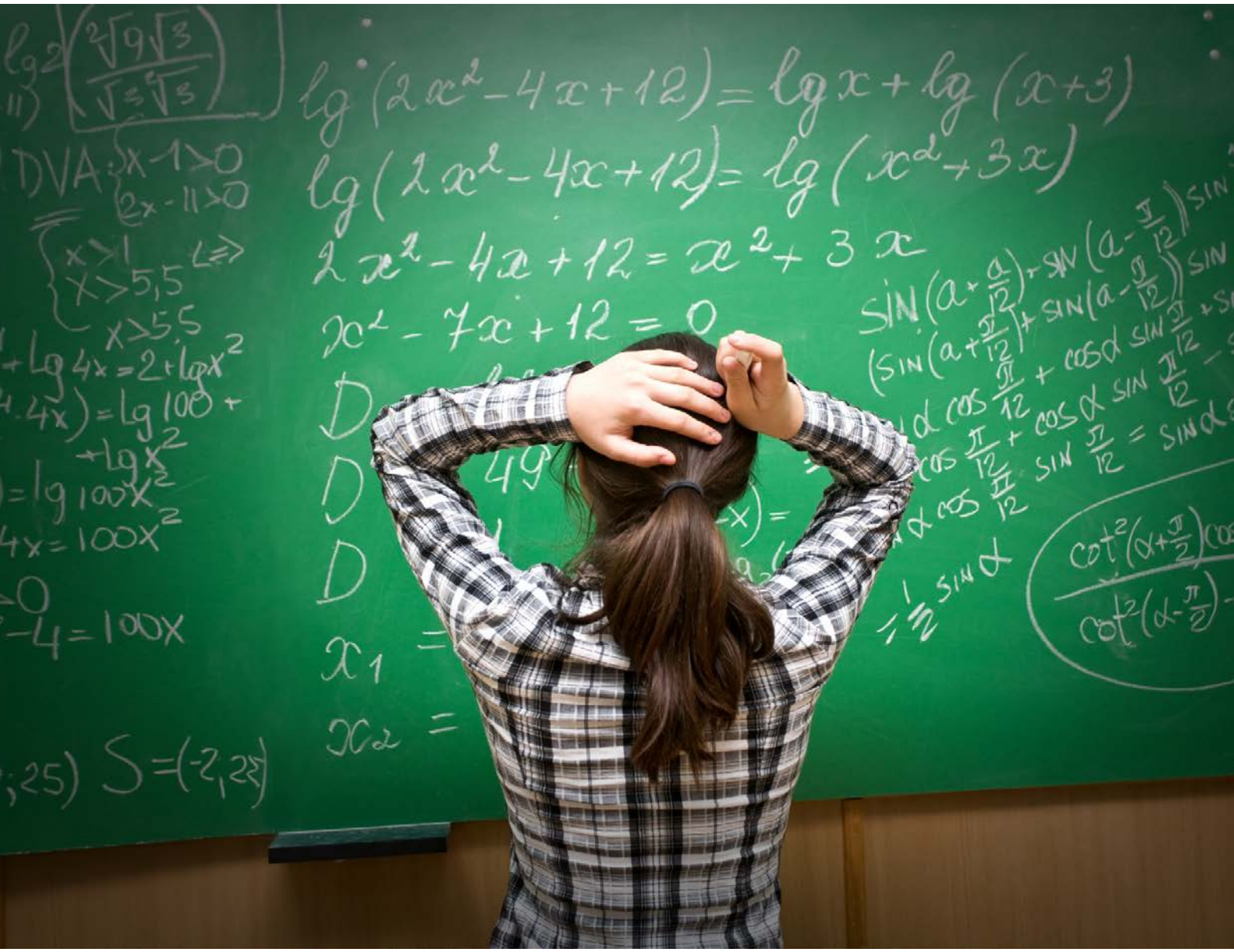
Being a Science Student

Motivational aspects of study elements related to the first year of tertiary studies

Nadia Rahbek Dyrberg

PhD Dissertation – September 2017



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Nadia Rahbek Dyrberg

PhD Dissertation - September 14, 2016
Supervisor: Claus Michelsen

Laboratory for Coherent Education and Learning,
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Nadia Rahbek Dyrberg

Preface

The present dissertation marks the conclusion of three years of PhD education. Throughout my research process, I have been privileged to be fully autonomous with regard to the choice of themes, subjects, and approaches. My research was conducted at the Faculty of Science, University of Southern Denmark (SDU) – it includes the students, content of the courses, structure of the study programmes, the study environment, etc. Having had no firm restrictions, I was free to follow arising opportunities. Consequently, during these three years of research (and work at the Faculty Secretariat) my attention has changed from a sole focus on first year students to a focus including older students as well.

With a Master's degree in biomedicine from SDU, I had first-hand knowledge of both structure and content of the study programmes at the Faculty of Science. Having most of my social circle from these study programmes as well, I continuously got input and inspirations for research paths to follow. During both my Master's and doctoral studies I have been highly engaged in the Danish Youth Association for Science (UNF - Ungdommens Naturvidenskabelige Forening) doing volunteer work with the aim of increasing young peoples' interest in the fields of natural, health, and technical sciences. I have witnessed how volunteering students often end up in PhD positions and/or are employed in different student or full-time positions in which they utilise competences obtained through their volunteering experience. Therefore, the possible benefits of being a volunteer worker at the university or being otherwise engaged (e.g. student employment) in the study environment have been of special interest to me.

My journey from a life science discipline to the field of science education has been influenced by my experiences with the biomedicine study programme. Among other things the study programme included a multidisciplinary first year of studies which was common to most of the science programmes at SDU. I felt that there was room for improvement in relation to both the teaching and the structure of study programmes. For example, I ran across many students who struggled motivationally; they struggled understanding the relevance of individual courses, struggled passing courses, and struggled to get confirmation that they had enrolled in the 'right' study programme. As evidenced through my research, these motivational struggles also exist today – both at SDU and at other universities.

During my Master studies I developed an interest for teaching and communicating science. I enrolled in a science communication profile, I taught molecular biology and biochemistry to medicine students as a teaching assistant, and I participated

in the development and execution of multiple science camps both as a student employee and as a volunteer worker. For my Master thesis I got the opportunity to evaluate the use of clickers (audience response systems) in a large enrolment first year course. Through that I got a taste of science education as a research field, and I was lucky to get a position at the Faculty Secretariat where I could be even more involved in the educational development of the science programmes. I especially worked with implementation, continuous evaluation, and development of the Three Phase Model (the teaching and learning model at the Faculty of Science) and the Study Group Concept. The latter of which became central to my doctoral research.

Acknowledgements

I wish to give thanks to all the people supporting me through the process of my PhD education and research. First, thanks to my supervisor Claus Michelsen for always believing in me - he has never dismissed an idea and always offered to shield me. Also thanks to the rest of LSUL (Laboratory for Coherent Education and Learning). Especially thanks to Linda Ahrenkiel for introducing me to the field of science education and communication. We have shared our environmental change, ideas, frustrations, and stress of upcoming deadlines. Both Linda and Morten Rask Petersen have provided constructive feedback on my dissertation.

Camilla Gundlach Kromann has been my closest colleague, my partner in crime, and my faithful supporter. Though (or perhaps because) she is my exact opposite in almost all personality traits, she has consistently challenged and validated my ideas, reflections, approaches, and writings as well as provided a boost of self-confidence when needed. The others at the Faculty Secretariat also deserve special thanks for sharing great interest in my project (and in me). Thanks for letting me make use of all your individual talents – especially, Anne Christiansen who continuously has been proof reading my material. Also thanks to Eva Sophia Myers for making the project possible in the first place.

Thanks to Knut Neumann and his group at IPN (Leibniz Institute for Science and Mathematics Education, Kiel University) and to the people at IND (Department of Science Education, Copenhagen University) for taking my in. Especially, thanks to Henriette Tolstrup Holmegaard. She provided valuable input to my research and co-authored a paper with me. She has taken time from her busy schedule to discuss the narrative of my dissertation.

Thanks to all the students who participated in my studies – especially, the study group mentors and the first year students enrolled in the fall of 2014. They have served as my primary test subjects and have received multiple questionnaires.

Thanks to family, friends, and co-volunteers in UNF for raising my aspirations and supporting me throughout the process. Thanks to Sören Möller for expert advice on statistics. And finally, thanks to Henrik Egemose Schmidt for support through ups and downs and for his willingness to discuss my project at home. He has followed me through the whole process – he was a respondent in my Master studies before I knew him and now he is my best friend and future husband.

