). This theme had contradicting storylines, indicating that the supervisors had differing opinions on the methodology that the doctoral student should apply in her research. The two storylines identified were

1. When following the formal ‘scientific method’ the researcher must distance herself from the object of research
2. Participatory research is an equally legitimate approach in research

The two storylines are evident throughout the interaction. One co-supervisor in particular repeatedly refers to the first storyline, and thereby positions the doctoral student as the objective observer in her research project. The principle supervisor refers

to the second storyline, with reference to his experience and to theory, and even speaks for the doctoral student to support her views. While this could be a source of conflict, the work by Dysthe (2002a) and Dysthe et al. (2006) offers a different perspective on this interaction. They use the concept of diverging voices from Bakhtin (Holquist, 1990) to understand how the tension provided in supervisors' diverging perspectives can be an opportunity for students to create their own understanding. This interpretation was confirmed in an interview with the doctoral student, who perceived the contrasting viewpoints of her supervisors as different opportunities for her to choose her approach and construct her own understanding and identity as a scientist.

In this instance, the involvement of multiple supervisors appears to enrich the learning environment and create learning opportunities.

4.4 The Experiencing Variation Study

Experiencing variation - learning opportunities in doctoral supervision

This paper aims to contribute towards an understanding of learning dynamics in doctoral supervision by analysing how learning opportunities are created in the interaction. We analyse interaction between supervisors and doctoral students using variation theory as a key for learning (Marton & Pang, 2013; Marton & Tsui, 2004). Earlier research into doctoral supervision has been rather vague on how doctoral students learn to conduct research. The focus in this study is on how opportunities are created for doctoral students to learn how to acquire subject knowledge and produce valid results and acquire the norms and values of life sciences. Empirically, we have based the study on four supervision sessions each with one doctoral student and his or her two supervisors. The supervision sessions were observed and captured on video and audio to provide for verbatim transcripts that were subsequently analysed.

Following Marton et al. (2004) the *space of learning* reflects what it is possible to learn about a specific object of learning in a certain situation. The space of learning is characterized by the way the critical features of the object of learning are *varied* in the situation; opening dimensions of variation expands the space of learning and thereby increases opportunities for learning. In the analysis of the interaction we explore learning opportunities, the *enacted* object of learning (what is possible to learn in the situation). The analysis was not concerned with the *intended* object of learning (what should be learned from a supervisor perspective) or the *lived* object of learning (what is actually learned by the doctoral student). The enacted object of learning can be identified through analysis of patterns of variation in the space of learning: *contrast*, *separation*, *fusion* and *generalisation* as defined by Marton and Tsui (2004).

We have identified all four patterns of variation described by Marton et al. (2004), i.e. contrasting, generalising, separating and fusing aspects of variation. The patterns of variation that we have seen demonstrate the opportunities that the scientific discussions during supervision offer in terms of learning how to produce valid results. The process of becoming a scientist is associated with taking on and personalising the values and norms of science. The first step in such process is to be able to discern those values and norms. We did not find representations of the different patterns of variation, but we do see how different aspects of values and norms in research are brought into focal awareness and through experiencing variation the doctoral student has an opportunity to discern otherwise tacit knowledge.

The results illustrate how supervisors and doctoral students create learning opportunities by varying aspects of research in the discussion. The study expands our understanding of supervision by explicating otherwise implicit practice in supervision. This is important both from a supervisor's practice perspective, from the perspective of doctoral education, and from the perspective of educational research.

4.5 The Two Perspectives Study

Learning opportunities in joint doctoral supervision - viewed from two perspectives on learning

This paper combines two theoretical perspectives, a sociocultural perspective and an individual constructivist perspective, in analysing the interaction of doctoral supervision in the same four cases from life science research as the Experiencing Variation Study. A coarse grained analysis of participation resulted in eight qualitatively different levels of participation. An episode from one of the sessions was selected for the fine grained analyses to explore the learning opportunities created from tensions in supervision. With the use of positioning theory we identified three storylines: ‘the responsible supervisor’, ‘the scientific argument’ and ‘maintaining good relations between supervisors’. These storylines are all hypothetical, but plausible, and from discussing them we gain insights into the power relations in supervision. This analysis illustrates how different storylines can be intertwined in the interaction reflecting the complexity of supervision with multiple supervisors. From the individual constructivist perspective we used variation theory to identify learning opportunities as patterns of variation. This enabled us to illustrate how supervisors and doctoral students together create learning opportunities by varying different aspects of research. Combining the two perspectives on learning enabled us to illustrate learning opportunities in relation to specific objects of learning, whether that may be subject matter, competencies, language or norms. This combined method enabled us to describe the learning opportunities for the doctoral student in listening to the supervisors’ internal dialogue as a way to observe the community of scholars. Our findings illustrate that focusing on variation only may miss out qualities of the learning situation that participation and positioning theory can reveal and vice versa.

The Two Perspectives Study illuminates how the inclusion of a co-supervisor can increase possibilities for learning. The discussions between supervisors can create potentials for new understanding and the authenticity of scientific discussions with

multiple supervisors is an entrance into the community of scholars.

4.6 Overview of main findings

The four manuscripts and the poster included in this thesis illuminate different aspects of doctoral supervision. The Agency paper is concerned with the supervisory relationship from the doctoral students' perspective, and results point to a way to contribute to building doctoral students' agency in relation to collaborating with the supervisors. The scaffolding from the Introduction Course is helpful, and shared understanding is an important stepping stone in building agency and repositioning. Forming identity by actively telling stories about one-self yields a stronger foundation to contribute as a supervisee. This indicates that identity and agency are interwoven and identity work is part of building agency.

While the initiative helps the majority of respondents, there are some who are still unsatisfied with the supervision they get, and other measures are needed to improve collaboration in such cases.

The Multiple Supervisors Studies illuminate an implicit practice. The Multivoicedness Study shows how supervision with multiple supervisors has a learning potential in that the supervisors have different understandings and opinions, identified as contrasting storylines, and the tension of the diverging voices of the supervisors can create an opportunity for the doctoral student to construct her own understanding. The conditions for this to work need further investigation, but other researchers have pointed to good atmosphere and team commitment among supervisors as a precondition, as shown in the Dialogical supervision study and poster.

The Experiencing Variation paper illustrates how opportunities to learn about subject matter as well as norms and values are created from bringing aspects of phenomena into focal awareness following patterns of variation that expand the space of learning.

The notion of variation is key to learning and in classroom teaching it can be used to plan the teaching. In doctoral supervision as natural conversation that is not planned to expose the student to patterns of variation, these patterns can be identified and offer learning opportunities. Phenomenography and the notion of variation are not concerned with the interactional aspects of learning, so another perspective on the data is needed to say something about the influence of having more than one supervisor. In the Two Perspectives paper variation theory is used together with positioning theory. This study identifies levels of participation in supervision with multiple supervisors. Specifically learning opportunities with multiple supervisors are identified as 'supervisors supplementing doctoral student' in presenting, 'engaging in common discussion' as a more complex setting than engaging in dialogue with one supervisor, and 'supervisors' internal dialogue'. The first is an opportunity for the supervisor to scaffold the doctoral student in presenting. The latter is an opportunity for the doctoral student to observe scientists engaging in scientific discussion. The opportunities to construct knowledge are identified as patterns of variation in the scientific discussions, for instance by contrasting different aspects of a concept or phenomenon. The ways that the doctoral students are positioned and position themselves illuminates the dynamics in play in doctoral supervision.

5. Discussion

The questions I set out to explore in this doctoral research were

Doctoral students' agency

Does the discussion with the supervisor about personal development planning and aligning expectations help doctoral students build their agency in managing collaboration with the supervisor, and strengthen the supervisory relationship as perceived by the doctoral students?

Interaction with multiple supervisors

How are learning opportunities created by supervisors and PhD students during supervision with multiple supervisors?

The results of my research into these questions are summarized in chapter 4. The assumptions and normative questions underpinning my research questions concern quality in doctoral education and supervision. Certainly some approaches to supervision must be better than others in terms of development of competence and autonomy. To me, quality supervision is a question of learning, as I go into details about in my philosophy statement in chapter 1. It is about creating conditions and opportunities for doctoral students to learn, to develop their understandings, skills and competences and to form their identities as scientists. This requires good communication, and alignment of expectations to provide for common ground rules.

5.1 Relating to the Agency Study

This study was my entry point to doctoral research, and it occupies me immensely how we can support doctoral students in becoming pro-active supervisees and in taking charge of their own education and learning process because of the inherent power asymmetries in the supervisory relationship.

The Agency Study shows how the Introduction Course can work by actively supporting doctoral students to build agency and

reposition themselves in relation to their supervisors. The main contribution of this study lies in the qualitative analysis of the mechanisms in play when the doctoral students manage to reposition themselves in relation to their supervisors and take on a more resourceful position. The simple quantification included in the study indicated that international doctoral students especially gain from the meeting. As I have elaborated on in the literature review (chapter 2) cross-cultural collaboration has many dimensions and the complexity cannot be summarised into, for instance, a matter of different expectations of the power relations. This is the reason behind the deliberate choice not to focus on cross-cultural issues in the manuscript, but I will discuss some of these issues in the following.

Scaffolding. The qualitative evaluation of the course (Grumløse et al., 2010) indicated that the personal development planning helped the doctoral students in taking charge of their studies. One interviewee described how the Personal Development Plan had helped him:

Whatever problems I had I could put into that PDP. First column: What are your problems? What are you missing? Second column: The solution. Third column: Where do you find it? So I started to fill in. (...) I was forced to think and look for ideas. Who should I meet? What do I do? So then I got to know my problems and at the same time I got to know the sources where I can get the answers.

Thus the preparation of the course assignment together with extended activities during the course can help the doctoral students to build agency, and this is an important scaffold for them leading a meeting with their supervisor(s). 'It was good to be forced' as many of them say.

Shared understandings. The responses from the reflective notes and the stimulated reflections indicate that doctoral students' satisfaction is higher when they have a close and informal relationship with their supervisors. The opportunity to get to know each other better and create a sense of a closer relationship

can be important for the creation of a robust relationship. Hemer (2012) explores supervision over coffee in 'third places' as a means to strengthen the relationship. Third places like coffee shops can be neutral and informal, which will improve the quality of supervision according to Kam (1997). The different kind of meeting, where the doctoral student sets the agenda scaffolded by the course may have similar effects because the unfamiliar or just different circumstances can legitimise improvisation.

The opportunity to get to know each other better may go both ways. For some it may be mainly the doctoral students knowing themselves better, and therefore being in a better position to express their needs in the supervisory relationship. Secondly getting to know the supervisor better may give them a sense of closer bonds and knowing how to communicate best with the supervisor. Another dimension is that the supervisor may get to know the doctoral student better and therefore is in a better position to supervise. The latter is actually not very agentive at first glance. It reflects an attitude to supervision as something 'done to the supervisee', being supervised as a passive role. But the experience of voicing one's needs and seeing that this can lead to better supervision can enhance self-efficacy beliefs. As I described in the Methodology chapter under Positioning Theory, enactive mastery experience serves as an indicator of capability and enhances self-efficacy beliefs. This may contribute to the doctoral student's relational agency and increase their capacity to seek support from others (Hopwood, 2010a). *Shared understandings* also covers that the doctoral student through the Personal Development Plan (PDP) shares their career goals and their motivations for doing a PhD. Mitkidis et al. (2013) have shown that ascribing mutual and explicit goals is associated with increased cooperation, and this may add to explain how the structured meeting with the supervisor can work to strengthen the relationship on the longer term.

Repositioning. Mutually being aware of each other's and own preferences and goals improves the possibilities to act and collaborate. So on one hand the alignment of expectations and sharing the personal development planning contributes to a closer and more trustful relationship. It may also reduce the

perceived power distance so that the doctoral students even change their perception of their position as more resourceful with less power differential towards the supervisor. This mechanism may explain why especially international doctoral students' benefit from the meeting, as many of them may expect a formal relationship charged with power. Kiley (2006) describes how Indonesian students in Australia consider their supervisor to be very busy and important, fearing that the supervisor might react negatively if interrupted, but also that some students were uncertain about how to approach their supervisor. Having an opportunity to mutually agree on the rules of the game can in itself be helpful to international doctoral students to avoid mismatch of expectations. As pointed out by Kiley (2006) their prior experience might be that the supervisor would take the initiative and call them for a meeting, while the supervisor actually expects the student to approach them whenever they have an issue.

For some international doctoral students the meeting might be the key for them to change their perception of the institutionally mediated relation - the first layer in the multi-layered description by Grant (2003) - to understand that they are actually viewed as colleagues. This again has implications for their perceptions of their social position, the third layer in Grant's description, and perhaps even the fourth layer if this means that their unconscious associations to earlier relationships (transference patterns) also change. As I described in chapter 2 under Cross-cultural supervision, Adrian-Taylor et al. (2007) identified a number of sources of conflict between supervisors and international graduate students. One was lack of openness (the student is unwilling to disagree with or confront supervisor because he or she is afraid of the supervisor's power to make things worse for him or her), and another is different expectations regarding responsibilities. According to Winchester-Seeto et al. (2013) cultural differences in dealing with hierarchy can result in difficulties in being assertive or disagreeing with the supervisor (lack of openness), difficulties in asking for guidance, and different expectations to the relationship, like viewing the supervisor as a boss. Adrian-Taylor et al. (2007) suggest that these two issues could be addressed through open discussions early in

the supervisory process. The discussion that doctoral students in our study have with their supervisors entails a discussion about expectations to responsibilities, and the lack of openness may be addressed as well even it is not explicitly a discussion item. However, those who reposition themselves and change their perception of the power distance may become more open as the quotation indicates

I also think that they trust in my abilities as a researcher and that makes me more confident in the work that I am doing. I am now more comfortable with putting things across to them without fear that they may be deemed disrespectful or not very clever.

The issues raised in literature about the dangers of an overly-friendly relationship - getting too close as termed by Hockey (1995) - may have more to do with power relations than the closeness of the relationship. Especially young / inexperienced supervisors find it difficult to strike the right balance between being friendly and approachable and at the same time being able to control and criticise. The power distance depends on the institutionally mediated asymmetry, as well as social identities (Grant, 2005). The social identity of a young supervisor is not very different from their doctoral student. The supervisor is not very much older and only has a few years more experience. If the supervisor also has not been trained in supervision, and feels unsure of the expectations, there is not much authority in the role of supervisor. Perhaps the supervisor feels powerless in this situation, lacking authority. The skills and competences of the supervisor can be developed, and this can perhaps enable the supervisor to distinguish between the roles of friend and supervisor in different contexts.

The dataset is too small and differences too insignificant to say anything about differences between men and women. Gender as a social position is negotiated in the situation, and not predictive of power structures in the interaction. As described in chapter 2, research into gender biases in doctoral education is limited and inconclusive.

The main contribution of this study is the qualitative investigation of *how* the initiative works to strengthen the doctoral students' position. The simple quantification attempted reveals that it is not an insignificant share of respondents who feel that the meeting helped to strengthen their supervisory relationship on the longer term. A proportion of respondents does not gain from the initiative and experience problematic supervisory relationships. Some supervisors seem out of reach, either because they are too busy, they have too many doctoral students, or they simply do not prioritize supervision. The Agency Study points to an important issue here that needs to be addressed both from further research and from policy initiatives to develop supervisors' competences and deciding on a code of conduct for doctoral supervision at faculty and university level.

Future research

The study does not answer whether or not this leads to higher completion rates or higher research self-efficacy beliefs, but this could be discussed if the relationship is seen as a condition for learning. Naturally, a good supervisory relationship is not a necessary pre-condition for learning, but it is one among other factors that influence the process. It is possible to get a PhD degree in spite of a non-functional supervisory relationship for instance if the doctoral student has other resource persons to draw on or if he or she is already a competent researcher. As described in the Methodology chapter, there are aspects left un-researched that need further investigation because the respondents were selected from certain criteria. A commonly discussed issue in supervisor development is how to reach those supervisors who do not attend supervisor training, but this bottom-up approach works for a proportion of them. Some respondents state that they do not gain from the initiative and they experience problematic supervisory relationships. Studies that explore self-efficacy beliefs and outcome expectancy beliefs may contribute to a better understanding of these mechanisms by uncovering connections between how well the doctoral students feel equipped to influence their supervisory relationships and processes, and their expectations of succeeding with their actual supervisors. I see measuring course participants' self-efficacy beliefs (Bandura, 1997) in utilizing and improving the supervisory

relationship as a way forward. I plan to develop a questionnaire to measure self-efficacy beliefs, and distribute this when participants start the Introduction Course, and again at the feedback session after their meeting with their supervisor.

Research into supervisory processes that involve problematic supervisory relationships and how doctoral students cope with such situations is also needed. There are some studies investigating conflict in supervision, including Brockman, Nunez and Basu (2010), Brockman et al. (2011) and Adrian-Taylor et al. (2007). The stimulated reflections reporting on insufficient or inappropriate supervision call for further investigation, for example through follow-up interviews. It could be important to get the supervisors' view as well, but the research design needs thorough planning to avoid ethically questionable methods. Another approach could be to offer conflict resolution workshops for supervisors and doctoral students and invite participants for interviews. Further, I would recommend that the University of Copenhagen completed a comprehensive survey to reveal the sources and extent of conflict in supervision.

Recommendations

This approach helps the majority of the respondents, but does not solve all the problems with insufficient and inappropriate supervision. For those ten something else needs to be done. Some of them are unsatisfied with their main supervisor, but get the supervision they need from a co-supervisor. Some have changed supervisor to get satisfactory supervision, and some try to get by with the supervision that they get. They seem to lack an independent body to turn to, like a PhD ombudsman. Independent coaching during difficult periods, as is provided in some universities, might be a viable measure for some doctoral students, but investigations of the effect of independent coaching are needed.

5.2 Relating to the Interaction Studies

The remaining studies pivot on learning opportunities created in the interaction between doctoral students and supervisors during supervision. Learning opportunities are discussed here through

each of the perspectives I used for exploring the interaction, and how these different perspectives work in combination.

The Dialogical Supervision Study

This study has been included in the thesis to show the context of the Multivoicedness Study. Here the use of another theoretical framework, that of Anthropological Theory of Didactics (Chevallard, 2006), resulted in foregrounding another aspect of the potentially problematic situation of having three supervisors who have different opinions. This analysis shows that the interdisciplinary nature of the research urges the supervisors to go into a dialogue with each other and with the doctoral student about the methodology to be employed in the research. It cannot be generalised from this analysis that interdisciplinary research leads to dialogical supervision. On the contrary, the other explanation for entering dialogue revealed through interviews, was a student-focus in supervision that made the contributions of the doctoral student of critical importance for decisions taken. This aspect has not been foregrounded in the Multivoicedness Study.

The Multivoicedness Study

In the Multivoicedness Study I have shown how discussion and different opinions among supervisors can be an asset for doctoral students' learning process. Supervisors do not necessarily need to align their opinions before they enter supervision, for it may provide a more creative environment with different opinions voiced in the meeting. In their interaction and discussion the storylines were incompatible and based on conflicting views, and the doctoral student remembered the meeting as confusing, but also crucial for her development as a researcher. It made her realize that she could chose three different approaches to her research. This is the agency hoped-for in proactive supervisees that I discuss in the Agency Study, and her agency here influences her possibilities to avail herself of the learning opportunities offered. The analysis of the interaction showed how she progressively took more charge of decisions during the meeting, and the interviews with supervisors revealed how they perceived

her as very independent. Her own self-perception, though, did not match the supervisors' perception of her. These contrasting perceptions of power relations clearly points to a risk of supervisors overestimating the doctoral students' capabilities. In the Multivoicedness Study I emphasize the importance of diverging voices being explicated, as was the case in this interaction, as the confusion for the doctoral student could become too grave to overcome had the storylines remained implicit throughout the interaction.