Nadia Rahbek Dyrberg

Abstract

High drop-out rates in higher education combined with an expected shortage of STEM graduates cause concern throughout Europe. In Denmark, this challenge is especially critical and 'student success' in terms of completion rates and time-to-degree is high on the political agenda. When trying to understand why some students choose to leave their studies while others stay, knowledge of students' motivation is essential – *without motivation, persistence is unlikely* (Tinto, 2016). Specific elements contributing to the overall student experience must be investigated in order to understand how these study elements support and/or challenge students' motivation. With a predominantly quantitative research approach, study elements related to the first year of tertiary science studies at the University of Southern Denmark (SDU) are investigated within a theoretical framework of motivation. The five contributing papers examine a broad sample of study elements ranging from concrete courses to the study environment. The papers concern both first year and older students. The papers involving first year students investigate their encounter with a first year of studies characterised by large-enrolment courses, study groups with affiliated mentors (the Study Group Concept), and a project-based research course (the First Year Project). The findings suggest that students struggle motivationally when their courses are perceived irrelevant and it is revealed that the motivational patterns towards learning in the same courses differ among students from different study programmes. It is problematized that first year teachers must respond to a wide range of motivations when teaching large-enrolment courses followed by students from multiple disciplines. The First Year Project is an example of a course able to embrace students' varying motivation and successfully foster students' sense of competence, autonomy, and relatedness as well as subjective task value. Similar positive experiences are reported on the Study Group Concept. The papers involving older, more experienced students revolve around the possible benefits of being employed in a student position e.g. as a study group mentor with regard to development of competences, network, and sense of university belonging. All of these seem to be positively affected and this can potentially induce even better students. Educational institutions are encouraged to include these positive side-effects on mentors and not just the mentees in the equation when considering which initiatives to implement. Joined together the papers contribute to the research fields of motivation and of 'first year experience' with both theoretically founded knowledge of students' motivation and practice-oriented knowledge in the form of two concrete, implementable examples of initiatives able to foster motivation: the First Year Project and the Study Group Concept.

Danish Abstract

Højt frafald på universitetsuddannelser kombineret med forventet mangel på STEM-uddannede kandidater vækker bekymring i Europa. Danmark er særligt hårdt ramt af disse udfordringer, og studerendes succes i form af gennemførsels-rater og -tid rangerer højt på den politiske dagsorden. Viden om studerendes motivation er essentiel for at forstå, hvorfor nogle studerende vælger at droppe ud af deres påbegyndte studier mens andre bliver – *uden motivation er fastholdelse usandsynlig* (Tinto, 2016). Elementer, der bidrager til studieoplevelsen, må undersøges for at skabe forståelse for, hvordan de enkelte studieelementer enten understøtter eller udfordrer de studerendes motivation. Denne afhandling sætter fokus på studieelementer relateret til første studieår på naturvidenskabelige uddannelser på Syddansk Universitet (SDU) og undersøger disse i en motivation-teoretisk ramme og med en overvejende kvantitativ tilgang. De fem bidragende artikler dækker et bredt udsnit af studieelementer – fra konkrete kurser til det omgivende studiemiljø. Artiklerne omhandler både førsteårs- og ældre studerende. De artikler, som omhandler førsteårsstuderende, undersøger mødet med et første studieår, der blandt andet er karakteriseret af store kurser fulgt af studerende fra flere studieretninger, studiegrupper med tilknyttede studiegruppevejledere (Studiegruppekonceptet) og et projektbaseret 'forsknings'-kursus (Førsteårsprojektet). Resultaterne viser, at de studerendes motivation for at lære udfordres, når de studerende ikke forstår relevansen af deres kurser, og at studerende fra forskellige studieretninger udviser forskellige motivationsmønstre over for kurserne. Det problematiseres, at undervisere på store kurser, fulgt af flere studieretninger samtidigt, skal forholde sig til så bredt et motivations-spektrum. Førsteårsprojektet udgør et eksempel på et kursus, der formår at favne de studerendes motivation og understøtte deres følelse af kompetence, autonomi, og tilhørsforhold såvel som en positiv opfattelse af kursets værdi. Lignende positive oplevelser rapporteres omkring Studiegruppekonceptet. Artiklerne omhandlende ældre og mere erfarne studerende centrerer sig om mulige udbytter ved studenter-ansættelse fx som studiegruppevejleder. Tilsyneladende medvirker studenteransættelser til udvikling af kompetencer, øget netværk og forhøjet tilhørsforhold, hvilket kan føre til endnu bedre studerende. Uddannelsesinstitutioner opfordres til at inkludere disse positive sideeffekter i beslutninger vedrørende igangsættelse af initiativer målrettet yngre studerende. Tilsammen bidrager artiklerne til forskningsfelterne inden for motivation og 'førsteårspædagogik'. Bidragene består i viden om studerendes motivation såvel som praksiseksempler på to initiativer: Førsteårsprojektet og Studiegruppe-konceptet, der formår at understøtte studerende motivation.

List of Publications

The list below presents the publications which have been published during the PhD education period: September 2013 - September 2016 or are in preparation by the end of the period. An asterisk (*) marks the papers that are included in this dissertation.

Journal articles (peer reviewed)

International journals

*Dyrberg, N.R. & Holmegaard, H.T. (2016). Motivational Patterns in STEM Education: A self-determination perspective on first year courses. *Manuscript in review for International Journal of Science Education.*

*Dyrberg, N.R. (2016). Supporting Students' Motivation in Large Enrolment Courses – A case study of the First Year Project. *Manuscript in preparation.*

*Dyrberg, N.R. & Michelsen, C. (2016). Mentoring First Year Study Groups: Benefits from the mentors' perspective. *Manuscript in review for European Journal of Science and Mathematics Education.*

*Dyrberg, N.R. (2016). University Belonging: Relation between students' sense of belonging and being a student employee at the university. *Manuscript in review for Educational Psychology.*

Dyrberg, N.R., Treusch, A.H., & Wiegand, C. (2016). Virtual Laboratories in Science Education - Students' motivation and experiences in two tertiary biology courses. *Accepted for publication in Journal of Biological Education.*

National journals

*Dyrberg, N.R., Michelsen, C., & Kromann, C.G. (2015). Studiegrupper og Studiegruppevejledere på Naturvidenskabelige Universitetsuddannelser [Study Groups and Study Group Mentors at Tertiary Science Programmes]. *Matematik- og Naturfagsdidaktik (MONA)*, 4, 44-64.

Michelsen, C. & Dyrberg, N.R. (2014). Trefasemodellen – Didaktisk planlægning af lokalprogression [The Three Phase Model – Didactical planning of local progression]. *Dansk Universitetspædagogisk Tidsskrift (DUT)*, 9:16, 18-30.

Dyrberg, N.R. (2014). Clickers – Forbedring af traditionelle forelæsninger? [Clickers – Improvement of traditional lectures?]. *Matematik- og Naturfagsdidaktik (MONA)*, 2, 22-41.

Conference contributions (peer reviewed)

Dyrberg, N.R. (2016). The Motivational Consequences of the Multidisciplinary Structure of the First Year in Science Education. Presentation no 62. *European First Year Experience (EFYE) Conference 2016.* Ghent, Belgium.

Dyrberg, N.R. (2014). Participation in the Community of Scientific Practice – Motivational aspects of project work in large enrolment classes. Poster no 25. *Society of Research into Higher Education (SRHE) Newer Researchers Conference 2014*. South Wales, United Kingdom.

Treusch, A.H., Wiegand, C., & Dyrberg, N.R. (2015). The Use of Virtual Laboratories as Preparation for and Supplement to Real Laboratory Exercises. Presentation no SC 5-2. *Teaching for Active Learning (TAL) Conference 2015.* Odense, Denmark.

Michelsen, C., Dyrberg, N.R., & Hansen, S.S. (2014). Feedback på Studiekompetence – Studiestartsopgaven [Feedback on Study Competence – The study start assignment]. In R. Troelsen (red.), *Proceedings fra Konference om Prøveformer, Feedback og Læring: 18. november 2013 på Syddansk Universitet.* No 23. Odense: University of Southern Denmark.

Dyrberg, N.R. & Kromann, C.G. (2014). Ældre Studerende som Facilatorer og Rollemodeller i Studiestarten [Older Students as Facilitators and Role Models in the Study Start]. Presentation no 9. *Dansk Universitetspædagogisk Netværk (DUN) Conference 2014*. Svendborg, Denmark.

Dyrberg, N.R. (2014). Clickers – Besvarelsesredskab til løbende elevevaluering [Clickers – Response tool for ongoing student assessment]. Presentation in track 1. *BIG BANG Conference 2014.* Vejle, Denmark.

Reports (non-peer reviewed)

Dyrberg, N.R. & Kromann, C. G. (2015). *Studiestartsevaluering 2014* [Study start evaluation 2014]. Odense: Faculty of Science, University of Southern Denmark.

Dyrberg, N.R. & Kromann, C. G. (2014). *Studiestartsevaluering 2013* [Study start evaluation 2013]. Odense: Faculty of Science, University of Southern Denmark.

Dyrberg, N.R. & Michelsen, C. (2013). *Evaluering af Førsteåret: Studieåret 2012-2013* [Evaluation of the First Year: The academic year 2012-2013]. Odense: Faculty of Science, University of Southern Denmark.

Keywords and Acronyms

Academic study start	Academic activities during the study start
BMB	Biochemistry and Molecular Biology, a study programme at the Faculty of Science, SDU
EFYE	European First Year Experience, annual conference
GPA	Grade point average. Often used as indicator of student achievement
Science student	Student enrolled in a tertiary science programme
SDU	University of Southern Denmark
Social study start	Social activities during the study start
Social tutors	Older students responsible for the social study start
STEM	Science, Technology, Engineering, and Mathematics
Student employment	Position at the university held by a student e.g. teaching assistant and study group mentor
Study Group Concept	Concept with (mandatory) study group and associated study group mentors at the first year of science programmes at SDU
Study group mentors	Older students facilitating first year students' group work at the first year of science programmes at SDU
Study start	The period where induction activities take place. At the science faculty, SDU, the study start is considered to be from the first day of the first semester to the end of first semester with a gradual decline in activities
SU	State education grant
Teaching assistants	Older students handling teaching in laboratory and class exercises
Three Phase Model	Model for teaching and learning at the Faculty of Science, SDU

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PART 1: INTRODUCTION AND THEORY

1 Introduction

The present dissertation takes its starting point in two prominent and interrelated European challenges: high drop-out rates in higher education (OECD, 2008) and expected shortage of STEM (science, technology, engineering, and mathematics) graduates (Business Europe, 2011; European Commission, 2004; Harrison, 2012). The Europe 2020 strategy goal of having at least 40% of 30-34-year-olds complete a higher education makes drop-out and completion rates a priority issue throughout Europe. A recent report concluded that 75% of the reviewed countries had 'student success' on their policy agenda (Vossensteyn et al., 2015). Student success is conceptualised in terms of completion rates, performance, and time-to-degree and Denmark was categorised as a high-prioritising country. In Denmark, the percentage of today's young people expected to obtain a bachelor's or equivalent degree is 52% compared to the OECD average of 36% (OECD, 2015). Despite extensive research on the reasons for drop-out, major challenges still exist, and STEM disciplines are among the disciplines with the highest drop-out rates (OECD, 2008).

Regarding the shortage of STEM graduates, voices have been raised to question the justification of the general call for more STEM graduates (e.g. Osborne & Dillon, 2008). A recent report concluded that on the overall level the supply of expected graduates actually matches the expected demand (Shapiro, Østergaard, & Hougaard, 2015). However, there are two issues of concern. First, a notable portion of STEM graduates end up in *non-core STEM sectors*. Secondly, the report points to significant regional mismatches, and Denmark is one of these mismatched regions. The Danish Ministry for Children, Education and Gender Equality (UddannelsesGuiden, 2016) confirms this; in 2020, the ministry expects a shortage of 500 graduates within the fields of especially physics, mathematics, and computer science. The problem will be especially evident in the upper secondary teaching work force where many science teachers are expected to retire within the next few years (UddannelsesGuiden, 2016).

Research on the above indicated challenges has mainly been addressed with two overall objectives: increasing the number of students entering STEM programmes and decreasing attrition rates among students already enrolled – the latter is the focus of this dissertation. Examples of larger projects with these goals are IRIS: Interest and Recruitment in Science (Henriksen, Dillon, & Ryder, 2015), ASPIRES: Science and Career Aspirations (ASPIRES, 2013), readySTEMgo (Pinxten, De Laet, Van Soom, & Langie, 2015), and ROSE: The Relevance of Science Education

(Sjøberg & Schreiner, 2012). In order to understand students' choice processes, a longitudinal sub-study in the IRIS project analysed a group of STEM interested students' considerations and narratives about choosing a STEM programme (Holmegaard, Madsen, & Ulriksen, 2014a). However, the topic also proved to be highly relevant in order to understand why some students choose to leave their studies; it was suggested that the choice of study programme is an on-going process that is continuously being renegotiated well into the first years of studies. Especially, if students do not feel that the study programmes live up to their expectations, they consider leaving their chosen programme and enter another educational path (Holmegaard et al., 2014a). In an analysis of drop-out in relation to the Danish national culture Troelsen and Laursen (2014) came to a similar conclusion:

> *"It is important for Danish students – and more so than for their European peers – that their study programme lives up to their intrinsic motivational expectations. If not, they drop out."* (p. 494)

Within the fields of retention and attrition, Vincent Tinto's model of student departure (1987) has guided many studies. The model marked the beginning of change from viewing attrition as a result of students' inadequacies towards viewing it as a result of students' social and academic experiences at their educational institution. Mediated by prior attributions (goals, beliefs, etc.) these experiences lead to a level of social and academic integration which primes the decision of either staying or leaving the study programme. In support of this notion and within the context of STEM education, Seymour and Hewitt (1997) concluded that the structure of the educational experiences (e.g. pedagogy, content, and sequence of courses in the study programmes) and the culture of the disciplines made greater contributions to students' decision to leave than the students' individual shortfalls. In a key note at the 'European First Year Experience' (EFYE) conference 2016, Tinto pointed to motivation as perhaps the most important psychological construct to investigate when trying to understand why some students decide to leave their studies:

> *"From the students' perspective, persistence can be understood as but one form of motivation. Students have to want to persist and do so even when faced with the challenges they sometimes encounter. Without motivation, persistence is unlikely."* (Tinto, 2016, p. 156)

The construct of motivation is in itself wide-ranging; student motivation is shaped by a number of factors of which Tinto declare *self-efficacy, sense of belonging, and perceptions of the value of the curriculum* as the most notable (2016, p. 156).

Although mediated by students' personal attributions, the motivational constructs are shaped by the experiences the students have at their study programmes and in the study environment. Thus, the educational institutions have the potential to either foster or hamper a positive development of students' motivation.

In congruence with the above, main parts of the research presented in this dissertation focus on students' encounter with their tertiary science programme (papers I, II, and III). Specifically, the research involves first year students and focuses on formalised teaching and learning activities. This focus is continuously called for by Tinto (2006; 2012; 2016) who describes the first year classrooms as 'ports of entry' to the academic and social communities of the university. Tinto argues that potentially the classroom is the most potent place to prevent attrition. The line of reasoning is that many students will not participate in out-of-class activities because of external obligations such as work or family; the only place to reach these students is in the classroom (Tinto, 2012).

Increasingly more attention is payed to studies in first year experience, and researchers have shown that the first year of studies is indeed critical to student success in higher education (Bonne & Nutt, 2016). The presentations at the annual EFYE conference reflect the focus areas for first year initiatives throughout Europe. Within the general objective of increasing retention and supporting student progression, these initiatives often address student engagement, sense of belonging, and peer mentoring (Bonne & Nutt, 2016). Thus, a common feature of many first year initiatives is the use of older, experienced students to mentor or tutor first year students. The mentees' benefits from such initiatives are well-established and include e.g. increased motivation and achievement (Altus, 2015; Bordes & Arredondo, 2005; Skaniakos, Penttinen, & Laira, 2014). But researching benefits from the mentors' perspective are interesting as well. Studies have found associations between students' level of voluntary involvement in the study environment and their sense of belonging (Hurtado & Carter, 1997; Strayhorn, 2012) as well as positive changes in learning strategies and social skills (Arco-Tirado, Fernandez-Martin, & Fernandez-Balboa, 2011). Papers IV and V of this dissertation investigate if formal employment in a student position at the university is associated with similar (motivational) benefits.

Based on the above it becomes clear that in order to hinder drop-out, attention must be drawn to students' meeting with their study programme in general, and in particular how students' motivation is supported and challenged in relation to specific study elements. Understanding which aspects of the student experience foster motivation will be essential for the development of a study environment

and a curriculum design that provides the best possible conditions to retain students.

1.1 Aim of study

It is evident that fostering students' motivation is essential to prevent drop-out. It is also clear that the first year plays an important role in the positive development of important motivational factors. Therefore, the overarching aim of the research presented in this dissertation is to:

> *Contribute to the understanding of how social and academic experiences associated with the first year of studies affect students' motivation to study tertiary science.*

The field of understanding how study experiences affect students is multifarious and vastly complex; a single person's doctoral research cannot begin to come to a full understanding. However, knowledge of study elements that are able to foster students' motivation composes essential pieces in the puzzle of how to prevent student drop-out. With a focus on first year associated experiences in a Danish science context, the dissertation seeks to make such contributions to the existing pool of knowledge.