The data-collection process can rightfully be questioned as there was almost three years between the supervision session and the interviews. The preliminary analysis of the meeting was sent to the interviewees before the interviews, and this has stimulated a reflection about the session, but probably more the whole supervisory process through the three years of doctoral studies. The supervisors recognised the supervisory style described in the preliminary analysis, and probably referring to the general style used with this student rather than this specific meeting. This means that they may have commented on the student's autonomy throughout the study, or even focusing on the independency she had developed by the end of the study, while the doctoral student specifically referred to power relations in the beginning of her study, and how they changed over time. So the perceptions of power relations may not have been as different between supervisors and graduate as described in the paper. The graduate though remembered the specific meeting as it was important for her development.

Although this study was not concerned with hostile interaction or conflict, it may be worthwhile dwelling on the potential risk of conflict when dealing with multiple supervisors. I have not come across studies that investigate how conflict influences doctoral supervision and learning. There are numerous 'warnings' to maintain good relationships and good communication, for instance by Estelle Phillips (1994): 'However, it cannot be too strongly emphasized that, if there is more than one supervisor, it is absolutely vital that communication occur between all the participants.' (p. 134). In my data from the Agency Study, one doctoral student writes that her supervisors have fallen out and

no longer talk with each other, and that this makes things difficult for her. Maintaining a positive spirit is a condition for learning, as is a good and trustful relationship. Negative emotions may impede learning because of the distraction it creates, see for instance Boekaerts (1993). Guerin et al. (2011) also state that team commitment is a precondition for supervision with multiple supervisors to be constructive. So even though the learning opportunities are available the doctoral students in distress are less likely to utilize the opportunities to learn.

In this study the doctoral student emphasized the importance of gathering all supervisors at the meetings, to avoid them pulling the project in different directions. In other cases that I have observed but not yet reported the doctoral students meet separately with each of the supervisors, because they were too busy to be able to fit in coordinated meetings in the calendars. In the interview with her she explains that for this to work she believes that it is a necessity that her supervisors trust her in her communication and use of the other supervisor. Apparently in the latter case there was not a problem with supervisors pulling in different directions. However, she missed the opportunity of observing and participating in her supervisors' discussions.

The findings of this qualitative analysis – the learning potential in diverging voices – may inspire supervisors to enter supervision without discussing and agreeing on beforehand. This is not obvious; when presenting this study at a conference I was asked if the supervisors should not have agreed on beforehand, and for instance Wellington (2010) warns against the danger of having supervisors who have different opinions. The problems in agreeing on beforehand are two-fold. First of all this weakens the position of the doctoral student and her possibilities to take charge, because she would be up against a group of experienced researchers who agree on the direction that the research should take. Secondly, she would miss the opportunity to observe and participate in the scientific discussion as a novice in the community of practice, and staging a scientific discussion would not be authentic, and would not work. However, the supervisors should approach the scientific discussions in a collaborative spirit with the aim of supporting the doctoral student in her learning

and decision making process, as was the case in this study.

Future research

There is need for research into supervisory processes that involve problematic relations between supervisors as well as problems in the dyadic supervisor – doctoral student relations, and how doctoral students cope with such situations. Such research can be difficult to design because of the sensitivity of the situation and the difficulty in identifying such cases early enough to investigate it while it unfolds. Rather this topic should be studied through interviews, preferably with both doctoral students and the involved supervisors, and probably as interviews looking back at a problematic process after completion or termination of studies. Alternatively it can be designed as action research with a researcher and mediator facilitating reconciliation meetings in supervisory teams.

Another aspect of complex supervision that has received little attention is the different ways that supervision is organised. In my data I have observations and interviews with supervisors who organise their supervision as group meetings with their doctoral students, post docs and Master's students together, supplemented with individual supervision meetings with the individuals. Each of the doctoral students may have additional supervisors elsewhere, and the set-up involves supervision of peers and building a learning and research community. I have only come across a few studies, including Borders et al. (2012), Fenge (2011) and Nordentoft et al. (2012) that concern supervision in groups. I plan to analyse these situations to explore if it offers different learning opportunities for the doctoral students, and what advantages and disadvantages this practice may entail.

The Experiencing Variation Study

In the Multivoicedness Study I viewed the contrasting storylines as diverging perspectives following Dysthe in the use of dialogism. Contrasting storylines could also be seen as a coarse-grained version of contrasting as a pattern of variation using the notion of variation that derives from phenomenography. In a study of the learning potential in an online discussion Dysthe

(2002a) uses two perspectives in her analysis of a web-discussion. As she writes, in order to capture new perspectives in the discussion she needs to make an analysis of content in addition to the interactional analysis. In my choice of two perspectives I was inspired by Sfard (1998) and her two metaphors for learning, and decided to use an acquisition perspective and a participation perspective to analyse the interaction in four cases with multiple supervisors. The choice of concrete theoretical frameworks was inspired by the work of Maria Berge (2011), who used variation theory, positioning theory and conversation analysis in her exploration of learning opportunities in physics group work. As I visited Maria Berge in Umeå and we started exploring my transcripts we found so much variation in different patterns in the material that I decided that this needed a deeper exploration in its own right and then first to write a paper using the notion of variation only.

In the Experiencing Variation Study I have explicated some of the tacit practices of supervision that support doctoral students in their learning process of becoming scientists, involving to acquire subject knowledge, competences and the norms and values of science. In the scientific discussions aspects of scientific terms and concepts came into focal awareness, were contrasted, generalised and fused in patterns of variation that expand the space of learning and thereby learning opportunities were created for the doctoral students to learn how to obtain valid results, to learn specific subject knowledge and how to discern the norms and values of science. Bowden and Marton (1998) argue that the three main functions of the university, teaching, research and community service, are ultimately all about formation of knowledge, and thus learning. Teaching contributes to the individual student's learning. Research is about finding out new things, new in an absolute sense, which means that the scholarly community or humanity learns, thus it is collective learning. And services, whether in the local community or society in general, is about making knowledge available or knowledge formation in response to a specific demand, and this is learning at the local level. As argued by for instance Pang (2003) and Marton and Pang (2006) variation is the *sine qua non* for learning. Without variation there cannot be learning, thus experiencing variation is

the general mechanism of learning. From this a logical conclusion is that knowledge formation in research is experiencing and documenting variation. Research involves a systematic variation of parameters that enables us to say something about a phenomenon (when certain validity criteria are met) or exploring the variation that can be observed. In my data I have examples illustrating both variation of aspects of a phenomenon that come into focal awareness and expand the space of learning, and variation as variables that the research is designed to investigate.

- | | |
|-----------------|--|
| PhD student | ehm, yes, we decided on the one hand we vary the <i>temperature</i> |
| Main supervisor | yeah, that we want to be a continuous variable |
| PhD student | yes, so to see what kind of effect this has on <i>extractability of the P</i> |
| Main supervisor | yeah, yes |
| PhD student | and on the other hand to take the fresh solids and adjust it to a certain <i>pH-range</i> and to see <i>changes in P</i> |
| Main supervisor | just for the <i>fresh solid</i> |
| PhD student | that's how I understood it |

In this episode the supervisor and the doctoral student discuss the variables (in italics) and we cannot assume that the space of learning is expanded here until they see the results of the experiment. In the following episode the supervisors discuss the variables of an experiment and they expand the learning space through their discussion

- | | |
|-----------------|--|
| Co-supervisor | so what do you want to, in those first experiments, what do we want to focus on there, is it just whether we can make it work with a very <i>efficient high surface area char</i> , or is it, or do we want to actually make it a point that we are actually dealing with a <i>cheap product</i> here, which can |
| Main supervisor | I think ideally it would be good to start with something very <i>well defined</i> , with a high <i>specific adsorption capacity</i> , but |

naturally if you want to say, validate it,
you have to go to other more simple
compound/ simple biochars

The supervisors here contrast aspects of adsorbents with regards to adsorption capacity and cost, and they bring out variation of adsorption capacity with regards to efficiency and specificity. They discuss how best to design the experiment in order to obtain valid knowledge. What we explicate with the use of the notion of variation is not just learning opportunities in doctoral supervision, but also how collective learning from research and individual learning both are conditioned by variation as argued by Bowden and Marton (1998).

Variation theory enables me to describe the space of learning, what it is possible to learn about an object of learning. The object of learning can be subject knowledge like characteristics of biochar, or competence like being stringent in following methods, or it can concern the norms and values of science. The latter is normally discussed in studies using a socio-cultural perspective on learning where participation and acceptance lead to development and internalisation of the norms and values of the community of practice. But understanding the norms and values also involves opportunities to discern them, and that is illustrated in the Experiencing Variation Study. Kvale (1997) discusses apprenticeship as a means to educate scientists, with reference to the way elite scientists experienced their learning trajectory as apprenticeship. He argued that learning this scientific style of thinking has to come from participation, because it is tacit knowledge that cannot be taught explicitly. Viewed from an acquisition perspective, the notion of variation enables us to understand just how this may happen.

The fact that I find variation and patterns of variation in the scientific discussions can contribute to understanding why supervision is important in doctoral education. The old and outdated notion of autonomy as the lone, isolated and totally absorbed scholar is no longer tenable, and the newer connotations of autonomy as capacity to work with others and addressing problems in their context seem better fit for

understanding research education. Production of new knowledge, individually as acquisition of knowledge, and knowledge as outcomes from research, happens in collaborations and situated in social settings, and supervision is the main social setting available to doctoral students for discussing their research. Doctoral students acquire scientific thinking from scientific discussions with their supervisors. The more the space of learning can be expanded in patterns of variation, the better the opportunities for learning.

The Two Perspectives Study

The four cases I analysed for the Experiencing Variation Study were selected because they were the examples I had of supervision with two supervisors present, and I also wanted to pursue the findings from the Multivoicedness Study regarding the learning opportunities created in discussion among multiple supervisors and the doctoral student. The Experiencing Variation Study explicates learning opportunities as expansion of the space of learning, but the notion of variation does not enable us to say anything about multiple supervisors. The four cases were supervision of doctoral students at different stages of their studies, but this seems not to influence the opportunities for learning made available from variation of concepts in these four cases. Variation is brought about from the scientific discussions during the interaction, and this happens independently of phases of the doctoral studies. What is different, then, must be found in the way the doctoral student participates and is positioned in the interaction. The notion of variation cannot be used to analyse the interaction between participants, as variation theory is concerned with the content and is not concerned with the agents involved and the affective, relational and cultural aspects of learning. Instead, positioning theory and learning as participation can be used to analyse this aspect of learning opportunities, and I therefore analysed the same four cases using both perspectives on learning.

The Two Perspectives Study combines two perspectives on learning as described in the Methodology chapter. I analysed the four cases with multiple supervisors using participation and

positioning theory as a sociocultural perspective and variation theory as the individual constructivist perspective on learning.

In the Two Perspectives Study I first make a coarse grained analysis of participation in the four cases. When seeing learning as participation then participation in itself and guidance in the participation are opportunities for learning. More active participation and (appropriate) guidance or scaffolding when needed will result in better learning opportunities. Thus quality supervision involves encouragement to participate actively and appropriate guidance when needed. Exactly what appropriate means in this connection can be discussed, but generally just enough guidance for the learner to proceed will give better options for active participation than abundant guidance. The other dimension of appropriateness is how the guidance is given, how it may work as encouragement and whether it helps enhance self-efficacy beliefs as a condition for learning. This dimension of appropriateness is the domain of positioning theory.

It can be argued that presenting something has further learning potential than practicing and being recognized as a member of a category or community. Teaching, explaining and telling others support the presenter in grasping it himself, and saying something aloud can have the translocutionary force of forming meaning while saying it (Duranti, 1991; Hede, 2010). But then again, these opportunities lie beyond the concept of learning as participation.

Some of these levels of participation require more than one supervisor present, but each can offer different learning opportunities. The doctoral student presenting in principle only requires one listener, but in my observations this was often a situation where the main supervisor was more into the project, and the doctoral student presented to the co-supervisor. This situation can then change into 'the supervisor supplementing', which requires a situation with two supervisors present. Engaging in common discussion, as opposed to engaging in dialogue, needs a second supervisor, and in such discussions the supervisors may disagree or have different perspectives or understandings, and this is a learning opportunity. In the Multivoicedness Study one of the supervisors described the supervision meetings as very

similar to research meetings with peers. The doctoral student in the Multivoicedness Study had a different perception of power relations in the group than the supervisors, but on the other hand, power relations are always in play, also in a meeting in a research group of peers. This is indicative of the common discussion with multiple supervisors being an opportunity to experience and engage in the discursive practices of the community of scholars. Supervisors' internal dialogue requires more than one supervisor present, and is an opportunity to observe practices perhaps without the same pressure to contribute. As indicated in the Methodology chapter, observation of practice can be useful before actual engagement, but supervisors should be observant about including the doctoral student at some point to encourage active engagement.

This coarse-grained analysis of the interaction was used to select an episode for finer-grained analyses on the basis that it could illustrate the difficult balancing acts in using tensions constructively in supervision. The episode is not extreme in any way, and it is the hope that the analysis and discussion will evoke recognition and reflection. On the other hand, the selected episode may not be typical of doctoral supervision, but it was not the intent to find a representative episode. In line with the general perception of transferability it is left to the reader to judge whether aspects of the analysis and discussion might be transferable to their own academic environment, as described in the Methodology chapter.

When analysing the episode using positioning theory I identified three storylines that participants seem to adhere to in the interaction, illustrated in figure 1 of the manuscript. When there are more participants involved in a meeting the interaction becomes more complex and there are more interests to take into consideration for all involved. This is one of the issues brought forward in criticism of allocating more supervisors: things do get more complicated, and here meta-communication could be an asset.

The analyses of this episode from the two perspectives yield different insights with regards to learning opportunities. Learning

as participation contributes to our understanding of learning opportunities from supervisors' internal dialogue. Here the opportunities for learning could be increased if supervisors are more observant to include the doctoral student in discussions. The notion of variation reveals an expansion of the learning space through variation, and if this type of learning opportunity should be utilised further it requires more aspects of the object of learning to be varied in a systematic manner. The use of positioning theory uncovers how learning opportunities are created or missed at the fine grained level of positioning and exchanging utterances, and how the cultural context comes into play. The opportunities include recognition of the discursive categories and the practices involved, and opportunities to position one-self in terms of these categories. But the analysis of how the doctoral student is (or may feel she is) positioned also contributes to understanding conditions for learning like the affective state of feeling hurt. The three theoretical frameworks complement each other to reach a fuller picture of learning opportunities in supervision.

The affective state hypothesised in the analysis, and how this influences conditions for learning also points back to the Agency Study and supervisory relationships. Both a higher sense of agency and a strong supervisory relationship where expectations are well clarified and aligned can alleviate the doctoral student's reluctance to join scientific discussion. To complete the loop, the supervisors can also support the doctoral student in building agency through the way they position her in the interaction.

In another episode the doctoral student presents his reasoning behind selection of sampling sites. For easy reference I enter the episode here.

PhD student	So I needed to select some ecological zones, which could represent kind of the whole country, but in a very small area
Main supervisor	Yes
PhD student	and for that I used a layer for some ecological zones that FAO, what's it called, defines them

Main supervisor	yes
PhD student	from, it has to do with crops, I haven't investigated how they produce them
Main supervisor	no
PhD student	but what I thought, it was better to look at that than for instance soil types
Co-supervisor	I think you are right about that
PhD student	because FAO's are defined according to a biological response, you can say, a plant says something about something complex, it says something about humidity and season and soil type and so on. So I used them as, as interpreter, you can say
Main supervisor	I would like if you, next time, would demonstrate this for [name of co-supervisor] and me, because then we are better prepared when we arrive, that we have kind of, eh, right?
Co-supervisor	Yes, that's a good idea
Main supervisor	that we also feel that we have good insight in the map, actually
PhD student	Yes

In order to identify this episode as 'doctoral student presents' at the coarser level of participation I do not need to go into the subject, but arrow diagrams of turn taking is sufficient. However, when hypothesizing storylines and testing if they hold as cultural context in the analysis of positioning it is necessary to consider the content. It requires an analysis of the content to identify his presentation as scientific reasoning, and for this purpose the notion of variation works very well in my view. As comparison, Dysthe (2002a) used a content analysis to identify new perspectives appearing in a web-based discussion, and this worked well for her purpose of identifying multiple voices with the use of dialogism. But when I use positioning theory it is not enough to identify utterances as responses to preceding utterances or new independent utterances. I need to be able to describe how the content is presented or discussed in order to label it 'scientific reasoning'. The patterns of variation facilitate that, but some level of knowledge of the subject is also needed.

My background in agricultural science is an advantage here, as I do not believe that I would be able to make similar analysis of doctoral supervision in mathematics or literature. In positioning theory the positioning triangle can be entered empirically at any one of the three angles, utterances, positioning and storyline. Harré and Moghaddam (2003) suggest starting from the storyline by proposing ‘as a working hypothesis about the principles or conventions that are being followed in the unfolding of the episode that is being studied’ (p. 9). I find it helpful to analyse the patterns of variation before I hypothesize a storyline. When describing the space of learning in this episode the learning object can be defined as selecting ecological zones for sampling. The doctoral student contrasts zones based on crops with zones based on soil types with regards to relevance for selection. He then expands the space of learning with regards to crops as selection parameter by generalising across aspects of biological response of the crops, humidity, seasons and soil type.

The two storylines I propose for this episode are ‘scientific reasoning’ and ‘thorough fieldwork preparation’. The doctoral student positions himself as the creative researcher crossing boundaries between zoology and botany as he presents his scientific reasoning. The main supervisor takes a position as the listener and the co-supervisor positions herself with the right and duty to acknowledge his scientific reasoning as she says ‘I think you are right about that’. The main supervisor changes the storyline into ‘thorough fieldwork preparation’ as he asks the doctoral student to demonstrate the map, and by doing that he simultaneously acknowledges the work of the doctoral student as thorough.

The learning opportunities that are offered in this episode are concerned with the content, how to select sampling sites, and the sociocultural opportunities of becoming. For the doctoral student who presents the content knowledge in this episode, the learning must have happened in preparation for the meeting, so using the notion of variation is not sufficient to explain learning opportunities for the doctoral student created in the meeting in this episode. The presentation is an opportunity to practice this specific discursive practice, and the confirmation from the

supervisors about his scientific reasoning functions to ‘confirm his membership’ of the scientific community.

Combining theories in this analysis enhances our understanding of learning opportunities. The partial analyses with each theoretical framework inspire or stimulate each other to an extent that they almost depend on each other in this case. The theories themselves are not undergoing any changes, but the potential lies in combining them, and even theories with different ontological assumptions can be intertwined to yield a better understanding.

The use of the two perspectives for learning shows how supervisors and PhD students can create learning opportunities through various levels of participation and by making variation in ‘how to produce valid results’ visible to the doctoral student. Learning in doctoral education involves becoming a member of the scientific community and constructing knowledge and expertise as a participant, and educational research thus needs to attend to content *and* interaction.