The selected study elements constitute a small sample of what students will experience or have the opportunity to experience while *being a science student* at the Faculty of Science, University of Southern Denmark (SDU). These experiences are shared by the students following the same study programme and the same courses. Therefore it makes sense to investigate groups of students collectively in order to understand how their motivation is supported and challenged when they meet their study programme.

The contributing papers provide input to the scholarly discussions from students' perspectives and at different levels of the study experience; from concrete courses (papers I and II) to the overall structure of study programmes (papers I, III, and IV) and the surrounding study environment (paper V). Furthermore, the dissertation provides two concrete examples of study elements from which others can take inspiration: the First Year Project (paper II) and the Study Group Concept (papers III and IV).

1.2 Limiting the scope

The studies constituting this dissertation take up several both prominent and persistent themes in the research fields of 'first year experience' and motivation. However, many other focus areas could have been included and strong limitations of the scope have been necessary. First, a focus on students' experiences was chosen. This encompassed a selection of students' perspectives and a deselection of the perspectives of first year teachers and the educational institution. Within the student perspective, both first year students and older students involved in the first year of studies were chosen.

Secondly, the studies focus on factors which the institution can influence: the students' educational experiences when meeting their tertiary science programme. Other underlying factors such as prior experiences and socio-economic background also affect students' motivation to study tertiary science. However, these factors are outside the control of the institution and therefore beyond the scope of this dissertation. Such background variables are not included in the studies. Thirdly, rather than focusing on the overall student experience, four concrete study elements were chosen for investigation leading to five papers. Figure 1 provides an overview of focus areas and the resulting papers contributing to this dissertation. A short introductory description of each paper is presented in the following section (1.2.1).

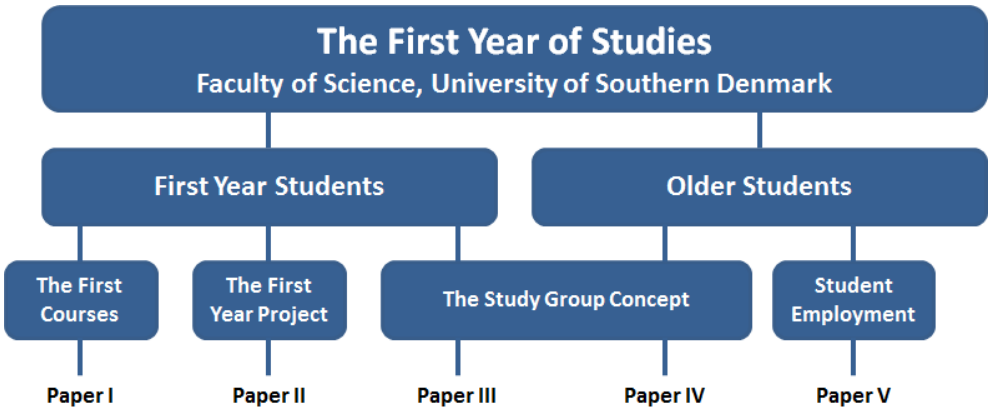

Figure 1 Overview of focus areas and the resulting papers contributing to this dissertation.

The study elements in focus largely correspond to the focus areas of the educational development at the Faculty of Science, SDU. An educational development process was kick-started in 2011 and resulted in the implementation of a new structure of the first year of science studies and a new model for teaching and learning: the Three Phase Model which includes the Study Group Concept. Details on the developmental work are provided in section 4.3.

1.2.1 The contributing papers

As indicated in Figure 1, the contributing papers are not part of one extensive coherent study; rather, they are individual studies that address different topics. However, the studies are interconnected through common features: I) all participating students are enrolled at the Faculty of Science, SDU, II) all investigated topics have a relation to the first year of studies, and III) all studies are based on students' self-reported attitudes and experiences.

Paper I	Investigates first year students' experiences with and motivation towards learning in their first university courses.
Paper II	Reports on the First Year Project – a course common to all first year Science students at SDU. The objective is to foster students' needs satisfaction and a positive task value.
Paper III	Evaluates first year students' experiences with the Study Group Concept at the Faculty of Science, SDU. Secondarily, the study group mentors' perspectives are included as well.
Paper IV	Also concerns the topic of the Study Group Concept but with a sole and more detailed focus on the experiences of the older students employed as study group mentors.
Paper V	Investigates sense of belonging to the university among third year and older students and compares employed students to non-employed students.

The dissertation provides a point of departure to understand the coherence across the papers; it forms a cape embedding the papers in a general introduction and discussion with respect to the overall challenge of retaining students in tertiary science programmes.

The papers, that were selected to constitute the dissertation, were chosen in order to represent the width of the conducted research. Three of the papers (I, II, and V) are the results of a descriptive research approach; data collections were guided by theory, and I, as a researcher had not been directly involved in the phenomena under investigation.

The other two papers (III and IV) are the results of an approach characterised as evaluation and action research. The two papers centre on the same topic, the Study Group Concept, and are closely related. In the dual role of both practitioner and researcher, I have been highly involved in the Study Group Concept and many hours have been spent on evaluation and development of this concept during my doctoral studies. Therefore, in order to be true to my overall research process, I chose to include these two papers in the dissertation.

Other studies than the ones included in this dissertation have also been conducted. Two of these studies are touched on and presented as paper outlines. Data for these studies have been collected and awaits thorough analysis. Joined together the contributing papers and the paper outlines demonstrate the width of the research which has been conducted during the three years of PhD education.

Other studies, that has been conducted alongside the work presented in this dissertation, are described in Dyrberg (2014), Michelsen and Dyrberg (2014), and Dyrberg, Treusch, and Wiegand (2016).

1.3 Structure of the dissertation

The present dissertation presents key elements of the research which has been conducted during three years of doctoral studies. The dissertation is centred on five papers which constitute the result section of the dissertation. Aside from presenting the research findings, the dissertation presents the overall background and context, methodology, theoretical framework, and a general discussion of the studies that constitute the contributing papers. The dissertation is structured in three parts:

Part 1	Introduction and Theory
Part 2	Research Background and Design
Part 3	Contributing Parts

In the first part, chapter 1 sets the stage with a framing of the problem and a presentation of the overarching aim. In chapter 2 a literature review provides an overview of state of the art research within the field of first year experience and motivation. A theoretical framework constitutes chapter 3. The second part describes the conducted studies with a presentation of background and context in chapter 4, and methodological design in chapter 5. The third part forms the core of the dissertation with the contributing papers in chapter 6, two additional paper outlines in chapter 7, a general discussion in chapter 8, and concluding remarks in chapter 9. The remainder constitutes the reference list and appendices.

It is important to note that the contributing papers are largely independent and can be read as such. The papers appear with their own layout, numbering of figures and tables, and reference lists.

2 Research on First Year Experience

The research topics and theoretical approaches relevant to investigating higher education in relation to the ultimate goal of reducing attrition constitute a broad spectrum of possible focus areas. The width of themes is evident in the present dissertation and multiple theories and research fields have been touched upon when appropriate. This implicates that a thorough review of literature within each field is rendered infeasible during the course of this dissertation and will not be conducted here. However, each contributing paper draws on appropriate literature within the topic specific to that paper.

The present chapter will address a feature common to all the contributing papers: the first year of studies. The first year is pertinent either directly with investigation of first year students or indirectly by investigating older students involved with the first year. As the research takes the students' perspective, it is their experiences which are in focus. Another recurring theme in the contributing papers is motivation; motivational theories that have guided main parts of the conducted research. Therefore, the literature review in section 2.2 is performed with delimitation to the themes of both first year students and motivation. Yet another feature common to all the students included in the research is that they are all science students. I could have chosen a sole focus on the first year in science programmes. However, as most of the conducted research has a general applicability and the challenge of student drop-out relates to most fields of education, I chose not to limit the literature review further.

Section 2.1 provides an introduction to the field of first year experience with an impression of current and recurrent themes at the EFYE conference. Following this introduction to the field, section 2.2 aims to provide an overview of the first year experience research dealing with motivational aspects through the presentation of a systematic literature review. The research field is highly diverse and addresses multifarious aspects of the first year of studies with different methodological approaches. The literature review categorises themes, theoretical frameworks, and methods utilised in journal papers through the last ten years. This period of time was chosen as it represents the years that the EFYE conference has existed.

2.1 European First Year Experience (EFYE) conference

To celebrate the ten year anniversary of the EFYE conference and thus ten years of European research in first year experience, an anthology with chapters serving as reminders of all the past conferences was published in connection with EFYE2016 (Bonne & Nutt, 2016). In the anthology, Diane Nutt, who established the EFYE Network and read every submitted abstract, reflected upon conference themes holding *'particular resonance'* (Bonne & Nutt, 2016). These themes are summarised as: retention and progression, relationships and belonging, student engagement, peer support and mentoring, student diversity, and skills acquisition.

Nutt reported that the EFYE's initial challenges of fostering retention and securing progression still apply, and that Tinto's concepts of social and academic integration, which inspired many presentations in the beginning, are still widely referenced (Bonne & Nutt, 2016). Nutt noticed that there seems to be a tendency to a higher degree than in the early EFYE years for higher educational institutions to take upon themselves to foster engagement, aid the development of study skills, and provide sufficient support to (and in some cases even identify) at-risk students.

A short survey of the EFYE2016 programme[1] and the associated abstracts confirms that the listed themes are still current. Especially, peer mentoring and tutoring was a part of many initiatives dealing with induction activities, teaching activities, and/or for fostering first year students' well-being. Motivation also seems to be an underlying theme of many presentations although more or less explicit; a number of presentations deal with students self-regulations and multiple induction activities aim to foster students' motivation.

2.2 Literature review

The literature review was carried out with a literature search in the databases ERIC, Teacher Reference Center, Academic Search Premier, and Web of Science. The following search-term was utilised: *"first year students"* and *"motivation"* and *"higher education"*. Studies not published in peer-review journals, in English, or before 2006 were excluded. Thus, the included literature consisted of peer reviewed journal papers published in the period January 2006 – July 2016. The search yielded 90 non-identical results. Some studies were beyond the scope of this dissertation and were excluded. Examples of such studies were studies focusing on gambling or alcohol (ab)use among students, a focus on faculty rather

[1] http://sites.arteveldehogeschool.be/efye/node/20

than students, and the influence of disgust sensitivity in the motivation to choose between different health science careers.

In total, 74 studies were included in the review. Of these, 11 dealt with STEM students or courses and 32 studies stemmed from European countries. USA accounts for the highest number of papers (21), followed by the UK (12), Australia (7), the Netherlands (5), Germany (5), and Canada (4). The remaining papers stemmed from countries with one or two contributions. However, only one paper originated from a Nordic country (Finland). Figure 2 illustrates the distribution of publication year for the European and non-European papers respectively. It is noted that interest in studies combining motivation and first year students seems to have increased in European countries a few years later than in the non-European countries.

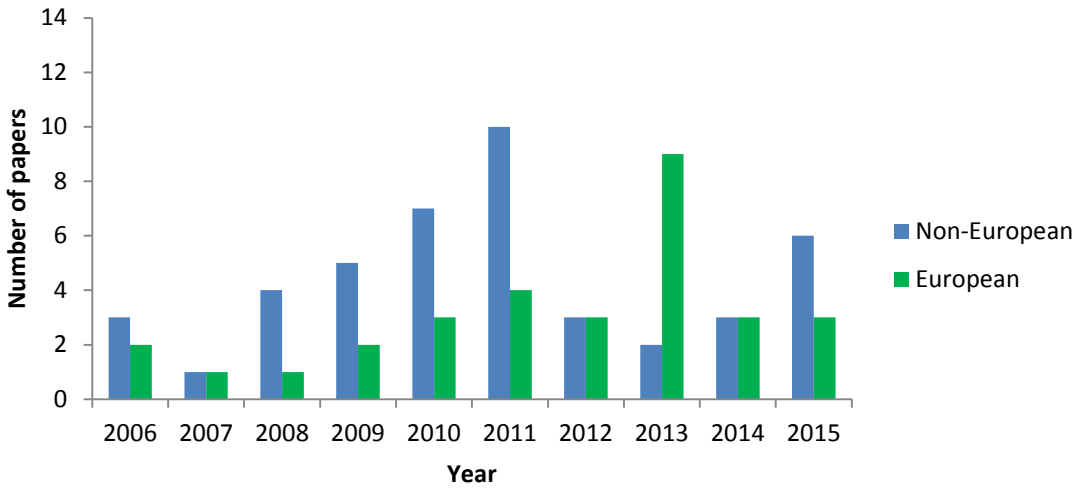

Figure 2 Number of papers in total and in Europe in the period 2006-2015.

In the following, a short review of tendencies in the international literature concerning both first year students and motivation is presented. This will serve as a point of departure for the empiric work of this dissertation with regards to selection of topics and methodology. The papers are categorised according to methodological orientations, the role and appearance of the concept of motivation, and themes and topics in the papers. Appendix 1 contains a complete reference list of the papers included in the review.

2.2.1 Methodological orientation

The vast majority of the papers (52) presented quantitative studies; only 11 predominantly qualitative studies appeared in the literature search (e.g. Asghar,

2010; Bussse, 2013a; Huntly & Donovan, 2009; Jessup-Anger, 2011), seven were mixed methods research (e.g. Bowles, Fisher, McPhail, Rosenstreich, & Dobson, 2014; Evans & Morrison, 2011; Rye, Mashinter, Meaney, Wood, & Gentile, 2015; Shih, 2011), and an additional four were theoretical papers (Gliebe, 2012; Kuh, 2007; Reilly, 2012) or 'communication of developmental project' without empiric data (Papinczak, Babri, Peterson, Kippers, & Wilkinson, 2011). The studies utilising a predominantly qualitative approach were mostly from the UK (7). The other four papers were from USA and Australia with two papers from each country. The mixed methods studies were geographically distributed with two papers from the UK and five papers from different non-European countries.

The studies utilising a quantitative research approach made use of I) institutional data on student GPA, first year completion rates, etc., II) questionnaires with separate questions or measures (typically Likert-scale measures) of e.g. motivational constructs, or III) a combination of both. The utilised measures were either self-developed or adjusted measures developed by other researchers. For example, Petersen, Louw, and Dumont (2009), Reynolds and Weigand (2010), and Terrion and Daoust (2011) utilised the 'Academic Motivation Scale' (Vallerand, Pelletier, Blais, Briére, Senécal, and Valliéres, 1992; 1993) which is based on Self-Determination Theory (see chapter 3 for a brief overview of motivational theories). Others (Garcia-Ros & Perez-Gonzalez, 2011; Kitsantas, Winsler, & Huie, 2008) used the 'Motivated Strategies for Learning Questionnaire' which includes subscales of e.g. self-efficacy and task value (Pintrich, Smith, Garcia, & McKeachie, 1993). A number of studies utilised a pre/post-test design measuring learning achievement or attitudinal change following an intervention (e.g. Kamp, van Berkel, Popeijus, Leppink, Schmidt, & Dolmans, 2014; Schrader & Brown, 2008; Suwantarathip & Orawiwatnakul, 2015).

2.2.2 The role of motivation in the papers

The concept of students' motivation (to study) appeared more or less directly in the papers and with varying degrees of theoretical underpinning. The papers that investigated motivational constructs within an identified theoretical framework utilised different motivational theories with self-efficacy and elements of Self-Determination Theory, especially, intrinsic motivation and the continuum of extrinsic motivation, as the most frequent. However, only few papers included the three basic needs for competence, autonomy and relatedness which also are central in self-determination theory. An example is Kamp et al. (2014) who deduced that sense of relatedness is relevant for their study on problem-based learning groups. Another is Copeland and Levesque-Bristol (2010) who included all three basic needs.

Winn, Harley, and Wilcox (2006) questioned the widespread use of Self-Determination Theory and proposed that the social context beyond the classroom should also be accounted for. A similar challenge of theory appeared in Tempelaar, Wosnitza, Volet, Rienties, Giesbers, and Gijselaers (2013) with the claim that students' goal orientations are more complex and contextual than what traditional achievement goal theories cover. The different motivational theories appearing in the papers are listed below along with examples of papers.

Self-efficacy (and related constructs)	Asghar (2010); Busse (2013a); (2013c); Gorges & Göke (2015); Reynolds & Weigand (2010)
Self-determination theory	Busse (2013a); Clark & Cundiff (2011); Copeland & Levesque-Bristol (2010); Coutts, Gilleard, & Baglin (2011); Morrow & Ackermann (2012); Petersen et al. (2009); Suhre, Jansen, & Torenbeek (2013); Terrion & Daoust (2011); Van Soom & Donche (2014)
Expectancy-value theory	Dresel & Grassinger (2013); Gorges & Göke (2015); Garcia-Ros & Pérez-González (2011)
Attribution theory	Perry, Stupnisky, Daniels, & Haynes (2008); Lavender, Nguyen-Rodriguez, & Spruijt-Metz (2010); Stewart, Clifton, Daniels, Perry, Chipperfield, & Ruthig (2011)
(Achievement) goal theory	Dresel & Grassinger (2013); Grehan, an Bhaird, & O'Shea (2016); Jessup-Anger (2011); Litmanen, Hirsto, & Lonka (2010); Smith, Dai, & Szelestm (2006)
Sense of belonging	Morrow & Ackermann (2012); Vaccaro, Daly-Cano, & Newman (2015)

The concept of Sense of belonging has become a research field in itself. However, it has strong relations to sense of relatedness (one of the three basic needs in Self-Determination Theory) and is included as a motivational construct in this dissertation.