Summing up the Interaction Studies

In his handbook for doctoral students Wellington (2010) sums up the positives and negatives of joint supervision. In the positives he includes ‘another reader’, ‘another viewpoint’, and in the negatives he includes ‘contradicting each other – they don’t always agree’, ‘discussing your work between themselves’. Contrary to this I find that the inclusion of a co-supervisor increases possibilities for dialogue and learning exactly because supervisors not always agree and because they talk about the doctoral students’ work between themselves. The analyses of supervision with multiple supervisors show that the disagreements can function as learning opportunities and that participation in authentic scientific discussions with multiple supervisors can be an entrance to the community of practice. This means that supervisors not necessarily need to align their views prior to supervision, but they need to be observant of the power relations in play and they need to agree on the process level of supervision and ensure that agreement is reached at some point. Adopting a student centred approach and maintaining a

positive spirit and good working relationships increases possibilities for the doctoral student to learn and develop.

The notion of variation explicates how the space of learning can be expanded in patterns of variation, and the more variation in all four patterns of variation the better the opportunities for learning. But what I illuminate with variation theory is also how collective learning from research and individual learning both are conditioned by variation.

The analysis with the use of positioning theory uncovers how learning opportunities are created at the fine level of exchange of utterances and positioning, drawing on the cultural context. This enables me to illustrate how there might be more potential in listening to supervisors discussing than would be expected from such low level of active engagement, but also why meta-communication can be a helpful way of communicating in supervision and that the opportunities for learning could be increased if supervisors include the doctoral student in discussions at early stages. The learning opportunities include opportunities to recognize the discursive categories and the practices involved, and opportunities to position one-self in terms of these categories.

Future research

This research has provided some interesting answers to the research question, but many aspects have not been covered, and the use of other theoretical approaches and other empirical data can add to the picture. Issues that call for further research include cross-cultural supervision, gender issues, group or collective supervision, distance supervision etc. Exploring supervision in other disciplines and at other educational levels will add to the picture, and other theoretical approaches could include conversation analysis.

The interaction during supervision includes both reactions to the work that takes place outside the meeting and it initiates new action to take place after a meeting. How the formal supervision sessions supplement informal ad hoc meetings and workplace learning could form an interesting study. However, this requires a

very research intensive study including many of the activities that doctoral students engage in on a daily basis. I do not believe that interview studies can reveal these feedback mechanisms, as it is a largely tacit practice like the creation of learning opportunities in supervision. Observation uncovers a much richer picture of the lived practice than interviews, which are mainly useful to get insights into people's experience and reflections on their practices.

There were some specific aspects of the interactions that call for further investigation. The use of meta-communication, talking at process level about the communication and interaction was used to a varying degree. A study of the use of meta-communication in doctoral supervision could be useful to further our understanding of this, as little research to date has focused on this, Baltzersen (2013) being an exception. One approach would be to reanalyse my data specifically with this focus. Another approach would be to set up an action research project with interventions where the supervisors are trained in active listening and meta-communication, to see what improvements in supervision such interventions could yield as experienced by the participants.

The storylines identified in the interactions are references to the cultural and historical context that participants take for granted. Cross-cultural supervision would imply that participants have different frames of reference that they take for granted, and this makes communication more complex with higher risk of miscommunication (van Langenhove & Harré, 1994). Some of the cases observed in this study are cross-cultural, but in order to identify storylines from the other culture than my own, I would need to know more about that other culture. But the use of positioning theory could possibly reveal some of the issues in the troubled terrain of cross-cultural supervision.

In the analyses of the interaction in these four cases I came across many examples of using jokes and humour. Unsworth et al. (2010) studied the role of gratitude in doctoral supervision, and similarly a study of humour could yield interesting new insights. This could be obtained from an analysis of my whole data-set with a focus on the function of humour. The role of

humour as a possible resource for learning can be studied with the use of variation theory as well as positioning theory, and this would contribute with more nuances and better understanding of the role of jokes and humour in supervision.

6. Concluding remarks

6.1 Revisiting the research questions

In what follows I revisit the research questions and discuss how far I have come in answering them.

Doctoral students' agency

The research question guiding this study was: Does the discussion with the supervisor about personal development planning and aligning expectations help doctoral students build their agency in managing collaboration with the supervisor, and strengthen the supervisory relationship as perceived by the doctoral students?

This study of doctoral students' agency is important for understanding how we can support autonomy of the doctoral students. When viewed in the perspective of higher education research, the results are preliminary in nature. The study contributes with insights into one way to strengthen doctoral students' agency and supervisory relationships, nested in a concrete context.

The Agency Study shows how the scaffolding through the Introduction Course can work for some as a way to build agency and to establish good working relationships. The study also reveals that not all doctoral students need this in order to establish a good working relationship as their supervisors are already aware of the importance of this. Furthermore, the study reveals that some doctoral students face problems with their supervisors in spite of the efforts through the course.

At the local level, the Faculty of Science at the University of Copenhagen, the study demonstrates the importance of the Introduction Course in building doctoral students' agency and strengthening supervisory relationships, but also points to a need for efforts to develop supervisors' competences and to develop a code of conduct for supervision.

Interaction with multiple supervisors

The research question guiding the Interaction Studies was: How are learning opportunities created by supervisors and PhD students during supervision with multiple supervisors?

There will of course never be a conclusive answer to the research question I set out to explore, but the practices that I have illuminated through this research cover some core aspects of becoming a scientist: to acquire content knowledge and competences, to learn about and adopt the norms and values of science and to develop an identity as a scientist. The interaction studies have contributed with illuminations of supervisory practices that may evoke recognition and reflection.

The use of different theories in combination enables me to give a fuller picture of learning opportunities in supervision. Not only do the different perspectives supplement each other, but the analysis with one theory supports the analysis with another theory. Learning as participation was used as a coarse grained analysis that enabled me to identify episodes for further analysis. Using the notion of variation to describe the space of learning facilitated the hypothesizing of storylines in the analysis using positioning theory.

Learning in doctoral education involves becoming a member of the scientific community and constructing knowledge and expertise as a participant, and educational research thus needs to attend to both content and interaction. This can contribute to establishing the field of supervisory pedagogy.

6.2 Perspectives and implications

This doctoral research was motivated by my engagement in doctoral education, teaching both doctoral students and supervisors about supervision, and organising other courses and support for doctoral students. The findings and understandings that this research has contributed with have implications for teaching, practice and policy.

At policy level, I clearly see a need for initiatives that can support supervisors and doctoral students experiencing 'communication breakdown' and problematic relationships. The Agency Study points to issues of reaching the supervisors who do not prioritize doctoral supervision for different reasons, and although a lot can be achieved by equipping the doctoral students, there is also a need for better consensus on what good and effective supervision is. Just having an agreed code of conduct for doctoral supervision might help, but the process of formulating it in a participatory manner might be more important than implementing it. Enforcement of participation in supervision courses or demanding new supervisors to complete a supervisory process successfully as co-supervisor before taking on the responsibilities of being the principal supervisor may help to some extent. I also see a strong need for other initiatives like a PhD ombudsman independent of the supervisors, and independent coaching for doctoral students and mediation or conflict resolution workshops for dyads and teams of supervisors and doctoral students.

The Interaction Studies yield insights relevant for workshops and courses for supervisors and doctoral students. Intended learning outcomes in future courses should include the benefits and challenges of supervision with multiple supervisors. If supervisors know more about how learning opportunities can be created through variation, participation and positioning, they can create better learning environments for the doctoral students. A recommendation for doctoral students is to gather all supervisors in common supervision at least in some supervision sessions. And a recommendation for supervisors is to align mutual expectations among supervisors as a means to create a good learning environment for the doctoral student. Not only is co-supervision a way to induce new supervisors into supervisory practice, but it adds value to supervision as such.

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List of publications

Appended to this thesis

Kobayashi, S., B. W. Grout and C. Ø. Rump (submitted), Building agency and strengthening supervisory relationships in doctoral education: Using a structured meeting about personal development planning and aligning expectations.

Kobayashi, S., B. W. Grout and C. Ø. Rump (2012) *Supervisors' approaches to supervision and how these relate to conceptions of research*. Poster presentation at the 10th Quality in Postgraduate Research Conference: Narratives of Transition: Perspectives of Research Leaders, Educators and Postgraduates. Adelaide, Australia, April 16-19, 2012. Award for best poster. Extended abstract published. <http://www.sapmea.asn.au/conventions/qpr2012/index.html>

Kobayashi, S., B. W. Grout and C. Ø. Rump (2013) Interaction and learning in PhD supervision – a qualitative study of supervision with multiple supervisors. *Danish Journal of Teaching and Learning in Higher Education*, Vol. 8, no. 14, (pp. 13-25).

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Additional publications

Due, J., Kobayashi, S., and Rump, C. Ø. (2009) *To lead the way. Inspiration for PhD students and their supervisors*. University of Copenhagen, Denmark. Retrieved from <http://www.science.ku.dk/english/research/phd/student/supervision>

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Kobayashi, S., B. W. Grout and C. Ø. Rump (2013) *Personal Development Planning as a means to strengthen supervisory relationships in doctoral education*. Paper presentation at the Annual Research Conference of the Society for Research into Higher Education, Newport, Wales, UK, 11-13 December 2013. <http://www.srhe.ac.uk/conference2013/>

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Kobayashi, S., B. W. Grout and C. Ø. Rump (2012) *Interaction in PhD supervision – a qualitative study of a supervision session with multiple supervisors*. Paper presented at the EARLI SIG Higher Education Conference, Creativity and Innovation in Higher Education, in Tallinn, Estonia August 14-17, 2012. http://www.tlu.ee/EARLI_SIG_2012.

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Kobayashi, S., S. P. Grumløse, B. W. Grout and C. Ø. Rump (2011) *An early-stage Personal Development & Planning course to engender effective self-management in PhD students*. Paper presented at the 14th Biennial EARLI conference: Education for a Global Networked Society, Exeter, UK, August 29 –September 3, 2011.

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Building agency and strengthening supervisory relationships in doctoral education: Using a structured meeting about personal development planning and aligning expectations

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Building agency and strengthening supervisory relationships in doctoral education: Using a structured meeting about personal development planning and aligning expectations

Abstract

The supervisory relationship is widely recognised as central for successful completion of doctoral studies. Higher education literature typically refers to the power relations between supervisor and student, and the importance of clarifying expectations of the supervisory process. The dimension of 'closeness' and building a trustful relationship has been the topic of only a few studies. As trust builds on good communication, mutually agreed ground rules and common goals, this study investigates the use of personal development planning as a tool for developing such a relationship. Within the frame of the asymmetric supervisory relationship a student may need support to establish a good working relationship. In an introduction course for new doctoral students at a major Danish university participants are required to share aspects of their personal development plan with their supervisor, and our analysis of their reflective notes reveals how this can contribute to a better supervisory relationship.

Key words

Doctoral student agency; doctoral supervision; research education; self-management; supervisory relationship

Introduction

The supervisory relationship is widely recognised as central for successful completion of doctoral studies (Ives & Rowley, 2005). This relationship is inherently asymmetrical, because of institutionally mediated power, and the informal power executed in the interaction based on the supervisor being more experienced and competent in research than the student (Grant, 2003, 2008; Grant & Graham, 1994; Manathinga, 2007, 2012).

This asymmetrical relationship frames the possibilities of establishing a good working relationship. Trust is viewed by many as essential for a high-quality relationship where students are able to engage in dialogue and thereby enhance learning (Boucher & Smyth, 2004; Engebretson et al., 2008; Sambrook, Stewart, & Roberts, 2008). Mutual trust and respect require good communication, agreed goals, and agreed ground rules for the interaction.

Handbooks and courses for supervisors emphasize the importance of aligning expectations to roles and responsibilities, see for instance Grant and Graham (1994), Phillips (1994) and Engebretson et al. (2008). Little research is available to date that can inform supervisors and candidates on how to establish and maintain a good working relationship, or whether some types of relationships are more likely to prove effective than others (Boucher & Smyth, 2004). Handbooks and websites suggest tools for aligning expectations, usually in the form of a set of questions that supervisors are encouraged to discuss with their students, see for instance Taylor and Beasley (2005). The difficulty with such strategies is that they are usually left to the initiative of the supervisors, and doctoral students have few means to take the initiative.

The supervisory relationship

There is general agreement that responsible supervisors do not only focus on the research and thesis, but demonstrate genuine interest in the learning process and well-being of their doctoral students (Engebretson et al., 2008; Hockey, 1995; Pearson & Brew, 2002; Pearson & Kayrooz, 2004). However, many emphasize the dangers of an overly-friendly relationship that can impair critical feedback, see for instance Hockey (1995) and Sambrook et al. (2008). Boucher and Smyth (2004) describe the advantages of a closer acquaintanceship, as the higher level of trust from the outset makes it easier to establish a good working relationship. Doctoral students depend on their supervisors for instruction and guidance, both to learn the methods and the argumentation in the discipline, as well as being socialised into a way of being, thinking and acting in the discipline in question.

The supervisor's authority, grounded in her knowledge and experience, supports the learning process. Yet, the power distance can become unhealthy if the doctoral student does not trust that she can reveal her doubts and get help without being judged as unworthy of supervision. It is a complex relationship with the thesis as a third party (Grant, 2003) and often involving more than one experienced supervisor, making it even more complex as described by Manathunga (2012). McPhail and Erwee (2000) point to three preconditions to establish a robust relationship that can endure difficulties: setting mutual goals and objectives, the emergence of social bonding and the development of trust (p. 85). Mutual goals and objectives require that both parties have a stake in the common project. Emergence of social bonding requires some level of acquaintance beyond the formal and professional relationship. Trust develops over time, is based on mutually agreed ground rules and appropriate feedback and recognition, and is earned through continuous accountability from both sides, (McPhail & Erwee, 2000). The power dynamics in play in supervision frame the possibilities for the doctoral student to participate and develop competence and identity as researcher, and therefore the agency of doctoral students is key to their development to become autonomous researchers (Jazvac-Martek, Chen, & McAlpine, 2011).

Agency in doctoral studies

The question about agency in doctoral education has been studied and discussed by a number of researchers. Hopwood (2010b) emphasises the importance of relationships and relational agency in doctoral research and learning. He defines relational agency as the ability to act on or interpret the world by seeking the help of others, involving the capacity to offer support and ask for support from others (Hopwood, 2010a). Wright (2003) showed that postgraduate students who successfully completed their PhD within four years in spite of personal or supervisory difficulties made use of support from their broader network. Pyhältö and Keskinen (2012) found that doctoral students lacking relational agency connected this to lack of interest in their studies, other negative emotions like anxiety and

exhaustion, and more frequent considerations of interrupting studies.

Through analysis of progress logs from doctoral students Jazvac-Martek et al. (2011) found that many doctoral students engage in academic work that does not directly progress their research or thesis, but that these interactions contribute to the students' development of academic identity and in establishing themselves as academics. Their study highlights students' agency in negotiating with others in order to achieve their intentions and in navigating difficulties (termed negotiated agency). Building confidence and identity through academic activities was also evidenced by Dunlap (2006), here through online journal editing, which supported doctoral students in identifying themselves as contributing members of the scholarly community. McAlpine and Amundsen (2009) found that doctoral students engaged in activities to bring about change in their faculty, developed important collective identity and agency that facilitated their identity building within the discipline. They also showed how supervisors explicitly model students' agency through text feedback and discussion of thesis work. Overall, Deane, and Peterson (2011) investigated the effect of academic support, personal support and autonomy support with regards to doctoral students' research self-efficacy beliefs drawing on Bandura (1997). They found that doctoral students with supervisors who encourage them to think and act autonomously while still guiding them on research tasks reported higher research self-efficacy regardless of the level of personal support. A supervision style with low autonomy support but high personal support resulted in low research self-efficacy beliefs. This suggests that more agentive doctoral students are more likely to be satisfied during their studies, they seem to complete studies faster, and they may be more successful in developing their academic and professional identity. It also points to the possibilities for supervisors and other support staff to help doctoral students build their identity and agency. In their review John and Denicolo (2013) call for further research into doctoral students' agency can be promoted.

This study investigates the effect of an initiative aimed to put the tools for aligning expectations and setting goals for their PhD in the hands of the doctoral students and to position them to lead discussions with their supervisors about collaboration. As Grant and Graham (1994) concluded that students need to become skilled in using the tools, rather than just provided with the tools, we aim to equip the doctoral students with such skills as described under *The context of the study*.

We use theory about identity and agency to better understand the mechanisms in play within the frame of the inescapable role of power in supervision. By analysing reflective notes from course participants and follow-up stimulated reflections we investigate if the discussion they have with their supervisor about personal development planning and aligning expectations has a potential in positioning and equipping the doctoral students to influence their supervisory relationship, so that they feel able to collaborate effectively with their supervisors, and thereby strengthen the supervisory relationship in the longer term, as perceived by the student.

Methodology

Framing the inquiry within identity and agency

We base our analysis on the understanding of identity and agency as framed by Holland et al. (1998). They refer to identity as self-understanding: 'People tell others who they are, but even more important, they tell themselves and even try to act as though they are who they say they are.' (p. 3). A person's positional and relational identity is shaped by her perception of her social position in the lived world, her perception of her access to spaces, resources, activities and voices. Identity is continuously constructed in situations and relations as people author their professional selves, while choosing to act in ways that are consistent with their self-understanding. When individuals craft their responses they improvise in response to particular situations. Holland and her co-authors view this art of improvisation as human agency. Further, they draw on Bourdieu, Bakhtin and Vygotsky to define their understanding of human

agency. They balance their understanding of the cultural and social context, since neglecting the structural constraints that inform the situation would dismiss the need for agency for humans to act. On the other hand an overemphasis on social constraints where culture is viewed as rules would be deterministic and leave no room for improvisation. But 'action takes place within an always present, partially durable construction of stratified social differences' (p. 279). Agency is the evocation of identity and the capacity to act intentionally to construct narratives in terms of personal intentions and the ability to influence one's experiences in spite of social and relational positions.

The context of the study

In Denmark doctoral students are typically viewed as colleagues of their supervisors as both are traditionally employed by the same university. Yet, hierarchy clearly exists as supervisors sign progress reports, and can decide to recommend termination of the student's studies. Often, especially in the sciences where this study is based, doctoral students do not have an opportunity to select a supervisor, but the position is advertised and the supervisor selects the candidate. The supervisor has a very real stake in the research with common publications as the norm. It adds complexity to the power relations when dependency goes both ways. Supervisors can meet their publication targets through their common publications with the doctoral students, and they depend on the research outcomes to fulfil the goals of their externally funded research projects. This gives the supervisors in our context more incentives to create a good working relationship than might be the case in other disciplines.

The Introduction Course concerned was opened in 2007 as a response to the growth and diversification of the doctoral student community and currently runs six times each year, reaching over 100 students out of the 200-250 enrolled annually. It is an optional, five-day residential course and participants make a personal development plan that requires them to reflect on their learning goals for the PhD study, and beyond, to examine their competencies and achievements and consider the actions needed

to reach their future goals. Personal development planning is a 'structured and supported process undertaken by an individual to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development' (Quality Assurance Agency, 2009, p. 2), and it is widely used in the UK in efforts to strengthen student learning in higher education (Strivens & Ward, 2010). The course participants are required to share their planning with their supervisor(s), to ensure that the goals and plans they have made can become integrated into the PhD process. The diversity across departments as well as mixing Danish and international doctoral students, together with the residential, off-campus venue, creates a space where the participants have a safe haven to talk about the issues that occupy them, and take a fresh look at the roles and relations they engage in. This reflective work is encouraged during the course with the aim of enabling the participants to successfully set up and steer the meeting with their supervisor(s). The plan, together with a reflective note on the meeting with the supervisor(s), is submitted to the course team, and individual, formative feedback is provided.

Our immediate post-course evaluations have consistently been very positive. A qualitative evaluation (2009) from doctoral students, who had attended the course some eighteen months earlier, indicated that the personal development planning was important for the participants' ability to take charge of their education and establish a strong working relationship with the supervisor. The long-lasting elements, according to respondents, came from being acknowledged as more than 'just a PhD student', developing personal development planning skills, having tools to manage an effective, working relationship with their supervisor and improved intercultural and cross-disciplinary understanding (Grumløse, Kobayashi, & Grout, 2010).

The present study therefore sets out to investigate whether the discussion with the supervisor about personal development planning and aligning expectations

- 1) helps doctoral students build their agency in managing collaboration with the supervisor, and

- 2) strengthens the supervisory relationship as perceived by the doctoral student.

Data collection and analysis

To answer our research questions we selected 110 out of 302 reflective notes authored by course participants as part of their assignments during 2009-2011. These were selected as they indicated that the meeting with the supervisor mattered to them, either by pointing to some difficulties, pointing to decisions taken about supervision, or giving an indication of expectations for an improved relationship. The reflective notes that we did not select contained too little information for a meaningful qualitative analysis. The authors of the selected reflective notes were then contacted individually by email and asked to reflect further on the effect of the meeting with their supervisor to gain insight into the long term effects of the course. In each email we included the text of the reflective note from that person's assignment with the aim of stimulating their reflection. We received back 71 of these stimulated reflections (65% response rate). The 71 replies were paired with the reflective note from the respondent's course assignment, gathered in one file and anonymised by removing names of people or places.

To answer the first research question: Does the discussion with the supervisor about personal development planning and aligning expectations help doctoral students build their confidence in managing collaboration with the supervisor, we first analysed the paired reflections thematically as described by Braun and Clarke (2006). The themes that emerged were then analysed through the theoretical lens of agency as an evocation of identity (Holland et al., 1998). We did not have a pre-existing coding frame from the outset, but developed it as a recursive process between the data and the theoretical lens. The results from this analysis are presented in the subsection *Identity and agency*.

We then coded the stimulated (follow-up) reflections thematically (Braun & Clarke, 2006) to answer the second research question: Does the discussion with the supervisor about personal development planning and aligning expectations strengthen the

supervisory relationship as perceived by the doctoral student. First we looked for qualitatively different categories that we identified as a recursive process in interaction with the data. The coding was done by the first and the second author individually, and then the coding was compared and the categories negotiated. Finally we quantified the data to find the prevalence of each category. This is presented in the subsection *Strengthening the relationship*.

Results

Identity and agency

We analysed the paired reflective notes thematically and for expressions of agency in a recursive process and we identified three major themes of relevance for identity and agency.

Scaffolding

The first theme that we identified relates to the course as *scaffolding* the doctoral student in the process of building agency. This includes having a structure to follow as a scaffold for the doctoral student when talking about ‘soft issues’, decisions made to change supervisory practices, aligning expectations, and the doctoral student expressing to have overcome reluctance of sharing thoughts and issues with the supervisor.

Again, the course material provided good directions for the discussion, focusing on details that I would not have thought of this early in the project. Setting the guidelines now might mean that we can avoid potential troubles in the future.

I believe that the meeting was very important in providing me with the chance to discuss some critical issues with my supervisor that I would not have had the courage to approach had it not been as part of the request of a course.

Holland et al. (1998) draws on Vygotsky to describe scaffolding as inter-individual skills becoming personally produced and relied upon by the learner. The skills that course participants acquire during the course together with the course material provide a scaffold for the doctoral student to discuss goals, expectations and sometimes also sensitive issues with their supervisors. The scaffolding supports them in overcoming perceived structures of power, to improvise in the moment and to interpose new actions.

Shared understandings

The second theme, *shared understandings* covers that the doctoral student and the supervisors get to understand each other better, become aware of preferences or needs. This also included that the doctoral student shared career goals with the supervisor, and that the doctoral students voiced their needs for example for competence development opportunities. Scaffolding might be a precondition for this.

The outcome of the meeting was that we both feel that we know each other a lot better. This has made the supervision process more beneficial already.

Talked about fear to disturb and take too much time (me) and supervisor's constant guilt on the subject of supervising PhDs (for not spending enough time on their supervision).

This theme draws on formation of identity. Sharing the personal development planning with the supervisor, and through that getting an opportunity to get to know each other better, allows the doctoral student to be seen in a different way and see themselves in a different way when recognised as such. The closer relationship may contribute to a perceived lower power distance that ultimately can change the doctoral student's apprehension of her social position and increase the doctoral students' ability to act.

Repositioning

The third theme is a more direct *repositioning* of the doctoral student to a more resourceful position. This includes expressions

of gained energy, overview or motivation, higher confidence, feeling supported by the supervisor, the supervisor actively builds agency by complimenting or confirming competences, being viewed as a whole person, being viewed as a colleague, and the supervisor responding to requests.

She told me that they consider PhD students as a part of staff and colleague not student. So, it gave me a feeling of confidence that it is my project and I should handle it.

I also think that they trust in my abilities as a researcher and that makes me more confident in the work that I am doing. I am now more comfortable with putting things across to them without fear that they may be deemed disrespectful or not very clever.

The doctoral students change their perception of their identity in practice into a social position imbued with more influence on their own education and research, and with a less asymmetrical perception of their relational position towards the supervisor. This enhances their ability to take charge of their study and become more self-directed.

Strengthening the relationship

The stimulated reflections were analysed and categorized according to type and degree of long-lasting effect. We found the following four categories, each exemplified with a quote.

- (1) No effect. The doctoral students describe this as a lost cause, as their supervisor was too busy or indifferent, and they did not get much supervision in spite of the meeting.

He has other PhDs as well and neglects us all... he simply doesn't have the time as he's too busy working on positioning himself in this new field.

- (2) No effect. This group already know their supervisor well and/or perceive that they would get good supervision anyway. They did not experience an effect from the meeting.

I do not think this particular meeting had any significant influence over time. I think what was important for me and my principal supervisor's relation was a confidence and mutual respect which inevitably evolved regardless of this meeting.

- (3) For this group the meeting helped the doctoral student, but the supervision as such did not change. The consciousness of the meeting was supportive in the process.

In short, I guess the meeting with my supervisor about the PDP did not change our relationship. Rather, it changed the relationship to myself and my expectations to myself (when I remember it, and don't just follow the stream), and ultimately, this might have effected how I see my supervisor.

- (4) The last group experienced the meeting as an opportunity to talk about sensitive issues and change some practices in the supervisory process. This could be in understanding roles and mutual expectations, for instance realising that the supervisor expects the student to take a lead. Some in this group use the term 'ice-breaker', and for a few it was even described as a turning point.

Seen from today, the discussion of my PDP was the starting point of a much closer relationship to my supervisor than it had been before that meeting. I am still thankful, that I had to, as part of passing the PhD Introduction Course, discuss the PDP with him... Through him knowing me, I got the perception, that I also know him better and it enabled me to more easily bring up more complicated topics in the following supervision meetings. It worked like an 'ice breaker'.

We can see that preparing doctoral students to organise and steer a meeting with their supervisor, structured around discussions

about their goals, competence development planning and aligning expectations, has a potential for a group of doctoral students to improve collaboration with their supervisors.

Finally, we attempted some simple quantification of the stimulated reflections in relation to the above categories to see if there is a trend that would indicate that the approach does, or does not, work (Table 1). The respondents were segregated by gender and nationality (Danish vs. international). There were 50 women and 21 men in the population of 38 Danish and 33 international students. Compared with enrolment this is a slight overrepresentation of international students, who typically make up one third of the doctoral student population, whereas the gender distribution matches enrolment figures. The respondents are representative of the 302 course participants from 2009-2011, and of the 110 authors of selected reflective notes with regards to gender and nationality.

Table 1. Frequency of responses in each category.

Category*	F, <i>DK</i>	F, <i>Int</i>	M, <i>DK</i>	M, <i>Int</i>	Total
1. No effect – insufficient supervision	6	2	0	2	10
2. No effect – good supervision	8	4	3	3	18
3. Supported the doctoral student	5	1	3	0	9
4. Strengthened relationship/ collaboration	13	11	0	10	34
Total	32	18	6	15	71

*F: Female, M: Male, *DK*: Danish, *Int*: International

The quantification shows that almost half of the respondents (34/71) perceived the meeting as an asset in strengthening the relationship and improving collaboration with their supervisors, and this is especially true for international doctoral students as almost two thirds (21/33) of them fall into this category. The sample is too small to say anything meaningful about the effect of gender.

Discussion

The quantification of the four categories indicates that a significant proportion of the course participants might feel that the initiative helps to reposition them in relation to their supervisor and strengthen the collaboration. The qualitative analysis reveals how this mechanism works.

The analysis indicates that aligning expectations is not only a matter of improving communication to avoid problems, but the doctoral students adjust their perception of the relations of power in play. Especially international students may have an expectation of a more formal relationship, as shown by Kiley (2006), and this may explain why the international doctoral students especially seem to gain from the course. Sharing the personal development planning and setting common goals in it-self can work to improve collaboration, but it also increases closeness in the relationship and makes it easier for the doctoral students to approach their supervisors. Again, this can add to the repositioning of the doctoral student into a more resourceful social and relational position.

A similar initiative described by Grant and Graham (1994) had little effect according to the authors because the students lacked the skills to lead discussions with their supervisor. We build these skills through the scaffolding from the five days internship course and this may explain how our initiative seems to work. The qualitative analysis indicates that putting the tools in the hands of the doctoral students works because the meeting is part of a formal requirement where the supervisor is equally compelled to contribute, and that it works through the scaffolding, shared understanding and repositioning that takes place because of the meeting. The personal development planning and the aligning expectations would not have the same effect had it not been for the extended activities at the course, e.g. competence mapping, problem solving in groups, managing the supervisor relationship, learning needs assessment and the community building in each cohort. The different kind of meeting that is required by the course gives the doctoral student an opportunity to improvise and to interpose new actions. The human ability to imagine how

the world could be different, the 'figured worlds' in Holland and co-authors' words, makes it possible for the doctoral students to craft responses in the situation and redirect them-selves away from their usual reaction patterns. The scaffolding from the course is critical for their possibilities to improvise.

Our study also clearly points to the difficulty in reaching some supervisors that appear to be too busy to contribute effectively to the process or are largely indifferent towards doctoral education. For these doctoral students other measures are necessary. The only place they can seek help independent of their department and their supervisor is the office of the graduate school, which mainly functions as a registry. What we would suggest is an independent institution like a PhD ombudsman or a coach independent of the departments where the doctoral students are employed. Further, the university should have a code of conduct for supervision that the doctoral students and supervisors could refer to, in addition to the courses offered for supervisors.

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Supervisors' approaches to supervision and how these relate to conceptions of research

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The nature of the problem

How is research supervision related to the nature of the research in question? Studies into the research-teaching nexus have shown how the nature of a research discipline relates to the teaching of that discipline. In this pilot case study we analyze how supervisors' approaches to supervision relate to their conceptions of research. In order to capture a more complete picture we analyze practice through observation of supervision and, through interviews, the meaning the supervisors made of it.

Theoretical Framework

This work lies within the research-teaching nexus arena of doctoral supervision, and is based on Chevallard's anthropological theory of didactics and his concept of praxeology (Chevallard 2007), developed further by Madsen and Winsløw (2009) into a coherent model for analyzing linkages between teaching and research within a discipline (see Figure 1). Chevallard's concept of praxeology has four elements: At the praxis level: The tasks we do and the methods or techniques we use in the doing; and at the logos level: the technology or discourse that the method is embedded in, and the theory, which the technology is embedded in. Madsen and Winsløw (2009) merge the technology with the theory, to formulate the questions: Why? as the explanation for our doing. This makes the praxeology very operational for interview purposes.

Theory	Logos Knowing	Why?
Technology		
Technique	Praxis Doing	How?
Task		What?

Figure 1. The praxeology as the body of knowledge (Chevallard, 2007), adapted for the purpose of interviewing researchers (Madsen and Winsløw, 2009).

When taking the praxeology into the realms of the research-supervision nexus, there is a need to elaborate on the praxeology of supervision to clarify what the different levels may entail. Pearson and Kayrooz (2004) present an elaborate framework of constructs that make up supervision practice. Each construct is divided into a number of tasks and activities, and these can be attributed to tasks or techniques in Chevallard's praxeology. The framework is not developed to uncover justifications for supervisory approaches – the Why in Chevallard's framework. Also, the framework does not in itself lead to any overall approaches to supervision. Here Dysthe's three models of supervision and her discernment between dialogical and monological supervision (Dysthe, 2002) give a coherent framework to connect the techniques with an overall approach to supervision.

Methods

The case was a supervision session which concerned methodologies to be employed in a study concerned with ‘Storm water management’ and included the PhD student, her principal supervisor and two co-supervisors. The first author was present as an observer and the session was audio-recorded to provide for a verbatim transcript. The transcript was first coded according to the framework of anthropological theory of didactics to analyze how the supervisors and the PhD student talked about research. Then it was coded and analyzed with regard to the supervision in play, using Pearson and Kayrooz’ five constructs (2004). Two of the supervisors were interviewed, individually, after the transcript of the supervision session had been analyzed. The third supervisor had moved to another institution and country, and was not interviewed.

Analysis and Results

The three supervisors and the PhD student discussed the research project, which concerned a design process in landscape architecture. None of the three supervisors were an expert on the whole project, since it was interdisciplinary in nature and supervisors came from different disciplines. They first discussed what the object of research was, and they agreed on ‘how the physical element for storm water management was changed in the planning process’. Then they discussed alternative research methodologies, the role of the researcher (the PhD student) as an observer or participant in the planning process, and the whole set-up of the project. A lot of the discussion actually took place between the supervisors who had different roles and opinions, but contributions by the PhD student were of decisive importance for the outcomes. The justifications they used in the discussion were concerned with the implications of the different methodologies, and what they viewed as scientifically sound and publishable in refereed journals. In the discussion the supervisors challenged themselves, each other and the PhD student through references to justifications, i.e. theory in praxeology terms:

Why - What are the scientific implications of the methodologies

How - What is the role of the researcher: Participant or observer

What - How the physical element is changed during the planning process

The transcript was then analyzed using Pearson and Kayrooz’ (2004) constructs. Since this framework is not developed to capture justifications or explanations for supervisory practices, the supervisors’ activities under each construct were categorized into how and what in Chevallard’s praxeology and used for coding and analyzing the transcript with the following outcome:

How -	<p>Facilitating Listens with attention, Respects the knowledge and expertise</p> <p>Mentoring Approachable, responsive and affirming</p> <p>Reflective practice Open to different research approaches, Open to critical discussion on research practice</p>
What -	<p>Expert coaching Challenge intellectually, Help plan and refine project, Encourages develop own ideas</p> <p>Facilitating Promotes good interaction among students and staff</p> <p>Mentoring Encourages publishing, Refers to relevant professional assistance</p> <p>Reflective practice Encourages open/critical discussion on research practices</p>

The supervision was mainly concerned with helping plan and refine the project (what they supervised in), and how they supervised can be characterized as dialogical in Dysthe’s terms (2002), including aspects like respecting the expertise of the PhD student and being open to different research approaches.

The first author then interviewed supervisors about their conceptions of research and their approaches to supervision. One of the supervisors described landscape architecture as concerned with designing objects and landscapes with a practical imperative and aesthetical attractiveness, and as an inherited iterative and interdisciplinary process. To this supervisor, this is the explanation for the supervisory approach: When the research process is interdisciplinary, supervision necessarily has to be dialogical in his view, see arrow in Table 1 below. Another supervisor described interdisciplinary supervision as a dialogue with the aim to find a focus that the PhD student wishes to pursue.

Table 1. Summary of results and analysis, based on anthropological theory of didactics (Chevallard 2007, and Madsen and Winsløw, 2009).

	Research	Supervision
Why	Practical imperative Aesthetically attractive Sound and publishable research	Interdisciplinary research process
How	Interdisciplinary research Researcher as participant or observer in the planning process	Dialogical Respects expertise Open to other research approaches
What	How the physical element is changed in the planning process	Help plan and refine the project

Discussion of results

Managing multiple supervisors can be problematic, especially when supervisors do not agree with each other, and not all PhD students may be capable of handling this insecurity (Grant and Pearson, 2007). The analysis of the present case shows how three supervisors in an interdisciplinary PhD project include the PhD student in an academic discussion about research methodologies. The interdisciplinary nature of the project seemed to urge the supervisors to go into a dialogue about the research as none of them were an expert on the whole project, thus in this case interdisciplinary research promotes dialogical supervision. This opens the question whether there is a general tendency that interdisciplinary research promotes dialogical supervision, not as a determining factor for supervision, but it might be one among other factors.

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Supervisors' approaches to supervision and how these relate to conceptions of research



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The nature of the problem

Is research supervision determined by the nature of the research in question? Studies into the research - teaching nexus shows relations between the nature of the research discipline and the teaching of that discipline. Can we find similar relations when it comes to research and doctoral supervision?

In this pilot study we have used the anthropological theory of didactics to study supervisors' conceptions of research to see how these relate to their approaches to supervision, both as reflection through interviews, and in practice through observation of a supervision session.

Theoretical Framework

Anthropological Theory of Didactics

Theory	Logos	Why?
Technology	Knowing	How?
Technique	Praxis	What?
Task	Doing	What?

Praxeology adapted from Chevallard (2006) and Madsen and Winslow (2009)



Five constructs of supervision

Expert coaching: The supervisor as expert and coach provides expertise on the research topic...

Facilitating the candidature: The supervisor as facilitator provides guidance that enables the student to manage their candidature...

Mentoring: The supervisor as mentor supports the student's development...


Sponsoring: The supervisor as sponsor assists the student to gain necessary access to resources and opportunities...

Reflective practice: The supervisor as reflective practitioner models openness to new ideas and encourages critical discussion...

From Pearson and Kayrooz 2004, pp. 103-105.

Results and Analysis

Research as it unfolds in supervision and through interview with supervisor

What	How	Why
Designing physical objects and landscapes	Interdisciplinary research Iterative research process	Practical imperative Aesthetically attractive
What is being researched: The physical element or the planning process	What is the role of the researcher: Participant or observer	What are the scientific implications of the methodologies
How the physical element is changed during the planning process	 Element for storm water management	

Supervision as it unfolds in supervision and through interview with supervisor

What	How	Why
Expert coaching Challenge intellectually Help plan and refine project Encourages develop own ideas	Facilitating Listens with attention Respects the knowledge and expertise Mentoring Approachable, responsive and affirming	Interdisciplinary research Iterative research process
Mentoring Encourages publishing Refers to relevant professional assistance Reflective practice Encourages open/critical discussion on research practices (Pearson & Kayrooz 2004)	Reflective practice Open to different research approaches Open to critical discussion on research practice (Pearson & Kayrooz 2004)	I would need your support... I cannot decide on my own this one (PhD student)
	Dialogical (Dysthe 2002)	

Findings and Discussion

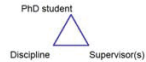
Summary of findings



- Managing multiple supervisors can be problematic, especially when supervisors do not agree with each other
- Not all PhD students are capable of handling this insecurity
- Does interdisciplinary research in general promote dialogical supervision?
- Is the supervision also dialogical in terms of meta-communication about the supervisory process?