A notable group of papers were motivated by students' lack of motivation and reported on initiatives to increase motivation. These papers inferred that their initiatives and findings will affect students' motivation, be affected by students' motivation, or make conclusions about motivation without defining the concept of motivation and, seemingly, without a theoretical framework of motivation (e.g. Baars, Bijvank, Tonnaer, & Jolles, 2015; Barlow & Fleischer, 2011; Laoui & O'Donoghue , 2008; Miley, 2009; Nedic, Nafalski, & Machotka, 2012; Tinwell , 2013).

The last group of papers to be mentioned here consists of papers that include constructs with many similarities to theoretically recognised motivational constructs, but without explicitly identifying motivation (e.g. Bowles et al., 2014). For example, Brooman and Darwent (2014) used the constructs of self-efficacy, but referred to it as a factor known to influence students' successful transitions. These papers appeared in the literature search because some of their references included the term 'motivation'.

2.2.3 Themes and topics

The papers represented a variety of themes and topics. Recurrent themes are outlined below. Some of these themes are overlapping. Other topics of investigation, than the ones outlined below, were e.g. students' perceptions of research culture (Sproken-Smith, Mirosa, & Darraou, 2014), attendance (Barlow & Fleischer, 2011; Moore, 2006; van Schalkwyk, Menkveld, & Ruiters, 2010), engagement with mathematics (Grehan et al., 2016; Härterich, Kiss, Rooch, Mönnigmann, Darup, & Span, 2012), assessment (Asghar, 2010; Coutts et al., 2011; Garcia-Ros & Perez-Gonzalez, 2011), development of measures (Dyehouse, Diefes-Dux, Bennett, & Brie, 2008; Smith et al., 2006), and emotional intelligence (Gliebe, 2012; Yarrish & Law, 2009).

2.2.3.1 Induction initiatives and transition

A number of papers reported on induction initiatives designed to aid students' transition into higher education. For example, Tinwell (2013) described a workshop (part of induction week) for Games Art undergraduates designed *to spark initial interest and motivation in research activities,* enhance the first year experience and to assist retention. Tinwell reported higher first-year completion rates after introducing the workshop, but did not establish causal relations. Others reported on similar initiatives and compared participants with non-participants. Schrader and Brown (2008) detected a slight positive change in knowledge of recourses, attitudes, and behaviour among participants in a 'First Year Experience programme'. After adjusting for selection bias, Clark and Cundiff (2011) found an increased likelihood to enter second year after participation in a freshman seminar, but no difference in GPA was detected between participants and non-participants.

A group of papers approached transition on a more general level exploring students' recollections of concerns, motivation, and perceived skill at study start (Gibney, Moore, Murphy, & O'Sullivan, 2011), identifying enablers of transition and persistence (Bowles et al., 2014; Huntly & Donovan, 2009), or investigating factors known to influence success of first-year student transition (Brooman & Darwent, 2014). Among other things, the latter of these studies concluded that

early contact with academic staff and the use of group work were important to a successful transition as these factors were associated with positive changes in sense of belonging. Brooman and Darwent (2014) suggested that transition activities should constitute a 'longer' process and proposed a transition model which:

> *"… runs alongside other core subjects in the first semester. A further recommendation is that similar interventions could be extended into substantive subject areas as development does not need to take place in an isolated single module."* (p. 1539)

This recommendation is brought forward because it seems to be a direct call for an initiative such as the Study Group Concept which is central to this dissertation and the topic of two of the contributing papers (papers III and IV).

2.2.3.2 Motivation

The heading 'Motivation' includes studies whose main objective was to describe or understand students' motivation (e.g. Fryer, Ginns, & Walker, 2014; Imhof & Spaeth-Hilbert, 2013; Piquemal & Renaud, 2006; Reynolds & Weigand, 2010; Winn et al., 2007). For example, Purcell (2009) investigated learning and grade orientations (parallel to mastery and performance goals) of first-year students and found it encouraging that generally *"students are motivated to learn for the sake of learning, not simply to earn good grades"* (p. 35).

Busse (2013a) investigated the impact of feedback on the motivation of first year students studying German in UK universities. Feedback was perceived highly important for motivation by students who had high writing proficiencies, but low levels of self-efficacy. However, the type of feedback given to the students was often detrimental to their motivation. In two other papers Busse (2013b; 2013c) explored general study motivation with the same first year students as subjects.

2.2.3.3 Academic achievement, retention rates, and 'time to degree'

A range of studies were about student success indicators such as academic achievement, retention rates and/or time-to-degree. These studies often included motivational constructs as predictors (e.g. Bruinsma & Jansen, 2009; Friedman & Mandel, 2011; Litmanen et al., 2010; Morrow & Ackermann, 2012; Perry et al., 2008; Stewart et al., 2011). One study considered motivation to be a mediating factor and therefore controlled for it when assessing the impact of supplemental instruction on the retention rates of undergraduate students (Terrion & Daoust, 2011). It was found that the final grades of the participants did not increase following the intervention, but the participants were more likely to persist.

Graunke, Woosley, & Helms (2006) explored three different types of commitment (to the institution, to an educational goal, and to a specific academic major) in relation to graduating within six years. Interestingly, they found that commitment to a specific major when beginning at college is negatively associated with the probability of degree completion, whereas commitment to an educational goal and to the institution was positively associated with obtaining the degree within six years.

2.2.3.4 Development of concrete courses and learning tools

A series of studies revolved around concrete learning initiatives in the form of full courses (Miley, 2009; Nedic et al., 2010), elements of courses (Hennrikus & Ferderber, 2015; Mabrouk, 2015; Orawiwatnakul, 2013; Papinczak et al., 2011), or technology-based learning or engagement tools (Laoui & O'Donoghue, 2008; Suwantarathip & Orawiwatnakul, 2015; Pfeiffer, Scheiter & Gemballa, 2012; Polisca, 2006; Shih, 2011).

An example, where the focus on motivation appeared central, is the development of MathePraxis – an engineering mathematics course that was aimed at increasing motivation and retention rates by making the relevance of mathematics explicit with real world examples (Härterich et al., 2012). Although the concept of motivation was not backed theoretically, the authors draw clear parallels to e.g. the constructs of utility value or identified extrinsic regulation (from expectancy-value theory and self-determination theory, respectively).

2.2.4 What can be drawn from the literature review?

The literature review included a sample of conducted research about first year students which also include motivation more or less directly. It can be argued that several studies include elements of motivation or outcomes of a motivated behaviour without identifying or labelling the motivational aspect of the study. Such studies would be relevant to the field of knowledge, but would fail to appear in the conducted literature search. A literature search that did include all such studies would be beyond the scope of the present dissertation.

Although the literature review only represents a subsample of the research interests within the fields of research in first year experience and motivation respectively, some tendencies stand out. First, the majority of international studies are approached quantitatively (70%). Secondly, multiple motivational theories inform the research with elements of self-determination theory, self-efficacy (and related constructs), and achievement goal theory as the three most prominent. Thirdly, many papers make conclusions about motivation without defining the concept of motivation and drawing on motivational theories. These

papers most often describe experiences with the development of concrete courses or course elements and are as such more orientated towards practice than theory. This could lead to a call for theoretically guided assessments of initiatives in order to establish bridges among theory and practice – bridges among researchers and practitioners. Paper II is an example of just that. Here a concrete course is evaluated within the frameworks of recognised motivational theories.

Furthermore, the lack of Scandinavian papers is noteworthy. Various explanations for this can be speculated. Studies including both first year students and motivation may be lacking or studies may be published in conference proceedings, in books, or in national non-English language journals. The literature search did not include studies on the motivation to enrol in higher education or in a specific field of education which has been investigated within the context of STEM in e.g. Bøe, Henriksen, Lyons, & Schreiner (2011). In Denmark, studies concerning first year students have described struggles that could be interpreted within a motivational framework (e.g. Holmegaard et al., 2014a; Holmegaard, Madsen, & Ulriksen, 2014b; 2015; Johannsen, 2012). However, these studies have had another focus and were therefore not included in the literature search.

Comparing the EFYE themes with the themes emerging from the literature review, the greatest overlap is observed between interest in indicators of student success (retention, progression, and achievement). Although both the EFYE conference and the journal papers feature many concrete examples from practice, their focus seem to differ with a strong focus on peer mentoring initiatives and initiatives outside the classroom at EFYE and a focus on courses and learning tools in the journal papers. Furthermore, the social dimension of the student experience, which is a central and recurrent theme at EFYE, does not appear to the same extent in the journal papers. However, many such papers might not have made the connection to motivation and will therefore not appear in the literature search.