Implications

In the recruitment of PhD students an important aspect might be to achieve the right match between PhD student, supervisor and the nature of the research.



Methods

The supervision session concerned methodologies to be employed in a study concerned with 'Storm water management' and included the PhD student, her principal supervisor and two co-supervisors. The author was present as an observer and the session was audio-recorded to provide a verbatim transcript. The transcript was coded according to the framework of anthropological theory of didactics and the five constructs in supervision described by Pearson and Kayrooz (2004). Supervisors were interviewed individually after the researcher had analyzed the transcript of the supervision session.

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Interaction and learning in PhD supervision – a qualitative study of supervision with multiple supervisors

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Reviewed article

This paper presents a case of a single PhD supervision session with multiple supervisors from a life science faculty. The aim is to identify how learning opportunities are created. The supervisors and PhD student were interviewed about their experiences of the supervisory process. The session was analysed using positioning theory. Learning opportunities were created through the diverging voices of the supervisors. This is apparent from the interaction and confirmed in the interviews.

'I think it was really good that I had three quite different supervisors, because, imagine that I only had one? Then I would just be like a clone of that supervisor.'

This is a quote from a PhD graduate that illustrates one of the advantages of PhD supervision involving multiple supervisors. Supervision is usually conceptualized as a one-to-one relationship, but supervisory arrangements are increasingly becoming more varied (Lee & Green, 2009; Pearson & Brew, 2002). Universities increasingly encourage doctoral students to have more than one supervisor to ensure breadth of supervision and to make sure that the student has access to supervision if one supervisor is absent (Kiley, 2011; Manathunga, 2012). PhD projects are increasingly diverse and interdisciplinary (Adkins, 2009; Hammond, Ryland, Tennant, & Boud, 2010; Manathunga, Lant, & Mellick, 2006), and this calls for supplementary supervisors to cover different, specialized aspects of the research. Inevitably, supplementary supervisors add to complexity, and a central question here is whether diverging or conflicting supervision is an impediment to the PhD student's learning and development, or whether it can add value in terms of higher learning potential. With this paper we present an analysis of a single supervision session and interviews with the

PhD student and supervisors involved, with the aim of identifying how learning opportunities may be created for a PhD student with multiple supervisors.

Multiple supervisors

Joint supervision with two or more supervisors is more common in the natural and technical sciences than the social sciences and humanities. In the natural and technical sciences PhD students often work as team members in a research group, with their PhD project being part of a larger project with a predefined research question (Adkins, 2009; Neumann, 2007; Pole, 1998). Pole questions whether joint supervision really is a safety net for doctoral students, as it can create problems for students and supervisors in cases where it is less than successful. It can be problematic for PhD students to manage their supervisors, especially if the supervisors do not collaborate well with each other (Guerin, Green, & Bastalich, 2011; Manathinga, 2012; Watts, 2010).

However, the tension between multiple supervisors' diverging or conflicting perspectives can also be a learning opportunity for PhD students, under the right circumstances. As studies by Dysthe, Samara, and Westrheim (2006) show, diverging voices create potential for new understandings. Similarly, Guerin et al. (2011) found that PhD students benefited from the academic debate among supervisors and actively responded to the variety of perspectives, 'provided there is team commitment in arriving at agreement about how to proceed' (p.147).

The local context

During workshops for PhD students on 'Collaborating with your supervisor(s)' PhD students often raise the issue of struggling with the different viewpoints of their supervisors and poor communication between supervisors. The course approach is to offer tools and guidance to put the PhD students in a position where they can take charge of both their PhD studies and collaboration with their supervisors, much in line with the advice given by Kearn and Gardiner (2011). A response by a participant in our course shows how this may work: *I finally got my supervisors to agree between themselves and I am on track! As we were taught, I took hold of the situation and focused on the fact that it is MY PHD!*

Typical of the institution involved in this study is a growing number of PhD students conducting research that sits at the interface between two or more distinct groups, and PhD students have a supervisor from each group. This situation, where the PhD student often has a central role, is illustrated in Figure 1. This is a departure from the more traditional situation, commonly described in the literature, where PhD students conduct their research in a single group with a common focus (Neumann, 2007).

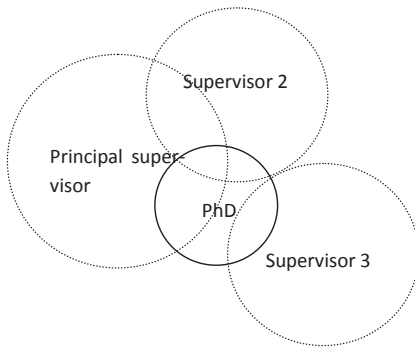


Figure 1: A representation of a supervisory arrangement for PhD students, who struggle with the conflicting viewpoints of multiple supervisors. The supervisors have their expertise in different fields, covering different parts of the PhD student's interdisciplinary research project. Overlaps vary from project to project.

Theoretical framework

This study is based on a socio-cultural understanding of learning as a human social activity conducted within institutional and cultural contexts (Lemke, 2001). We are looking at supervision as a space for learning, with the discipline and institution as the wider social and cultural context. We are not only concerned with the individuals and their relations and interaction, but how the interaction between supervisors and PhD student can lead to learning opportunities in this particular social and cultural context. We are interested in the practice of supervision with multiple supervisors, and we use the concept of learning opportunities for the PhD student, or the learning potential of the interaction, as we do not aim to produce evidence of actual learning, in line with studies by Dysthe (2002a). As argued by Lillejord and Dysthe (2008) learning often results from disturbance, conflicting perspectives, problems and tensions that the students have to relate to and choose between in order to make sense of the world. Dysthe uses the concept of diverging voices (multivoicedness) based on Bakhtin and dialogism, and this frames our discussions in the present study (Dysthe, 2002a, 2002b; Dysthe et al., 2006; Lillejord & Dysthe, 2008).

As recommended by Pearson and Brew (2002), we intend to take discussions beyond the static roles, and we therefore use *positioning theory* for the analysis of the present case. In their introduction to positioning theory van Langenhove and Harré (1999) present the concept of *positions* as 'a dynamic alternative to the more static concept of role' (p. 14). In positioning theory, conversations are viewed as a tri-polar structure of *speech-act* (e.g. utterances and gestures), *positions* and *storylines* that are mutually determining (van Langenhove & Harré, 1999), see Figure 2. Positioning is the act of

assigning rights and duties to oneself and to others from moment to moment, and relative to one another or towards a task or an object. Storylines are the personal use of the cultural context in the situation.

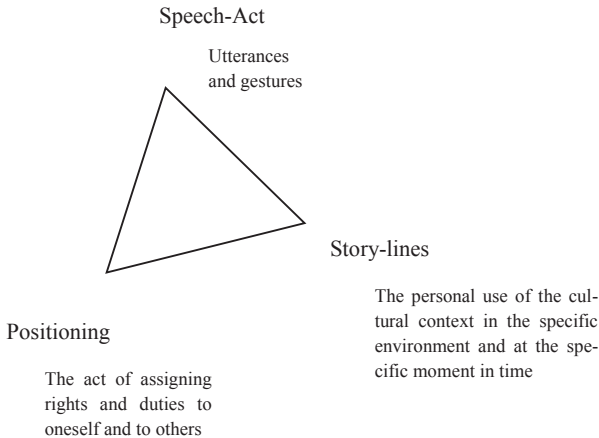


Figure 2. The tri-polar structure of positioning theory based on van Langenhove and Harré (1999).

Brinkmann (2010) provides an illustrative example of storylines: ‘Sometimes participants in some social episodes disagree on which storyline is unfolding. If a man is opening a door for a woman, the man may interpret the event according to a storyline of gentlemanship and civility, whereas the woman may interpret the event as one involving male chauvinism that positions the woman as weak and in need of male protection.’ In the present investigation the general cultural context was the local research environment that the supervisors and PhD student belong to, but with their different scientific backgrounds there are still discrepancies between the storylines, as they each take for given that their individual scientific background is common ground. The strength of using positions as a concept is that it allows a focus on the relations between the individual and the cultural context at an appropriate level of detail. Positions can be assigned and negotiated from moment to moment, challenged and changed, as the conversation unfolds in a storyline.

Methods

The supervision session took place half a year into the PhD study, while interviews took place four months after the PhD student had graduated. The supervision session concerned methodologies to be employed in a study at the interface between landscape architecture design and storm water management, and included the PhD student, her principal supervisor (Sup A) and two co-supervisors (Sup B and C). Only two of the three supervisors were subsequently interviewed (Sup A and B),

since the third (Sup C) had taken up a new position in a different country.

The first author was present as an observer at the supervision session and conducted the interviews, and both the session and interviews were audio-recorded to provide *verbatim* transcripts. The supervision session was analysed using positioning theory, through descriptive coding, positional coding and creation of storylines (van Langenhove & Harré, 1999). The three concepts of speech-act, positions and storylines are mutually determining, and storylines were identified from combining the descriptive coding with the positional coding.

The interviews followed an interview guide as described by Kvale and Brinkmann (2009). The interviews were conducted after the transcript of the supervision session had been analysed, and the interviewees got the opportunity to read the analysis before the interviews. Hereby we included the respondents in the interpretation, and thus we established a discourse in the interview as a means to prepare respondents and to reduce the power distance in the interview situation, as described by Kvale (2006). The time lapse between the supervision session and the interviews means that respondents see the supervisory process in retrospect and they put the specific session into the context of the overall supervisory process. Interviews were analysed thematically (Braun & Clarke, 2006) with a focus on supervision with multiple supervisors. Quotes from interviews were translated from Danish to English by the first author, while the observed supervision was carried out in English. English was the second language of all involved.

This study design provides the opportunity to analyse the dynamics of an interaction, and then put this interaction into the context of the overall PhD study as experienced by the PhD student and her supervisors.

Findings and Discussion

Interaction in the supervision session. The most prevalent theme emerging from the descriptive coding was discussion of the research approach suggested for the PhD study and subsequent analysis was focused on this. Through initial discussions the supervisors and the PhD student defined the objective of the research as ‘the process of developing a physical element for storm water management’. The discussion then revolved around the approach to be taken in the research. A lot of the discussion took place between the supervisors who had different opinions about what they perceived as sound scientific methods, what would be publishable in refereed journals, and whether the PhD student should be a distant observer or involve herself directly in the process of developing the element. The PhD student most frequently appears as the listener uttering acknowledgements like ‘yes’. However, she also positioned herself as someone who can make decisions and give suggestions to her supervisors.

In the beginning she replied hesitantly to her supervisor's questions, although still positioning herself as someone with an opinion:

Sup C: *It's interesting, and it is also the question, because is it really the focus of your PhD? Someone who wants to study planning processes, so I think it is very good, but is it really what you want to do?*

PhD: *yeah, no, I don't want to get into all this planning process... I don't know...*

Later she takes a more firm stand, and gets support from the co-supervisor, who had otherwise been critical to the participatory approach:

PhD: *If I really be part of it, and be part of the design process, then I will gain knowledge from it, very much, I guess. Because then I really involøe myself. So, if I only see other people working, then I am not really able to see why did they decide to change the [element] this way, so I think I have to be involved, so*

Sup B: *I think so too, yeah, ...you will definitely learn a lot, and you need to go into the process.*

By the end of discussions she positions herself as someone who can even make suggestions to her supervisors:

Sup A: *That's what I meant for you, [name], ... you should also point out: where is your starting point, ... What is the theory about participation or not participation in a process*

PhD: *yeah, yeah, but at the moment I already started to trying to find out... I am always talking about this research by design. This approach of doing research while you are working on something. And that, that's the way I think I have to look at it. And then, there is this book I am reading at the moment about it, and there is this group at [other institution] talking about this. They are more designers, but then, in a way, I think I am more a designer myself, so*

Sup A: *Good*

Sup B: *yeah,*

PhD: *that's what I am trying to do then, ... but then I think, then I would need your support, and discussing about this matter, because I cannot decide on my own this one, and then you may also have to read an article...*
 [quotes from supervision session]

She takes more charge as the session unfolds, and ends up suggesting that they read an article. The supervisors, for their part, position themselves with the authority to challenge the PhD student, to question her focus and project ideas, and also with the right to support her ideas. They appear to exercise their power in the relation by accepting her suggestions explicitly, 'allowing' her to proceed.

Supervisor B, with a natural science background, was especially concerned about getting publishable results and that good research was objective and so argued that the researcher should distance herself from the object of research. The principal supervisor from landscape architecture saw research as an iterative process where the researcher is inevitably involved in the design process. They talked from these two different understandings, and two different storylines stood out from the transcript:

1. When following the formal 'scientific method' the researcher must distance herself from the object of research
2. Research in landscape architecture is an iterative process, where the researcher is involved in the design process

The two storylines are evident throughout the interaction as parallel references, such as supervisor B stating '*You don't want to get involved anyway*' [laughing], taking as given that direct researcher involvement is not scientifically sound. The principal supervisor (A) thinks along the lines of a participatory project and has suggestions like: '*I think that it is very important that there is a group [...] where [name] can meet*'. At one point the two understandings are confronted in discussion as conflicting perspectives. Supervisor B in particular refers to the first storyline, while the principal supervisor (A) refers to the second storyline:

Sup B: Then you are becoming part of the decision making process. And you would not be observing what is going on, in fact

Sup A: OK, but I am not sure about that, because we are the ones who are following the process, and we should be observing, but then we should also have a role in terms of solving the problems in the project group, that might be lack of knowledge, it could be that they disagree, or it could be facilitative...

Sup B: But we might have a problem, scientifically, if we want to make a paper stating 'how is a planning process being performed in a municipality' if we are actually very strongly interfering with that process. Then the general value of the paper is very limited

Sup C: Yes, but I think this type of research can also ... Where you reflect on your own input and see how it is used in the process ...

[quoted from supervision session]

The two different understandings of 'good research' stand out in this dialogue as diverging voices in Dysthe's terms, while in the preceding interaction they were underlying references, taken for given by each of the supervisors who thus seemed to be playing by different rules of the game, as different storylines. According to Dysthe et al. (2006) the tensions between the diverging perspectives create a potential for new understanding. The PhD student is confronted with the accommodation of the different methodological approaches in building her own understanding of 'good research'. As the PhD student constructs her own understanding from the multi-voicedness of the supervision, the supervisors' diverging voices are processed by the PhD student as an inner dialogue. If this works according to Dysthe's perceptions, the involvement of multiple supervisors would enrich the learning environment with a higher learning potential. This will be further explored through the analysis of interviews below.

Interviews. As described above, the interviews were conducted 4 years after the supervision session was observed and recorded, and the interviewees had the opportunity of reading the preliminary analysis of the session before the interviews. This means that they had time to reflect on issues of dialogical supervision, power relations and multiple perspectives in supervision before the interviews took place. They recognized the themes and found the analysis relevant.

The interviews revealed how supervisors and PhD student (now PhD graduate) experienced the session and the process differently. The principal supervisor recognized the description of dialogical supervision, whilst the PhD graduate remembered the session as very confusing:

There was a holiday where I was very worried... They talked like, the four of us sat around the table, and they talked a lot, and I was just listening, and in the end I came out and didn't really know what I was going to do and not do, because there wasn't agreement about what I should and could do... [PhD graduate].

It was confirmed in the interview that it was this specific session she recalled. However, when talking about the overall process, the PhD graduate appreciated the diversity among her supervisors.

I think it has given me a good understanding of what science is. That there is not one right way to do research, but therefore different opinions on the same subject are needed, and all you need to do is to take conscious decisions about it, and then you are a good researcher. That's what I learned from the process. To really see the diversity [PhD graduate].

She explains that her three supervisors had very different perceptions of what good research is, and that it took some time for her to figure out that there was not one research plan.

And it took some time for me to notice that, because when you enter, then you think that this is a close relationship, they have employed me, and they agree on what they want to do and what that PhD should look like, and then it takes half a year or so until you notice, oh, I can actually choose between three different directions to do this [PhD graduate].

This specific session stood out in her memory four years after it took place. Whilst the session itself had put her into a period of confusion and worry, her later reflections on the overall process of PhD studies and supervision support the findings by Dysthe et al. (2006) that diverging perspectives created learning potential. It might well be that the diverging voices of the supervisors would have been confusing had they remained implicit storylines, but as they are confronted in the dialogue as conflicting understandings of 'good research', they are made visible and become alternative approaches to consider. In the interaction the utterances of a supervisor would be authoritative given the power relations between a supervisor and a PhD student. For the PhD student to be able to accommodate the supervisors' diverging and authoritative voices they need to leave room for the PhD student to use them constructively in her own inner dialogue, as inner persuasive voices in Bakhtin's terms (Dysthe et al., 2006). For this to work the supervisors need to signal that they are ready to adjust their views. The co-supervisor B does this very explicitly in stating '*I am not an expert in this. I can just see that there is a dilemma that we have to be aware about*'.

To the principal supervisor (A) the supervision session was not really different from a typical group research meeting among colleagues, where an agreement will be reached through discussion. The co-supervisor (B) perceives the PhD student as very independent:

[Name] is a very independent student. So, she can maintain her position, and say 'Now I decide that I will do like this', and then she takes what she needs from each of us [...] presenting herself as a real colleague, an equal partner [Co-supervisor B]

This perception of the power relations is in contrast to the way the PhD graduate experienced the interaction with her supervisors. To her, it was important to have them all present at the supervision sessions, so that they would balance out each other. As she puts it:

...sometimes, because they were all very busy, I met with just one of them, but that was not a very good idea. [...] if I only used one, then I might go in the wrong direction, because that supervisor was not kept back by the other supervisor [PhD graduate]

She found it difficult as a PhD student, to argue against an experienced researcher in a higher position and with a strong opinion. When they were all present they would counterbalance each other and she would not be pulled in any one direction. Here, internal power relations between supervisors come into play, similar to what Manathunga (2012) found in her study of team supervision.

The principal supervisor connects the dialogical supervision with the type of research they engage in:

...another less independent PhD student would maybe suffer in such discussive work environment, right? Then they just want to be told what to do. But that is a trait we do not possess, it doesn't work well as a creative landscape architect [Principal supervisor]

He believes that individuals who do not thrive in this work environment choose a different path, like more natural or technical sciences. The co-supervisor, being involved in a number of interdisciplinary research projects, prefers PhD students who 'take fewer notes' and throw themselves into the discussions, preferably from the outset, but she also realises that it is a matter of maturing as a researcher. To the PhD graduate, this is a learning process and it takes time to build confidence to engage in discussions with supervisors.

...that demands perhaps also that the PhD student also is capable of saying yes and no to different.. different methods and different ideas. When you build up your own position and you are strong enough to maintain your stance when the supervisor isn't of the same opinion as you are. That is something you need to learn. It is clearly not something you do when you have just started your PhD study. [PhD graduate]

The analysis of the supervision session and the interviews shows how the PhD student needed to relate to her three supervisors with different viewpoints and different understandings of 'good research', and defend her views within the game of power relations she perceived. The interview with the PhD student revealed that she was actually confused after the meeting, so confused that it stands out in her memory three years later. But also that it was around this time that she started noticing that she had alternative research approaches to choose between. The analysis tells us

something about the quality of the diverging or conflicting voices as learning potential: They need to be explicit diverging perspectives rather than implicit conflicting storylines, where each supervisor simply takes their own understanding for granted as common ground. As stated by Davies and Harré (1990) 'In making choices between contradictory demands there is a complex weaving together of the positions [...] that are available within any number of discourses, the emotional meaning attached to each of those positions [...] and the moral system that legitimates the choices that are being made' (p. 59). Here, the moral system includes the expectation that a PhD student will consider the advice given by her supervisors. Her ability to benefit from the learning potential of the diverging voices was influenced by the power relations in play, also the power relations between supervisors and their commitment to reach agreement. When the storylines turn into conflicting views and the supervisors realize their disagreement they adjust their opinions in order to make it possible to reach an agreement. The interview indicates that the PhD student found the disagreement more problematic than the supervisors, who believed that she was fully capable of taking her own decisions. The contrasting perceptions of power relations could be an obstacle, as supervisors might be less attentive to her subordinate position. To her, the power relations changed over time as she became familiar with research in the field, and at some point she became the expert.