3 Motivational Theories

As stated by Vincent Tinto, motivation is a highly important construct in relation to student success and persistence (2016). The literature review further illustrated that motivation is directly or indirectly present in a range of educational studies concerning the first year of studies, and a growing interest in investigation of motivational constructs is reported within the field of science education research (Koballa & Glynn, 2007).

Most questionnaires collecting data for studies presented in this dissertation contained measures assessing motivational aspects of the investigated topic. Therefore, this chapter provides a short introduction to motivational theories informing educational research in general and the contributing papers in particular. Papers I, II, and V specify the theory relevant to the study presented in the individual papers and present relevant theoretical details. Papers III and IV do not apply motivational theories directly, but will be discussed in relation to motivation in the general discussion in section 8.1.2.1.

Motivation is a highly complex psychological phenomenon relevant to all aspects of life that demand an effort to be executed. Motivation is what drives a person's actions towards reaching his/her goals; it incites making a choice to pursue the goal, putting in the effort to complete, and persisting to overcome challenges (Hofer, 2014). Schunk, Pintrich and Meece (2008) provide the following short definition of motivation:

> *"Motivation is the process whereby goal-directed activity is instigated and sustained"* (p. 4)

Three aspects of this definition are brought out here. First, motivation is regarded a process rather than a product. Secondly, motivation is not directly observable; it is inferred from a person's goal-directed actions. And thirdly, goals provide the incentive to take action. In the context of this dissertation, relevant educational goals could be to obtain a tertiary degree, to graduate with a high GPA, or to master the material in a specific course.

Various psychological constructs are important in relation to motivation and motivational theories are plentiful – some are contradicting, some are overlapping, and some are supplementary. However, there has been a general movement from the early behavioural (and later humanistic) theories towards theories based on social-cognitive perspectives (Alexander, 2006; Schunk et al.,

2008). This movement encompassed a change from viewing motivation as stemming from external stimuli or as fixed individual characteristics towards viewing motivation as a contextual construct derived by persons' values, self-perceptions, goals or other mental structures (Schunk et al., 2008). All of these elements are affected by prior, current, and expected experiences, and just as values, self-perceptions, and goals change and evolve over time, the motivation also changes in both nature and intensity concurrently with the accumulation of experiences. Different motivational theories emphasize different mental aspects, e.g. perceptions of own abilities or goal-orientation.

As indicated above, the research field of motivation encompasses a variety of psychological constructs. Sometimes the overlapping nature of these constructs cause confusion and inaccuracies. For example, at times the terms interest, motivation, and engagement are used interchangeably. However, when researching motivation it is important to separate these concepts: interest can be described as something that is able to stimulate motivation, and engagement can be described as a motivated behaviour (Dohn, 2014).

Below the motivational view of this dissertation is illustrated followed by a brief presentation of three prominent (achievement) motivation theories within the field of educational research; self-efficacy theory, self-determination theory, and expectancy-value theory. Especially self-determination theory and in continuation hereof sense of belonging is central to the research presented in this dissertation (papers I, II, and V and paper outline II). Expectancy-value theory is also applied in one paper (II) and a paper outline (I), and the notion of self-efficacy has strong relations to elements of both self-determination and expectancy-value theory.

3.1 The motivational view of this dissertation

In the present dissertation focus is on motivation that manifests itself in students' efforts to complete their studies (continue studying rather than dropping out). In the light of the examined motivational theories, motivation is viewed upon as the overall collection of a range of constructs which themselves are the continuously changing products (self-perceptions, beliefs, and feelings) of mental processing of experiences. Four central constructs are brought out here: feeling of competence, sense of autonomy, sense of relatedness, and subjective task value.

It is the understanding of the present dissertation that students' motivation can be supported if the study environment both in- and outside of class fosters feelings of competence, autonomy, relatedness, and positive task values. The four constructs are considered components that contribute to (but not necessarily fully

explain) the overall intensity and orientation of students' motivation. The central role of the four constructs is illustrated in Figure 3.

The figure is not a model of motivation, but rather an overview of the headlines of constructs that are brought out from motivational theories and investigated in the present dissertation. The individual figure components embrace elements from one or more motivational theories. 'Competence' encompasses self-efficacy, feeling of competence, and expectancy of success. 'Autonomy' refers to sense of autonomy, 'Relatedness' to sense of relatedness and sense of belonging, and 'Task value' covers the constructs of subjective task values, extrinsic motivation, and intrinsic motivation. Together these constructs are able to capture motivational differences among students in relation to attitudes, self-perceptions, and needs satisfaction.

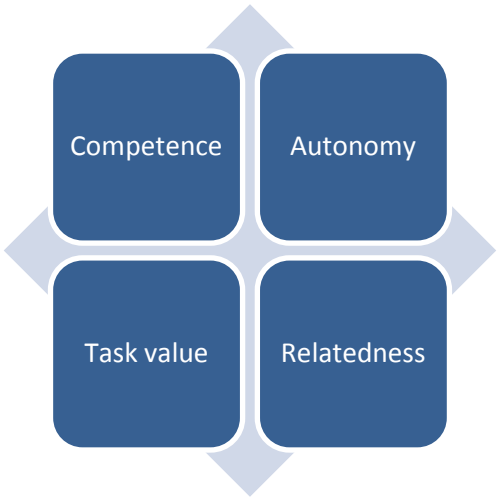

Figure 3 Motivational constructs important to the doctoral research. The constructs are interrelated and each construct contributes to the overall study motivation.

The theoretical similarities, parallels and differences between the constructs that are represented by each component in the figure are indicated in the subsequent theory introductions. These short presentations purely touch upon theoretical aspects; relevant empirical studies are brought out in the individual contributing papers.

As evident in the literature review (section 2.2.2) other motivational theories are also relevant in educational settings and could have been highlighted. Among these are attribution theories which revolve around what students perceive to be the causes of their successes and failures and the subsequent motivational consequences hereof (Weiner, 2005), and goal-orientation theories which

concern students' motives to learn, often with a distinction between mastery and performance goals (Elliot, 2005).

3.2 Self-efficacy

Bandura (1986) defined self-efficacy as *''people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances''* (p. 391). Hence, in Bandura's self-efficacy theory, motivation is considered a behaviour that is driven by the individual's belief in their own capabilities to successfully complete the task at hand. A person with low self-efficacy may be unwilling to engage in a task or may opt out when difficulties are encountered (Schunk et al., 2008). Self-efficacy is not a global trait of a person (Bandura, 2006). It is contextual and situational; a level of self-efficacy is associated with any given task or domain at a given time. However, self-efficacy levels for related tasks are likely to be correlated (Bandura, 2006). Self-efficacy is not to be confused with self-esteem; these two psychological constructs concern the judgement of (domain specific) capability and (general) self-worth respectively.

Self-efficacy is derived from mastery experiences (actual experiences of being competent), vicarious experiences (observing others perform the action), and social persuasion (encouragement/urging from others) (reviewed by Koballa and Glynn, 2007). The observation and persuasion affect self-efficacy most positively when the student relates to and identifies with the persons being observed and when the persons providing encouragement are respected. The mastery experiences (successes) are more likely to occur when students possess high self-efficacy (reviewed by McCoach, Gable, & Madura, 2013). Thus, at positive feedback loop exists between the level of self-efficacy and the likelihood of success.

The self-efficacy-related constructs 'feeling of competence' from self-determination theory and 'expectancy of success' from expectancy-value theory are assessed in paper II and outlines I and II.

3.3 Self-determination theory

The self-determination theory was developed by Deci and Ryan (1985) who describe their theory as an orgasmic theory of human motivation which attempts *"to explicate the dialectic of the organism's acting on and being acted upon by the social and physical environments"* (p. VIII). The theory emanates from the traditional distinction between intrinsic (to be motivated by inherent pleasure) and extrinsic motivation (to be motivated by external factors) and draw on other

motivation theories as well (Schunk et al., 2008). In educational situations, intrinsic motivation is said to promote high-quality (deep) learning, whereas extrinsic motivation traditionally is said to undermine this (Deci, Ryan, & Williams, 1996; Ryan & Deci, 2000).

Self-determination theory argues that extrinsic motivation can be further divided into four extrinsic regulatory styles characterised by varying degrees of self-determination (autonomy); external motivation, introjection, identification, and integration. Thus, the regulatory styles range from fully controlled motivations to fully autonomous motivations with intrinsic motivation as the prototype of autonomous motivation (Ryan & Deci, 2000). When students are intrinsically motivated, their engagement in an activity is based on interest and enjoyment, whereas the different types of extrinsic regulatory styles are motivated by external factors that are more or less internalised and integrated. Through the processes of internalisation and integration the regulation of behaviour moves along the continuum of extrinsic regulations and becomes more autonomous (self-determined) with the end-point being a regulation that is integrated into the self – engagement it considered personally important (Deci & Ryan, 1985; Ryan & Deci, 2000).