Concluding

Joint supervision with multiple supervisors and diverging voices created learning opportunities for the PhD student in this case. Findings from a single qualitative study cannot be conclusive, but our analysis of the supervision session and subsequent interviews point in the same direction as other studies by e.g. Lillejord and Dysthe (2008), Dysthe et al. (2006) and Guerin et al. (2011), that supervision with multiple supervisors and diverging voices and perspectives enables the student to create their own understanding. This study shows how this may happen as a result of conflicting storylines.

The use of positioning theory enabled us to go beyond the static roles such as the critical and the supportive supervisor, and show how competing storylines developed into conflicting voices. The interviews revealed how the supervisors and their PhD student perceived the power relations differently, and how this influences their interaction.

Joint supervision is a pressing theme in supervisor development and the issue of balance needs to be discussed during development activities: Clearly supervisors have to adapt their style to the individual PhD student, but the involvement of multiple supervisors adds another level of complexity. The power relations between the supervisors and the PhD student, as well as between supervisors, have to be consid-

ered for the use of multiple voices to be constructive and develop into inner persuasive voices rather than conflicting authoritative voices.

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Experiencing variation - learning opportunities in doctoral supervision

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Abstract

With this paper we aim to contribute towards a better understanding of learning dynamics in doctoral supervision by analysing how learning opportunities are created in the interaction between supervisors and PhD students, using the notion of experiencing variation as a key for learning. To date research on how PhD students learn to carry out research has been rather limited, especially research based on observations of actual interaction. Empirically, we have based the study on four sessions with four different PhD students and their supervisors, all from life sciences. The supervision sessions were video-recorded to provide for verbatim transcripts that were subsequently analysed. Our results illustrate how supervisors and PhD students create learning opportunities by varying different key aspects of research in their discussions. Better understanding of this mechanism, whereby learning opportunities are created, can help supervisors develop their competences in supervisory pedagogy.

Key words: PhD supervision, interaction, learning dynamics, variation theory, life science

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Introduction

With this paper we aim to contribute to a better understanding of learning dynamics in doctoral supervision by analysing how learning opportunities are created in this interaction. There is an extensive body of literature on doctoral supervision researching many aspects of supervision from the perspective of higher education. Effective supervision is regarded as the spine of doctoral education and among the most important factors for timely and successful completion. The aspect we focus on in this study is how PhD students develop competences in, and understanding of, research. We explore actual supervision sessions with a focus on *content* in a particular discipline, in this instance life sciences, that shifts the focus from higher to science education.

The general perception in higher education literature is that doctoral supervision involves pedagogy and elements of teaching, for example Bruce and Stoodley (2011), Alison Lee and Green (2009) and Manathunga and Goozée (2007). Most research on doctoral supervision is based on interviews, yet relatively few studies analyse actual interaction (Anne Lee, 2008; Alison Lee & Green, 2009). Moreover, most of the literature addresses generic questions that focus on the process rather than exploring how supervisors guide and direct PhD students to acquire specific understanding or build specific competences. There is a limited body of studies that get behind the general terms of guiding and directing. Based on interviews with successful supervisors Manathunga (2005) found that a common strategy is to show PhD students how to write a methods chapter or analyse data, for example. Manathunga and Goozée (2007) found that strategies to develop critical thinking skills include feedback on students' writing, engaging in critical conversations, making assessment criteria explicit, and peer-to-peer collaborative learning. Kiley (2009) suggested that PhD students gain insight through research under 'skilful supervision', where supervisors help candidates recognize the development they go through as novice researchers. Kiley and Mullins (2005) researched the strategies supervisors use to support student development of desirable research skills and attitudes. They found that the supervisors' strategies ranged from

'get rid of unsuitable students' (p. 258), over probing and challenging questions, to broader perceptions of dialogue and communication. Austin (2009) reports on a course where she uses the notion of cognitive apprenticeship in her teaching, helping PhD students learn to "think as scholars" (p. 181). Meyer, Shanahan, and Laughksch (2007) challenged a common assumption they encountered about supervision: "The transmission of the ability to "think like a researcher" in a particular discipline is seen as some indefinable osmotic process that "just happens" in the process of supervisor/ candidate interactions and with the passage of time.' (p. 432). This assumption, though anecdotal, pins down the subject of this paper as we set out to unveil different mechanisms of learning dynamics in doctoral supervision. This is in line with Kiley's suggestion (2009) that future research in this area should include *how* supervisors help students develop their understandings of the nature of research.

This paper aims to address gaps in previous research about supervision and explore how PhD students develop competences in and understanding of conducting research. The focus is on the content of what is said during supervision and exploring how learning opportunities are created for the individual to construct new understandings. Bowden and Marton (1998) point to a fundamental aspect of learning, which they call "its oneness with its object" (p. 281); when we learn – we learn *something*. Further, Marton and Pang (2013) demonstrate how meanings are acquired from experiencing differences against a background of sameness. For a child to learn what a dog is, it is not enough to see many different dogs (experiencing sameness), but to really acquire the concept of dog the child also needs to see other animals and contrast these other animals with dogs (experiencing difference). Marton and Pang (2013) call this the *Variation Theory (of Learning)* (p. 24). We endorse this understanding of how individuals acquire new concepts and understandings, and use the notion of variation in the analysis of actual supervision in this study.

The questions we set out to explore in this study are:

Can we identify opportunities for learning, viewed as opportunities for the individual to construct new understanding, using the notion of variation?

If so, how can these learning opportunities be described and how are they created?

If we can describe how opportunities for learning are created in supervision, then supervisors can intentionally expand learning opportunities by exposing their PhD students to variation.

Methodology

Variation theory has been developed from phenomenography and the basic idea is that the learner can only notice or *discern* what is varied, and experiencing variation provides opportunities for learning (Marton & Booth, 1997). The *space of learning* reflects what it is possible to learn about a specific object of learning in a certain situation, and the space of learning is characterized by the way the critical features of the object of learning are varied in the situation (Marton, Runesson, & Tsui, 2004). When something is varied it comes into *focal awareness* and is noticed in a way that it was not seen before, it is discerned.

In this study we draw on an earlier study of physics group work by Berge (2011) and Ingerman, Berge, and Booth (2009) that studied first year engineering students discussing physics problems in small groups. They found that the students created a *shared space of learning* primarily by themselves. Although the educational context differs from our study, one important aspect is similar in that neither of these two learning situations have a teacher as a main agent knowing ‘the true answer’ and planning the session in detail. In a classroom situation the teacher can plan how to bring out variation of aspects of the object of learning and the *intended objects of learning* can be therefore be spotted (Kullberg, 2010; Marton et al., 2004). In doctoral supervision, although the supervisor might have some idea about intended objects of learning when entering a session objects of learning cannot be planned on beforehand, since the session is co-constructed by all involved. Thus it makes little sense to study the

intended objects of learning, e.g. by interviewing the supervisor before a supervision session. However, what we can identify from observing and recording the session is the *enacted object of learning*, i.e. what it is *possible* to learn from what actually happened.

What is actually learned, *the lived object of learning*, lies beyond the scope of this study as it would require different methods to measure actual learning. As Dysthe (2002) notes, it would be too complex to measure what is learned as a result of a specific supervisory interaction and to isolate that from what is learned in the wider context. Therefore, we are not attempting to answer what is actually learned, nor what should be learned, but what it is possible to learn in the situation. Teaching, and supervision, does not necessarily cause learning to happen, but the right conditions for learning make it *possible* for the learner to learn certain things. In this analysis we are looking for learning opportunities in forms of *variation* of aspects of a phenomenon made visible through the conversation about research. As stated by Marton and Pang (2013) 'one condition for experiencing variation is that there is variation to be experienced' (p38).

Marton and Tsui (2004) have identified four patterns of variation, each describing what varies and what is invariant in a learning situation. These are presented below together with examples of learning what a geometric square is (Fraser & Linder, 2009; Kullberg, 2010):

Recognition of contrasts (to know what a square is, you must discern what it is not, in order to distinguish it - if you vary the angles it is no longer a square)

Generalising across aspects (the concept of a square is invariant, but instances of the concept square varies, e.g. different sizes or colours of squares)

Separating critical aspects. In order to discern certain aspects of a phenomenon, that aspect must vary while others remain invariant (you could vary the length of the sides and show that it is still a square)

Fusing critical aspects (being able to discern several features simultaneously, not just one by one)

Experiencing variation in each of these four patterns constitutes an opportunity for learning, although generalising in itself is not sufficient to learn a new concept as shown by Marton and Pang (2013). Marton et al. (2004) state that ‘separating aspects first and then fusing them together is more efficient than never taking the critical aspects apart’ (p. 17). Simultaneous refers to the learner’s perception, while the experience of variation may be a past experience she has in mind when fusing aspects of a phenomenon (Bussey, Orgill, & Crippen, 2013; Kullberg, 2010; Linder & Fraser, 2009; Marton et al., 2004).

Data collection

In this study we set the boundaries for exploring learning opportunities to the space of scheduled supervision meetings, which are feasible to explore through observation. A total of twelve cases have been observed in the overall study, and this paper reports on four such cases. In selecting the cases for observation we contacted supervisors and PhD students at various departments of life sciences at a major, research intensive Danish university. Life sciences was chosen because the first author has a research degree in that field and has the capabilities of understanding the research sufficiently well to analyse the content of the supervision sessions. The twelve cases were selected aiming to achieve variation in gender, supervisors’ experience, PhD students’ time into PhD studies, and disciplines. The cases selected for the present study were the four sessions with two supervisors present; see Table 1 for description of cases. These were chosen because we want to analyse the same cases in a different study using other perspectives on learning to study the effects of having two supervisors. In this paper we present the deeper analysis of one of the four cases (case 1), while the analyses of the other three cases (2-4) will serve to provide a perspective on the findings of this single case. Case 1 was selected for illustration because we found all four patterns of variation in this case, while the other three cases only had three of four patterns of variation. The supervision sessions were observed by

the first author, and they were video recorded and audio recorded. The audio recordings were transcribed verbatim with the video recordings used as support, and they have been made anonymous.

Table 1: Overview of 4 cases of supervision

Case	Research topic	Months into PhD studies	Topic of supervision session	Length of session
1	Soil fertility, manure treatment	15 months	Protocol for experiment	1 hr 22 min
2	Soil fertility, biogas digestate	5 months	PhD plan (proposal)	1 hr 44 min
3*	Agrohydrology modelling	12 months	Explaining results	1 hr 54 min
4*	Parasitology and environment/climate	18 months	Preparing fieldwork	1 hr 2 min

*Case 3 and 4 were conducted in Danish, and episodes are translated into English by the first author.

The PhD student in case 1 is one year into her PhD study. The PhD student has emailed an agenda and a protocol for an experiment before the meeting. The field of research is plant nutrition and soil fertility, more specifically how soil fertility can be increased with the use of natural fertilizers from manure separation, aiming to increase the amount of soluble phosphorus available for plant uptake. Animal manure (faeces) is used as fertilizer in agriculture and it can be separated into a liquid and a solid fraction. The solids can then be thermally treated into biochar or ash with different properties as fertilizers. The discussion concerns the protocol for an experiment in her research project.

Analytical process

The variation perspective on learning makes it possible to use a theoretical model in analysing the content of the conversation and identify opportunities to experience variation (Linder & Fraser, 2009, p. 279). In the analysis we first looked for variation: critical aspects of a phenomenon, which can be varied. We focused on the parts of the supervision sessions concerning

research, which means that we omitted parts concerning conferences, course work, formalities and logistics, which to a varying degree also took up time. Case 1 and 2 were mainly concerned with the research, and so was case 3, but the latter rather a discussion of variables than variation that expands the space of learning. Especially in case 4 a lot of the conversation concerned logistics in connection with a field trip.

The analytical process started with coding for aspects of phenomena that were brought into focal awareness, and coding for variation of these aspects. In this process we identified two different levels of communication resulting in two different themes that variation was created in and around. The first theme concerned ways of conducting research to produce valid results, while the second theme concerned the values and norms within research in life sciences, the hidden assumptions, what counts, expectations and progress. We have named the two themes

- 1) The content of research and how to produce valid results
- 2) Values and norms in life science research.

An example of content matter could be to understand soil structure, and an example of producing valid results could be the number of measure points necessary to make statistical correlations.

The next step in coding the transcripts was to set boundaries around and identify episodes in the conversation. For each episode we then described the enacted object of learning and the pattern of variation (contrasting, generalising, separating and fusing). This was an iterative process as the pattern of variation depends on how the object of learning is defined: what is in focus and what is the background of sameness (invariant) in the episode (Marton & Pang, 2013).

The final phase was to analyse data from case 2-4 in order to put the results gained from case 1 into a slightly wider context and to validate that case 1 is not unique. In the results section we give

examples of patterns of variation that illustrate learning opportunities for the individual to construct new understanding.

Results

This section is organised in two subsections corresponding to the two themes; the content of research and how to produce valid results, and learning about values and norms in life science research. The first subsection is then divided into another five headings. First we focus on the constitution of variation in order to distinguish between simple variables described in the research, and the variation of aspects of a phenomenon that expands the learning space. From there we move on to describe patterns of variation found in the data, i.e. the four patterns of contrasting, generalising, separating and fusing (Linder & Fraser, 2009; Marton & Tsui, 2004). We use the first case on manure treatment and soil fertility to illustrate and exemplify the specific patterns of variation as all four patterns were present in that case, and then we give examples of the same pattern of variation from the other three cases.

Theme I: The content of research and how to produce valid results

In the analysis we first looked for variation: Critical aspects of a phenomenon that can be varied and that are relevant for theme I – the content of research and how to produce valid results. Our first observation was that a major topic in the conversation was different variables in the research, and how they influence each other:

- | | | |
|-----|-----------------|---|
| 101 | PhD student | ehm, yes, we decided on the one hand we vary the <i>temperature</i> |
| 102 | Main supervisor | yeah, that we want to be a continuous variable |
| 103 | PhD student | yes, so to see what kind of effect this has on <i>extractability of the P</i> |
| 104 | Main supervisor | yeah, yes |
| 105 | PhD student | and on the other hand to take the fresh |

- solids and adjust it to a certain *pH-range*
and to see *changes in P*
- 106 Main supervisor just for the *fresh solid*
- 107 PhD student that's how I understood it

In lines 101 to 105 the PhD student and the main supervisor mention different variables (temperature, extractability of P, pH-range and changes in P) in the research process and how they influence each other. Here they are talking about variables, but we cannot assume that the space of learning is expanded, since the participants refer to variables that they all three seem to understand the relationship between and this is merely repetition of issues discussed earlier. The conversation changes structure in line 106: the main supervisor *questions* a variable and brings thereby this particular variable into focal awareness. It is not obvious to the supervisor that the PhD student should only adjust the pH-range for the fresh solid and not the thermally treated solids. In lines 106-107 the conversation becomes more than merely exchanging information and the space of learning is expanded. This aspect of materials (fresh or thermally treated solids) is not necessarily difficult to discern, but in the example above it cannot be taken for granted in the research process, and this makes it a critical aspect in this particular situation.

Contrasting

Recognition of contrasts was the most common pattern of variation found in the data. In the following episode from the first case the PhD student implicitly contrasts valid results with invalid results by judging that not following the same method would be bad, and this discernment is confirmed by the main supervisor.

- 201 Main supervisor so there you have the problem, of course
- 202 PhD student yes, for the ash I can do a sequential extraction, that's what I was also thinking of [*unclear*] if I save on

- producing ash,
- 203 Main supervisor hmm
- 204 PhD student then I could do it sequentially for the
ash, but then if I don't do it
sequentially for the other material, it's
bad
- 205 Main supervisor that would be terrible

The PhD student contrasts (in line 204) the outcome of not using the same method for the different materials in the experiments: the results will not be comparable and thus the results are not valid. The enacted learning object is the importance of being stringent in methods in order to produce valid results, and it is an opportunity to apprehend a competence. The Main supervisor confirms (in line 305) this recognition of contrast.

Another example of contrasting is seen in the following episode.

- 310 PhD student I'm just a bit, yeah, I don't know, of
course an ash always more or less
mixes, especially if it's wet
- 311 Main supervisor yes
- 312 PhD student but the char and the solids, they are
completely different

The PhD student contrasts ash with biochar and solids with respect to one aspect, how well the material mixes with sand. The enacted learning object here is the properties of the different solids, and it is an opportunity to learn content knowledge. Other examples of contrasting include contrasting types of separators with regards to dry matter content and contrasting temperate and tropical soils with regards to P availability.

Likewise we find examples of contrasting in the other three cases. In case 2 the supervision meeting concerns the PhD plan (proposal) and the experiments within it. Like case 1 this research is about soil fertility and plant nutrition, but using digestate from

biogas. The co-supervisor *contrasts* activated carbon with biochar from manure. “so I am wondering, is this important that, is this biochar, or is it activated carbon. I mean activated carbon is basically just biochar that is activated, so it’s been treated somehow with ... with steam or something else to give it an even higher surface”. By contrasting the two materials with respect to the aspects of treatment and surface area, the co-supervisor opens the opportunity for the PhD student to learn about aspects of biochar. In case 3 the co-supervisor contrasts soil types with regards to sensibility: “so the clay soil is more sensible than the sand soil, right? after all, can’t you say that? I would guess so”. This allows the PhD student to discern critical aspects of soil types.

We find another example of contrasting in the meeting in case 4, which concerns preparations for field work in an African country. The supervisors and the PhD student are going to collect snails that act as vectors for human diseases and compare with collections done by the main supervisor in 1988. The PhD student brings the collection procedures into focus when he asks if he should select waterholes (where the snails are collected) according to the same criteria as the supervisor used back then, to ensure reliable results. He suggests that following the same collection criteria is a critical aspect of reliable results. Then the main supervisor brings another aspect of reliability into focus; the reliability of his own data with respect to types of waterholes. “I never used the information on which waterholes they came from, because I did not trust that... we did not educate each of these guys” [who collected the snails]. Thus the supervisor dismisses the type of waterhole as a critical feature for collection procedures. He is contrasting aspects of reliability, following the same procedure vs. trustworthiness of that level of information, allowing the PhD student to discern the critical aspects of reliability in this situation.

Generalising

The following episode is an example of generalising across aspects.

- 110 Co-supervisor and this is also what you will be using in these experiments?
- 111 PhD student yes, so it's these two fractions both from the decanter centrifuge from [place] and the screw press stuff from [another place]
- 112 Co-supervisor ok
- 113 Main supervisor and then we discussed whether you should also include the biogassified and decanter centrifuged
- 114 PhD student yes
- 115 Main supervisor solids, because then you would have solids that should be as wide ranging in P content as possible
- 116 PhD student yes

In this episode they go through the different samples of solids available for the experiment, and the different sources of solids give different properties of the solids. The enacted object of learning here is the relevance of differences in solids, and it is an opportunity to learn content knowledge. The enacted learning object cannot be solids as such, because there is no opportunity to experience the difference between solids and something that is not a solid like a gas or liquid.

In case 4, the PhD student makes use of contrasting aspects when justifying his choice of mapping ecological zones. First he *contrasts* a map of soil types with FAO's map of crop zones. He brings out the different aspects that can vary in FAO's crop zones, humidity, season, soil type, which he finds more comparable with the biological response he is looking for. The crop zones are more complex in that they reflect the plant's biological response to a number of aspects that are also relevant for the snails' biological response. "because FAO's are defined according to a biological response, you can say, a plant says something about something complex, it says something about humidity and season and soil type and so on. So I used them as, as interpreter, you can say". The enacted object of learning is biological response. By first *contrasting* biological zones with

abiotic zones, and then *generalising* aspects of biological response across crops and snails, the PhD student expands the space of learning using two patterns of variation.

In case 3 the supervisor explains to the PhD student how he views soil structure as a critical aspect of soil types: “You can postulate that we only have two soil types in the world, right? those with structure and those without.” thus *contrasting* soil with and without structure. Then, to help her discern these critical aspects, he brings out variation within the aspect of structure. The supervisor *generalises* across different types of structure with different hydraulic traits, dependent on e.g. macro pores in the soil. Then, rhetorically, he asks her what is important in her research: “where is the story? what is the story you want to tell? Is it about the importance of macro pores versus not having macro pores in the system?” By *generalising* across aspects of structure as well as *contrasting* soil types with and without structure the supervisor enables her to distinguish between essential and irrelevant features: “yes, yes, because that is obvious, because it is not that, which is the principal in this”. This enables her to reduce complexity of her research by using two models only, one model of soil type with and one without structure. The enacted object of learning is soil structure.

Separation

This pattern of variation enables the learner to discern certain aspects of an object of learning from other aspects by varying one aspect at a time while others remain invariant.

The PhD student raises a dilemma she faces. The experiment they decided will take too much time - they need to simplify the experiment but still produce valid results. If following the steps as described in her protocol she should produce solids for the experiment treated thermally at different temperatures ranging from 300 to 800 degrees with intervals of 50 degrees. The co-supervisor had earlier indicated that a high number of treatment points are necessary to make correlates and thus get valid and publishable results.

- 421 Co-supervisor but maybe it's a good idea start out producing ashes and biochar at three hundred, four, five, six, seven, eight, and then if we decide that this is..
- 422 Main supervisor not enough, go back and do the in between
- 423 Co-supervisor ..not enough, and we have enough time, you can do the in between
- 424 Main supervisor that's another way, yeah, of cutting it a little bit short
- 425 Co-supervisor even shorter, we still have one, and then we make the six ones, and then we can choose to do additional ones if it turns out to be really easy to produce biochar and ashes and
- 426 Main supervisor I think that's a good strategy

They discuss consequences of reducing complexity by increasing intervals, reducing temperature range, or reducing number of solids, thus separating different ways of producing valid results. The enacted object of learning is: How to reduce work load but still produce valid results. The co-supervisor explains that he would rather reduce the number of solids than increasing the temperature interval from 50 to 100 degrees. He takes different aspects into account simultaneously (*fusing*) in order to decide a way forward: Number of solids, temperature range and temperature intervals. It is an opportunity to discern and learn scientific thinking.

Fusion

Fusing critical aspects means to bring the separated aspects together again as the example above also showed. In the following episode they discuss which solid to select, since they have decided to reduce the experiment to one solid.

- 501 Main supervisor and it would, but then basically you can say that the most interesting solid to do it all the temperatures for

- would be the one containing the most phosphorus, right?
- 502 PhD student yes, from my perspective, because I want to have a phosphorus fertilizer, yes
- 503 Main supervisor yeah, yeah, but I mean, I mean it is not that interesting to know a small change in availability or solubility of phosphorus if the phosphorus content is anyway very low of course the thing is that in the ash, there may not be that large a difference, because those containing little phosphorus are also containing little ash
- 504 PhD student yes
- 505 Main supervisor and vice versa
- 506 PhD student yeah

When selecting one solid they need to take different aspects of the solids into account simultaneously. The enacted object of learning is criteria for selecting a solid.

In case 3 the PhD student presents data from running a model to predict leaching of pesticides, and together they discuss the data and try to find explanations. In presenting the data the PhD student brings many different aspects into focal awareness, and in between the supervisors ask about or suggest other critical aspects. Well into the conversation (around one hour) the PhD student brings two aspects forward simultaneously, decomposition and depth in the soil, and by *fusing* these two aspects she can explain data: “yes, and then, when it comes slowly [rainfall], then it will be, then it will stay longer in the top soil where decomposition is higher”. Her supervisors acknowledge this and comment on how interesting they find these results.

Theme II: Values and norms in life science research

Another dimension of PhD education is about the PhD student becoming a researcher. At this level the aim is to become a member of the scientific community, to participate in international discussions and collaborations, and this requires an understanding of the values and norms in life science research. While this aspect of becoming a scientist seemingly calls for a sociocultural perspective on learning, our analysis revealed how the notion of variation can also contribute to further the understanding of this learning process. In what follows we present five examples at this level of communication. The examples are in no way exhaustive, some phenomena appeared in more than one case, while some were only found in one of the four cases.

Revealing doubt

The main supervisor in case 1 clarifies how well he has thought through what he says; it can vary and should not be taken for granted: "I'm not saying we should do it, I'm just thinking". Through this meta-communication he is giving variation to how the other participants can understand what he is saying. By thinking aloud so to speak, he allows for the others to engage in discussion and help evaluating new ideas and thoughts. In case 2 we see a similar episode of meta-communication, where the co-supervisor expresses his thoughts and doubts: "I'm not saying we should investigate it, it's just, eh, ...".

The purpose of research

In case 1 the co-supervisor gives relevance to another parameter that he suggested - he was arguing for his case, since the others did not find this parameter relevant: "but at the same time we also want to understand things". He is giving variation to why we are carrying out research, varying reasons for conducting research.

Monitoring progress

The main supervisor in case 1 judges the PhD student's production so far, monitoring progress, by putting the research into the context of PhD studies: "yeah, but that's also more than enough for now". This could also have been too little, opening the possibility of this much being too little or just enough, or more than enough.

In case 3 the main supervisor exemplifies where the PhD student is in the research process by changing the context. "But that corresponds to, if you were in the lab then you would have kind of learned the protocols by now, and the tools... now you know what it takes and how long time you need to estimate if you are going to do this and that..." and he calls this an important milestone. The supervisor brings out variation in progress, generalising across aspects of progress in different settings, and thereby allows the PhD student to identify critical aspects of progress and 'milestones'. In addition to monitoring progress in research this latter example also illustrates how the supervisor gives feedback to the doctoral student on her learning process.

Respecting expertise

The main supervisor in case 1 addresses the co-supervisor with respect: "I trust you in that"... "I am not the one who has worked with the biochar and the ash". Supervisors / researchers have different levels of experience in different specific fields and by bringing this into focal awareness he allows the PhD student to discern levels of expertise. We find the same type of respecting expertise in all four cases. In case 2 the main supervisor says "good, and... now again, this is not so much my field, [name of co-supervisor] but the other question of the influence of any conditioning of the char, I mean". Similarly in case 3 the main supervisor asks the co-supervisor "What do you say, [name of main supervisor], how, you have the experience with this..?" In the same vein of humility, we find an episode in case 4 where the main supervisor refers the PhD student to other people with more expertise. "I can't overview that statistically, because you are using Bayesian statistics, and then, I am not so familiar with that, but you will have to check with, or ask [name] in Switzerland, I do realize that you need to be up front with that". When bringing

the expertise of other people into focal awareness the supervisors vary how much expertise experienced researchers may have, and allow the PhD students to discern aspects of expertise.

The nature of research

In case 2 about the PhD plan (the proposal) they discuss what is doable in a three years' period. The co-supervisor questions whether the fourth objective of the proposal is realistic. The main supervisor contrasts a good thesis with a thesis that "tried to do too much" and ends up only scratching the surface of the research questions. By contrasting, the supervisor creates the opportunity for the PhD student to discern what a good PhD research project is in contrast to what it is not. He continues in saying "So it is a balance how to focus and how to still have some objectives that eh, that are just, because I mean, this is research, this is not a project that you are building a house, so there should be some goals in the end that we didn't fulfil, because otherwise we are targeting too low I think". By contrasting research with a construction project he brings out what research *is not*, and thereby creates the possibility for the PhD student to discern certain critical features of research, like uncertainty and unpredictability and the value of aiming high.

Discussion and conclusions

We have identified and described learning opportunities using the notion of variation, and our results illustrate how learning opportunities are created in the scientific discussion among supervisors and PhD students during supervision. Earlier research reported in higher education literature has been rather vague on the question of how PhD students learn to conduct research. One explanation for this can be that earlier research is mainly based on interviews, and interviewees refer to their practice in more general terms like engaging in conversation, dialogue and communication. By observing actual supervision and analysing transcripts with the use of variation theory our study illustrates just how engaging in conversations can contribute to learning through experiencing variation. Under the first theme, producing valid results, we have identified all four

patterns of variation described by Marton et al. (2004), i.e. contrasting, generalising, separating and fusing. The patterns of variation illustrate the opportunities that the scientific discussions during supervision offer around specific objects of learning by bringing critical aspects of the content of research and of producing valid results into focal awareness and varying dimensions of these aspects. Under the second theme, values and norms in research, our results illustrate how tacit knowledge of the discipline can be acquired by PhD students.

Doctoral supervision resembles the physics group work studied by Ingerman et al. (2009) with supervisors and PhD students as active members in scientific discussions, where supervisors can be in doubt and learn too. Like in physics group work, what is in focus in the discussion is more open than in classroom teaching, and variation is brought about by supervisors and PhD students alike. According to Bussey et al. (2013) separation is not easily found in real life situations, but learning experiences can be set up in classrooms. We do find all patterns of variation in our data, but contrasting is by far the most prevalent pattern. This is not surprising, as it is the fundamental aspect of variation when seeing learning as experiencing differences against a background of invariance (Marton & Pang, 2013).

The four cases we observed were with PhD students at different stages in their PhD studies. We can see from our research that learning opportunities from experiencing variation are created independently of the phases of study with these four cases as exemplars. Scientific discussions happen all the way through, from discussing the proposal and protocols, solving problems in experiments, and interpreting data. While we cannot conclude that all supervision at all stages would have these learning opportunities, the exemplars illustrate the possibility, and this knowledge can be valuable for supervisors to use actively in supervision.

Further, the notion of variation enabled us to identify learning opportunities for the PhD students to discern aspects of values and norms in research that the novice researcher needs to master when becoming a scientist. Research reported to date in this area

has generally used sociocultural perspectives on learning to study this phenomenon. Hopwood (2010a) , Hopwood (2010b), McAlpine and Amundsen (2009) and van Rensburg et al. (2012) focused on identity formation and agency to study how doctoral students become scientists through workplace learning. Kvale (1997) uses the concept of apprenticeship in communities of practice, drawing on Lave and Wenger (1991), to describe how the tacit knowledge of research is learned, seemingly with no need to explicate this tacit knowledge. Gerholm (1990) studied the acquisition of tacit knowledge in academia in Sweden, and he sees access to the 'inner circles' as a prerequisite or facilitator of acquiring the tacit knowledge of the discipline (p. 267). He expects the organisation of research in teams, as seen in the natural sciences, as an efficient way to communicate tacit knowledge. The interaction we analysed in this study can be viewed as the inner circles that Gerholm describes, and our study illustrates the dynamics that he hypothesises. The process of becoming a scientist is associated with taking on and personalising the values and norms of science. The first step in such process is to be able to discern those values and norms. We did not find representations of all the different patterns of variation under the second theme, but we do see how different aspects of values and norms in research are brought into focal awareness and through experiencing variation the PhD student has an opportunity to discern otherwise tacit knowledge.

Bowden and Marton (1998) describe the connection between learning, teaching and research as forming knowledge: teaching contributes to the individual student's learning and research is about finding out new things, new in an absolute sense. Research is about forming pristine knowledge, which makes it a joint learning process between PhD student and supervisors. Not only does a PhD student's research connect with her or his individual learning process to become a researcher, but the PhD student's research is also connected with a *collective learning* process, where the scholarly community and humanity learn. The distinction we make between variation that expands the space of learning and variables in the research reflect these different levels of forming knowledge. Variables in research contribute to the collective

learning process, and variation contributes to the individual's construction of new understanding.

Implications

For future research

A question that emerges from this research is whether, or to what extent, the PhD students take up the learning opportunities available. This lies beyond the scope of this study, as we did not measure the lived learning. However, our results are in line with earlier research conducted by our research group, where we with benefit from position theory have shown how supervision with multiple supervisors has an additional learning potential in that the supervisors have different understandings and opinions (Kobayashi, Grout, & Rump, 2013). There we used the concept *diverging voices* (Dysthe, Samara, & Westrheim, 2006; Lillejord & Dysthe, 2008) to illustrate the tension when the supervisors have different understandings of the same phenomenon and found that diverging voices offer opportunities for the PhD student to construct her own understanding, but also that the supervisors learn from each other. If viewed from the perspective of experiencing variation as the mechanism for learning the concept of diverging voices as well as multiple supervisors are possibilities for greater learning. It seems that both supervisors and PhD students contribute to the creation of learning opportunities. Like in the example of physics group work (Ingerman et al., 2009), supervisors and PhD students engage in dialogues about the research as partners albeit with different levels of experience. This does not necessarily mean that they are equals in the interaction, but variation theory does not give insights into the power relations obviously present in the interaction. Whether a PhD student avails herself to the opportunities depends not only on personal factors, like affective state, but also how supervisors position the PhD student while bringing out variation, what kind of positions the participants take and give each other during the scientific discussions, and how the positioning affects the space of learning. Combining variation theory and a perspective that includes power relations, such as positioning theory, should be a

potentially promising route for further research about supervision.

The use of the notion of variation to analyse actual interaction is a new approach in researching how PhD students can learn about the norms and values of science. This theme is brought to our awareness because we look for variation in the transcripts, and a next natural step would be to expand the data to more supervision sessions in order to validate the issues found in the present study and to enrich the picture with more issues.

For practice

This study expands our understanding of the dynamics of doctoral supervision and contributes to explaining the importance of supervision in doctoral education. This is important both from a supervisor's practice perspective, from the perspective of doctoral education, and from the perspective of educational research. To our knowledge it is the first study of doctoral supervision looking at actual interaction and using the notion of variation from variation theory, so more studies are needed to validate our results, and to test whether the findings can be generalised into the realms of doctoral education in the social sciences and humanities. The wider implications of our study for supervisor development are that supervisors can improve their practice by consciously using variation in scientific discussions as a learning opportunity in doctoral supervision.

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Learning opportunities in joint doctoral supervision - viewed from two perspectives on learning

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Abstract

Supervision is a key factor for satisfaction as well as completion in doctoral education. However, our understanding of how doctoral students learn from supervision is limited; especially little work is reported based on observation of actual supervision. While joint supervision has become widely used, its learning dynamics remains under-researched. This paper aims to address these gaps in research by exploring learning opportunities in doctoral supervision with two supervisors.

The study explores how learning opportunities are linked to levels of participation, and how the tensions in scientific discussion between supervisors can become learning opportunities. We combine two different theoretical perspectives, using participation and positioning theory as a sociocultural perspective and the notion of variation as an individual constructivist perspective on learning. Our findings illustrate the advantages and limitations in using tensions constructively in joint supervision.

Key words

Doctoral supervision; joint supervision; multiple supervisors; interaction; storylines; experiencing variation.

Introduction

The aim of this study is to further the understanding of learning dynamics in joint doctoral supervision. Doctoral supervision is increasingly a shared responsibility among multiple (two or more) supervisors (Hopwood, 2010; Lee & Green, 2009) and thus it becomes increasingly relevant to focus research on these more complex supervisory settings. To our knowledge, only a limited number of studies have focused specifically on multiple

supervisors, including Pole (1998), Dysthe, Samara, and Westrheim (2006), Spooner-Lane et al. (2007), Watts (2010), Guerin and Green (2013), Guerin, Green, and Bastalich (2011), Manathunga (2012), as well as our own research (Authors, 2013). While joint supervision becomes increasingly commonplace it is also questioned. For instance Wellington (2010) warns doctoral students about the difficulties in having two or more supervisors who disagree or contradict each other, or discuss the work of the doctoral student between themselves. However, in earlier research we have shown how supervision with multiple supervisors has a learning potential in that the tension of the diverging voices of the supervisors can create an opportunity for the doctoral student to construct her own understanding (Authors, 2013). Because of the power relations characterizing supervisory relationships it can be a difficult balancing act to create tension that enhance learning opportunities, but avoid tensions that might impair learning.

Studies into doctoral supervision tend to describe supervision in more general terms like ‘guiding’, advising’, or ‘engaging in conversation’ that the supervisors use when reflecting on their own supervision in interviews. Some interview based studies do get behind the general terms of guiding and directing. Manathunga (2005) found that a common strategy reported by supervisors is to *show* students how to for instance write a methods chapter, and Manathunga and Goozée (2007) found that strategies to develop critical thinking skills include feedback on students’ writing, engaging in critical conversations and explicating assessment criteria. Pearson, Cowan, and Liston (2009) describe how supervisors and students create learning opportunities ‘from the ongoing business of doing research’ (p. 108). These include seminars, lab-meetings, solving problems and discussion of data. By observing supervision we aim to uncover how this takes place. A better understanding of the tacit mechanisms in use can help supervisors develop their competences. Thus the question that we explore in this study is

How are learning opportunities created in supervision sessions with multiple supervisors for doctoral students to learn to conduct research?

Learning opportunities

We are interested in how learning *opportunities* are created in joint supervision. Dysthe (2002) argues that measuring actual learning from supervision is infeasible because of the problems in isolating the learning gained from the supervision meeting from learning gained in the surrounding situations. Marton, Runesson, and Tsui (2004) distinguish between intended object of learning (what we should learn), enacted object of learning (what it is possible to learn) and lived object of learning (what is actually learned). What we can identify from analysing actual supervision is the enacted object of learning, what it is possible to learn about a particular object of learning in a certain setting. The enacted object of learning is the researchers' (our) description of the learning opportunities.

Two perspectives on learning

The research question we have posed points to a broad object of learning (to conduct research) as well as the interpersonal question of multiple supervisors, and here we need to take two different perspectives on learning: an individual constructivist perspective and a sociocultural perspective. The sociocultural perspective is concerned with how interaction leads to development of the individual and the community, but is not concerned with the individual act of learning. The individual constructivist perspective is concerned with how knowledge is constructed as a result of the learner's action, but is not concerned with interpersonal relations (Packer & Goicoechea, 2000; Sfard, 1998). Marton et al. (2004) argue that the structure of learning cannot be separated from the content – 'learning is always the acquired knowledge of something' (p. 4), and therefore we need to analyse the content of the conversation. To be able to say anything about the effect of involving multiple supervisors we also need to analyse the social interaction in supervision. Similarly Dysthe (2002) analysed the learning potential of the multiple voices in a web-mediated discussion by analysing both the interactional patterns and the development of the content.

This leads to two specific research questions:

- (1) What patterns of interaction can be identified at different levels of participation, and how does this relate to learning potentials when seeing learning as participation?
- (2) When considering the delicate balance of using tension constructively in the light of the power relations in play, what can supervisors do to strike the right balance?

Methodology

This study takes a case study approach in observing four supervision sessions. The four cases (A-D) are all from the same faculty of life sciences in a research intensive university in Denmark and all are supervision meetings with a doctoral student, a main supervisor and a co-supervisor.

The study first applies a coarse grained analysis of participation (Lave & Wenger, 1991) to analyse supervision sessions from a sociocultural perspective to answer the first question. As for the second question we select an episode that can illustrate this balancing act and analyse it from two perspectives using the notion of variation (Marton & Tsui, 2004) as well as positioning theory (Harré & van Langenhove, 1999). Our choice of analytical approaches is inspired by work by Berge, who studied group work in university physics education using positioning theory and the notion of variation from phenomenography to analyse how students learn (Berge, 2011).

The individual constructivist perspective

When taking the individual constructivist perspective on learning we focus on the content and the doctoral student's opportunities to engage with the content. We use the notion of variation to explore learning opportunities emerging from the interaction in supervision meetings. When something is varied it comes into *focal awareness* and is noticed in a way that it was not seen before, it

is discerned. The fundamental argument in this theory is that the learner can only discern what is varied, and experiencing variation provides opportunities for learning. Further, variation can only be experienced against a background of invariance (Marton & Pang, 2013; Marton & Tsui, 2004).

In doctoral supervision the supervisors may have intended learning objects in mind when entering supervision, but because supervision is co-constructed to a much higher degree than classroom teaching, and because it concerns an unpredictable process of research, supervisors cannot plan the supervision to an extent where they define each intended object of learning and plan how to vary aspects of phenomena against a background of invariance. However, as researchers we can observe and describe the learning opportunities as enacted objects of learning co-created in the interaction.

The sociocultural perspective

From the sociocultural perspective we first make a coarse grained analysis of the interaction for levels of participation (Lave & Wenger, 1991). Learning as participation is a process of becoming, so it is associated with building one's identity in a certain community of practice, collectively shaped within this community of practice and mutually shaping the community of practice. Supervision sessions can offer opportunities to train the use of the scientific language by engaging in scientific discussions, but also observing other scientists (supervisors) in scientific discussions.

We use positioning theory for a fine grained analysis of a selected episode to explore how the interaction affects opportunities for learning. Positioning theory was originally developed as an alternative to the concept of roles (Davies & Harré, 1990). While roles are static and formal, and something we 'take on', the dynamic concept of positioning enables us to focus on the mutuality between the individual and the social context. The cultural meanings are produced and understood through the processes of discursive practice. Who we are as individuals varies with time and with the multitude of arenas we occupy, dependent

on the discursive practices we participate in and the positions available within those discursive practices. In terms of learning opportunities for doctoral students the supervision sessions offer specific discursive practices that they can observe and engage in and thereby expand their multiplicity of selves or fluid identities that ultimately contribute to their identity as scientists (Davies & Harré, 1990; Harré & van Langenhove, 1999).

Positioning theory is typically applied as a research framework to analyse face-to-face conversations, where the participants actively construct meaning through utterances and gestures within the norms given by the social setting. Conversations are viewed as a tri-polar structure of (1) *acts*, (2) *positioning* and (3) *storylines* (van Langenhove & Harré, 1999).

(1) An *act* in positioning theory is a meaningful social action. In a conversation every utterance or gesture is an attempt to communicate meaning, and an utterance becomes a *speech-act* only to the extent that it is taken up by others as such (Davies & Harré, 1990). The action of a handshake becomes an act when it is attributed social meaning as a farewell, a congratulation or otherwise (Harré & Moghaddam, 2003). An utterance can be interpreted differently depending on the positions of the speaker and the hearer, and there is a tight interrelationship between acts and positions.

(2) *Positioning* is the act of assigning rights and duties to oneself and to others to perform significant, intentional acts. Positions can be assigned and negotiated from moment to moment, challenged and changed, as the conversation unfolds in a storyline. Positions are both relatively determined by and determining the unfolding storyline and the social forces in play.

(3) *Storylines* are the personal use of the cultural context in the situation. In an episode the actors may refer to more than one storyline, and these storylines may be contradictory. The identification of positioning and storylines is an iterative process of engaging with the data, as the three concepts of act, positions and storylines are mutually determining.

Data collection

In selecting the cases for this study we contacted doctoral students and supervisors at a faculty of life sciences at a major Danish university. Life sciences was selected because the first author has a degree in that field and therefore has the capabilities of understanding the research sufficiently well to analyse the supervision sessions in terms of variation in content. A total of twelve cases have been observed in the overall study, and this paper reports on the four cases with two supervisors present simultaneously. The supervision sessions were observed by the first author, and video and audio recorded. The audio recordings were transcribed verbatim with the video recordings used as support, and the transcripts have been made anonymous.

Analytical procedure


First transcripts were coded for participation, using arrow diagrams to indicate interaction as described by Dyshe (2002). The focus in this coarse grained analysis is on interaction patterns and the extent of engagement with others. Next, an episode was selected on the basis that it could illustrate the delicate balance of using tension constructively. This episode was then analysed using the fine grained methods from positioning theory and variation theory.

Results

Learning as participation

When seeing learning opportunities through the coarser grained analysis of participation we identified a number of interaction patterns at different levels of participation, as presented in Table 1 below. The levels of participation represent different types of dialogue of varying complexity, which makes them qualitatively different. The prevalence of the patterns of interaction in the four cases is shown in Table 2.

Table 1. Interaction patterns at different levels of participation

Participation by	Interaction pattern	Complexity
Mainly Doctoral student	Doctoral student presenting	Lower
 All	Dealing with clarifying questions	Highest
	Engaging in dialogue	
	Engaging in common discussion	
	Supervisor supplementing	
Mainly supervisor	Supervisor thinks aloud	Lower

The *doctoral student presenting* something is mainly one-way communication with the supervisors signalling that they are listening through gestures and expressions like ‘hmm’. It is an opportunity to practice, but as long as there is no guidance or scaffolding involved from the supervisors’ side we must assume that the development of the individual lies in the practice and recognition by self and others as capable of performing this practice.

Dealing with clarifying questions involves challenges and scaffolding. The supervisors ask questions that need responses and this is an encouragement to engage actively.

Engaging in dialogue and *engaging in discussion* both imply active participation and engagement. This is a more equal interaction than dealing with clarifying questions in that both the supervisor(s) and the doctoral student ask questions. It is an evocation of the doctoral student’s capabilities to engage in the activities of the community of practice. This might equally be a learning opportunity for the supervisors as for the doctoral student.

When the *supervisor supplements* the doctoral student this is a way of scaffolding his/her presentation. Following Vygotsky's conception of development the individual must try to accomplish a task and if unable to complete, then the more skilled member of the group supplements the efforts with instruction, guidance or hands-on showing. It is a delicate balance of just enough for her to continue, or so abundant that it becomes taking over. The latter can still be a learning opportunity, though, as an opportunity to observe.

Direction and advice from the supervisor is mainly one-way communication with little active engagement from the part of the doctoral student in the situation. However, if the setting of activities is extended to her work beyond the meeting, this is guidance that creates learning opportunities in her continued work.

Supervisors' internal dialogue does not engage the doctoral student directly and is therefore less complex and demanding, but still a learning opportunity as it provides the doctoral student with an opportunity to observe the norms and language of the community of practice.

Supervisor thinks aloud is also an opportunity to observe practice, for instance the practice of scientific reasoning, with the same qualities and limitations as 'the supervisor supplements' and 'supervisors' internal dialogue'.

Some of these situations can be found in all supervision, but some require two or more supervisors present. Engaging in common discussion, as opposed to engaging in dialogue, needs a second supervisor, but apart from being more complex it may not differ much from the dialogue situation. Supervisor supplementing demands that there is a situation to be supplemented, like the doctoral student presenting to the co-supervisor. And lastly, Supervisors' internal dialogue requires more than one supervisor.

Table 2. Prevalence of patterns of interaction at different levels of participation. Patterns in bold are more prevalent while empty boxes imply absence of pattern.

Case	A	B	C	D
Months into PhD	5	15	12	18
Main topic	PhD plan (proposal)	Protocol for experiments	Interpreting data	Preparing fieldwork
Patterns of interaction	Presenting	Presenting	Presenting	Presenting
	Clarifying questions	Clarifying questions	Clarifying questions	Clarifying questions
		Dialogue	Dialogue	Dialogue
		Common discussion	Common discussion	Common discussion
	Supervisor supplementing	Supervisor supplementing	Supervisor supplementing	Supervisor supplementing
	Direction, advice	Direction, advice	Direction, advice	Direction, advice
	Supervisors' dialogue	Supervisors' dialogue		
			Thinking aloud	

The finer grained analyses

We have selected an episode from case A. The main supervisor is closely engaged in the research of the doctoral student, who presents aspects of the project to the co-supervisor. The research topic is the use of adsorbents to increase soil fertility. In agriculture, clinoptilolite (a mineral) and biochar can be used to adsorb (bind to the surface) plant nutrients for later release. The main supervisor supplements the doctoral student in presenting and in answering clarifying questions from the co-supervisor. At times it turns into dialogue between supervisors, where the doctoral student is mostly listening, as the selected episode illustrates (Figure 1).

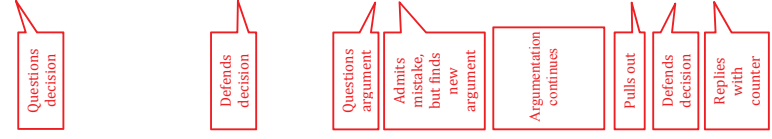
The notion of variation

The opportunities for constructing knowledge in this episode are defined by the space of learning, what it is possible to learn about a specific enacted object of learning. The enacted object of learning here is artificial adsorbents as they are contrasted with natural adsorbents. The background of invariance is adsorbents. The space of learning is expanded when aspects of artificial adsorbents are brought into focal awareness and varied as shown in Figure 1. While artificial adsorbents are (perhaps) more efficient, they are not recognized for use in agriculture and the natural adsorbents are expected to be cheaper. In turns 195 to 204 the aspect of degradability of different artificial adsorbents are contrasted as being persistent or quickly degrading. When the aspects are evaluated against each other in turn 208 it becomes apparent that all aspects must be taken into account simultaneously to make a judgement, but the contrasting of each aspect separately enables the learning that is necessary to make the judgement. The contrasting at different levels expands the space of learning about artificial adsorbents, and the scientific discussion opens opportunities to learn content knowledge. Further expansion of the learning space would require more aspects of the object of learning to be varied in a systematic manner. Whether the doctoral student avails herself to this learning opportunity depends not only on personal factors but

Three storylines



Tensions

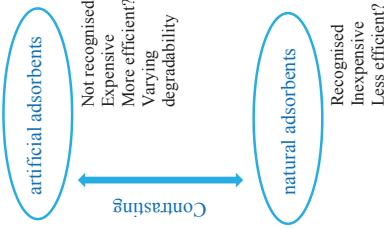


Episode

- 187 Co-supervisor
- 188 Main supervisor
- 189 Doctoral student
- 190 Main supervisor
- 191 Co-supervisor
- 192 Main supervisor
- 193 Co-supervisor
- 194 Main supervisor
- 195 Co-supervisor
- 196 Main supervisor
- 197 Co-supervisor
- 198 Main supervisor
- 199 Co-supervisor
- 200 Main supervisor
- 201 Co-supervisor
- 202 Main supervisor
- 203 Co-supervisor
- 204 Main supervisor
- 205 Co-supervisor
- 206 Main supervisor
- 207 Doctoral student
- 208 Main supervisor
- 209 Doctoral student

will you say something about, eh... artificial adsorbents are not relevant [reading from notes]
 yeah, that was one of the, I can't remember who asked the question, but, I think it was [name] who said, well, why
 yeah
 why use biochar and clinoptilolite, there are lots of chemical adsorption material, I mean materials used for adsorption in industrial processes, why not use that. (...) clearly we came to the conclusion that if it is an artificial material, you would not be interested in applying it. I mean you may be able to recover nutrients, but you would never apply it to soil (...)
 but what if
 point one, it's too expensive, and it would probably be difficult to get it recognized for application to soil, whereas natural material like clinoptilolite or biochar would be easier.
 yeah, probably
 but of course/
 but it could be, I mean it's mineralized once it is in the soil, and then well that depends on what kind of material it is
 yeah... does it?
 no, not, of course not, but if you have some sort of organic, persistent organic chemical, you would not be interested in applying that to the soil
 no, but if you could find something which is degrading quickly in the soil
 hmhm, yeah, of course it could be a
 or you could degrade it already before you apply it, so you just can't use it to concentrate the
 hmhm yeah, that's true
 then you, yeah, you can either combust it, or you can, yeah, there are lots of
 yeah, of other options
 yeah, but I'm not saying we should investigate it, it's just, eh,
 yeah
 yeah it's an idea but probably it should be more expensive than natural materials
 yeah, but, again, if it was a material which was much more efficient, then the cost may not be higher, depends,
 true

Experiencing variation



Enacted learning object
 Relevance of artificial adsorbents
 The space of learning is expanded when artificial and natural adsorbents are contrasted, and when aspects of artificial adsorbents are varied.

Legend
 Blue: Notion of variation
 Red: Tensions in interaction

Figure 1. Fine grained analyses of a selected episode using variation theory and positioning theory

also on the level of participation and how she is positioned in the interaction as described below.

Positioning theory

We find three intertwining storylines in this episode. One is ‘the responsible supervisor’, which runs through the entire session, and is about the main supervisor giving guidance, direction and support to the doctoral student. The second storyline we call ‘scientific argument’, where scientists discuss in the true spirit of science, critically searching counter arguments that could question their research. As described by Handal and Lauvås (2006) this is ideally a conversation between equal partners (or with reduced asymmetry), the conversation concerns a topic of mutual interest, and the aim is to reach new apprehension. In this type of scientific dialogue the best argument wins (pp. 106-107). The third storyline is ‘maintaining good relations between supervisors’, which reflects the complexity of the interactions.

In the selected episode the two supervisors discuss the scientific relevance of testing artificial material for the adsorption of nutrients. The co-supervisor picks on a point from the notes from a previous meeting, and questions the conclusion, while the main supervisor defends the conclusion. The co-supervisor buys his argument, but in turn 194 the main supervisor reopens the discussion, and here a new storyline of ‘maintaining good relations between supervisors’ may be in play. From turn 195 to 204 the two supervisors discuss in the true spirit of science, following the ‘scientific argument’-storyline. Then, using meta-communication in turn 205 the co-supervisor comments on the purpose of his exploring alternatives: it is not to insist on testing artificial material instead of natural materials. So, if the storyline holds, the purpose might be to search for counter-arguments of the conclusion to make sure that their research can stand criticism. When the doctoral student in turn 207 uses the argument of her main supervisor to stick to natural adsorbents, the main supervisor responds to her with the counter-argument, following the ‘scientific argument’-storyline and maybe also the ‘maintaining good relations between supervisors’-storyline. In the preceding episodes a dominating storyline was ‘the responsible

supervisor’, signifying that the main supervisor is very observant in guiding and supporting the doctoral student in presenting. This storyline may still prevail in the head of the doctoral student when she finally joins the discussion, and she may have expected that her supervisor would adhere to the ‘responsible supervisor’-storyline, and support her. Alternatively she may have felt included in the discussion on equal terms and recognised as a scientist when the main supervisor responds to her with a counter-argument.

Discussion

The co-supervisor starts the ‘scientific argument’ in the selected episode, and this pattern is seen repeatedly in cases A and B. The ‘Scientific argument’-storyline frequently appears in the internal dialogues between supervisors in these two cases, and in these episodes the tensions deriving from diverging voices of the supervisors are opportunities for the doctoral student to observe how to interact and reason in science. The presence of the co-supervisor seems to increase opportunities for scientific discussion, and the doctoral students are included to a varying extent. Scientific discussions are piece and parcel of science, and an opportunity to take part is a learning opportunity. In the analysis of the four cases we have identified frequent and rich opportunities to learn from the scientific discussion as the content is experienced in patterns of variation that expand the space of learning (Authors, forthcoming). From the sociocultural perspective the doctoral student can position herself as a (novice) scientist contributing to the scientific reasoning, and when the supervisors respond to her contributions she can feel included and recognized as a scientist. The selected episode is a learning opportunity in the sense that the doctoral student can observe scientific argumentation (and experience the variation), and just being present in the discursive practice is an opportunity to learn. However, the supervisors do not distribute rights to her to contribute, they do not invite her into the discussions, and in that sense the episode can also be viewed as a missed opportunity.

We cannot know which storylines were actually in play in that situation, but all three storylines are plausible, and discussing

them is important because of the power relations involved and the consequences for the learning opportunities that each interpretation might offer. The supervisors can also not be sure of the storylines in play in the mind of the doctoral student, and only meta-communication in the situation can bring that out in the open.

If we assume that the storylines hold, then the supervisor positions the doctoral student as mistaken, and she may feel corrected and let down. This may discourage her from joining in and thereby it becomes a missed learning opportunity. It may also influence her self-efficacy beliefs and her affective state negatively, and thereby conditions for learning can become impaired. Meta-communication about the scientific discussion could be helpful in this situation, and a similar episode in the session was finalised by the main supervisor stating that 'this discussion is also relevant because...' and advising her how to use it in her proposal. In the selected episode the co-supervisor actually does start meta-communicating about why he took up this discussion, but the sentence was not finished. An alternative unfolding could be that the main supervisor picks up on the meta-communication and continues in saying something along the lines 'yes, it's good to have these scientific discussions even if we do not change the research plan'. This way he would acknowledge the contribution from the co-supervisor and maintain good relations, and he would increase the possibilities for the doctoral student to learn about the function of the discussion as second order learning.

The third storyline of 'maintaining good relations between supervisors' reflects the complexity of more supervisors being involved as there are more interests to take into consideration for all involved. This is one of the issues raised in criticism of allocating multiple supervisors. However, this is also the case in research groups discussing their research, and as such it makes the supervision more authentic as a community of practice and hence it prepares the doctoral student better for practice. And in terms of participation, complexity may be seen to provide more opportunities for learning.

Judging from the low level of participation by the doctoral student in the selected episode, such internal discussions between supervisors would not be expected to offer great learning opportunities. In an interview from our overall study a doctoral student was asked what she gains from having two supervisors discussing among themselves, and she responded that she gained a lot. 'Just being there while more experienced people discuss something I think always helps in the beginning just... just from listening...', 'that just gives you a more... I think more complex idea of the subject.' In Pearson et al. (2009) an example of a situated learning opportunity is participation in seminars. Their respondent explained that 'I didn't actively participate, but it was useful for me to watch the process, and over time I started to pick it up' (p. 106). Green (2009) emphasises the importance of participating in seminars as a powerful means to learn: 'It is for students a matter of often watching and learning how to be, how to interact and intervene' (p. 244). However, supervision with multiple supervisors offers an array of further opportunities for the supervisors to support, scaffold and challenge the doctoral student. They can include the doctoral students in discussion, or let her lean back and watch, depending on the situation. Observation of practice can be useful before actual engagement, but supervisors should be observant about including the doctoral student at some point to encourage active engagement. Contrary to the advice given by Wellington (2010) there might be more potential in listening to others discussing than would be expected from such low level of active engagement. Guerin et al. (2011) conclude that disagreement is beneficial as long as the supervisors are committed to reach agreement. Supervisors who aim to use the tensions of scientific arguments constructively should be wary of the power positions they are in. They must agree that the aim of supervision is to create a space for the doctoral student to learn, and leave aside any internal rivalry they may have.

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