Table 1 provides an overview of the different regulatory styles and their sequential order in the self-determination continuum (paper I provides a more detailed description). Ryan and Deci (2000) also include amotivation to describe the situation where a student is without any type of motivation and consequently will refrain from performing the task. The different types of motivation are context-specific; they apply to a specific task. A student might put in effort to learn both biology and mathematics, but could be motivated by (intrinsic) interest in one subject and by (extrinsic) fear of failing in the other subject.

Amotivation	**Extrinsic motivation**				**Intrinsic motivation**
	External regulation	Introjection	Identification	Integration	
No engagement	Engage to obtain rewards or avoid punishment	Engage to please others and due to a feeling of obligation	Engage on the basis of perceived utility value	Engage because it is important to sense of self	Engage on the basis of inherent satisfaction
	Increasing levels of self-determination →				

Table 1 Categorisation of motivational types and regulatory styles of behaviour in Self-Determination Theory. Based on Ryan and Deci (2000).

Underlying the different types of motivations (or regulatory styles), Self-Determination Theory proposes three basic innate psychological needs which must be fulfilled in order for students to be fully self-determined/autonomously motivated. These needs are the needs for a feeling of competence, a sense of autonomy, and a sense of relatedness. The characteristics of the three basic needs are listed below.

Feeling of competence	Students must feel that they are competent. Feedback and positive experiences of accomplishment aid this feeling. Feeling competent is related to self-efficacy and expectancy of success.
Sense of autonomy	Students must feel that they influence the teaching and learning activities. Situations promoting this feeling could be teachers making adjustments according to students' input/feedback or presenting students with choices regarding topic, procedures, etc.
Sense of relatedness	Students must feel positive relations to teachers and other students at the educational institution, e.g. feeling care and acknowledgement from others. Relatedness is also referred to as belongingness (see below) which encompasses feeling a part of a group or community (the institution).

The three basic needs are interrelated. For example, if students feel that the teacher listens to their input and adapts teaching accordingly, it can be reflected in both the sense of autonomy (the students influence teaching) and the sense of relatedness (the students interpret that the teacher cares about them). According to Self-Determination Theory, intrinsic motivation is supported if the three basic needs are fulfilled (Deci & Ryan, 1985; Ryan & Deci, 2000).

Self-determination theory constituted the theoretical framework of two papers and one outline. In paper I students' level of autonomous and controlled motivation was assessed in relation to two first year courses. In paper II the fulfilment of students' basic needs was evaluated in relation to the First Year Project, and in outline II the change in needs satisfaction from the end of first semester to the end of second semester was investigated.

3.3.1 Sense of belonging

Sense of relatedness is also referred to as belongingness and is often linked to Tinto's social integration (1987). Sense of belonging constitutes a self-standing research field with sub-fields of school and university belonging which is

considered essential for student success (Strayhorn, 2012). However, the use of the construct in relation to older students (college and university) is still limited. Osterman (2000) concludes:

> *"…belongingness is an extremely important concept. As a psychological phenomenon, it has far reaching impact on human motivation and behaviour"* (p. 359)

School and university belonging is more than mere admission to the educational institution; it also encompasses a feeling of I) belonging to the academic environment and among the other students, II) obligation towards the institution and doing a good job and being acknowledged for this, and III) being a part of a community (Pittmann & Richmond, 2008). School belonging is also called perceived school membership (Goodeknow, 1993) and connectedness to one's school (Shochet, Dadds, Ham, & Montague, 2006). The concept of university belonging acts as theoretical framework of paper V.

3.4 Expectancy-value theory

The core idea of expectancy-value theory is that students will engage in activities (tasks) they value and in which they have some expectancy to succeed (Wigfield & Eccles, 2000). The two main components of expectancy-value theory are 'expectancy of success' and 'task value'. A person must possess some degree of each component in relation to an activity in order to engage in that activity. Wigfield, Eccles, and their colleagues revised earlier expectancy-value theories and proposed the current expectancy-value theory of achievement motivation which is more social-cognitive in nature (reviewed in Eccles & Wigfield, 2002; Wigfield & Eccles, 1992; Schunk et al., 2008). They developed the expectancy-value model of achievement motivation (or achievement related behaviour) which includes cognitive processes that link (social) experiences to motivational beliefs which in turn forms the individual's expectancy and value beliefs leading to the achievement behaviour. However, in the following only the two main components of the theory are highlighted and the remaining (although comprehensive) part of the theory is deemed beyond the scope of this dissertation.

Expectancy of success is composed of the individual's beliefs and judgements about their own capabilities to perform a task (Schunk et al., 2008). It is unlikely, that students will engage in a task in which they expect to fail. The expectancy-component is also referred to as expectancy beliefs and ability beliefs bearing relations to the construct of self-efficacy. The value-component, task values refers

to the reasons individuals offer (themselves) to explain their engagement in achievement behaviours. Such reasons may take on a variety of forms, e.g. relating to interest or possible rewards. Task value can be divided into four sub-constructs: attainment value, intrinsic (interest) value, (extrinsic) utility value, and cost beliefs/relative costs (revisited in Eccles & Wigfield, 2002). These constructs are briefly defined below:

Task value	Perceived value of the task
Attainment value	Perceived importance to perform the task, e.g. identity matching
Intrinsic value	Perceived interest in and enjoyment from the task
Utility value	Perceived usefulness (relevance) of the task. e.g. future access to a study programme or to the dream job or living up to parents' expectations
Cost beliefs	Perceived negative aspects of the task, e.g. mental effort and time consumption

The highest level of task value is obtained with high value-beliefs and low cost-beliefs; thus a student may value a task, but if the cost beliefs are too high he/she may deem that the required effort is not worthwhile. It is important to note that the theory deals with the perceived value (subjective task value) as opposed to objective value of a task (as judged or approved by society). Likewise, it is the perceived chance to succeed that matters.

The construct of intrinsic value is conceptually similar to Deci and Ryan's intrinsic motivation and utility value bears references to the controlled forms of extrinsic motivations in self-determination theory (Wigfield & Eccles, 1992; 2000). Furthermore, attainment value is similar to 'integration' – the extrinsic regulatory style possessing the highest level of self-determination. These overlapping features illustrate that the theories are in some way supplementary. Expectancy-value theory is often used to predict choices to engage in activities. For example, the theory has often been applied in studies of educational choices, e.g. the choice of a study programme or the choice to attend college (Bøe, 2012; Eccles, Vida, & Barber, 2004; Poulsen, 2016).

In the present dissertation, expectancy-value theory is utilised in paper II to assess students' subjective task values of the First Year Project and in outline I to detect differences among students' motives to choose a particular science programme.

PART 2: RESEARCH BACKGROUND AND DESIGN

Chapter 4: Background and Context of Studies

Chapter 5: Research Design

4 Background and Context of Studies

To understand the studies presented in the contributing papers in their proper context, some background and contextual knowledge is necessary. Therefore, knowledge of the enrolment and completion at Danish universities, the student population at the Faculty of Science, and educational developmental initiatives at the faculty are presented in the following sections which set the stage for the conducted studies. In addition, appendix 2 provides an overview of the Danish educational system.

4.1 Enrolment and completion at Danish universities

In Denmark, students generally choose a specific study programme when applying for university enrolment. There are few exceptions where students enrol into an enrolment unit (a group of related study programmes) and make their final choice during their bachelor studies. The first year of studies is typically fixed – filled with mandatory courses.

After an annual increase in the enrolment of students at the Danish universities for a number of years, the enrolment numbers stabilised in 2014 with an approximate enrolment of 29,300 bachelor students in 2014, 2015, and 2016 (Ministry of Higher Education and Science, 2016a). However, the distribution of students in the five main fields is changing; the natural and technical sciences are enrolling a larger portion of the student cohort than earlier. In 2006, these two fields enrolled 20.2% of the students and in 2015 this portion had increased to 27.1% (Universities Denmark, 2015).

The explosive growth in higher education enrolment from 1960 till now has been characterised as a developmental process 'from elitist to mass university' (Ulriksen, 2014). Consequences hereof are greater variations in students' qualifycations, experiences, socio-economic status, etc. Furthermore, the gender distribution has changed. Females have outnumbered males since 1978 (Ulriksen, 2014) and in the 2016-bachelor enrolment, females comprise 53% of the students. However, the pattern differs across fields; the natural and especially the technical sciences are dominated by male students (Figure 4).

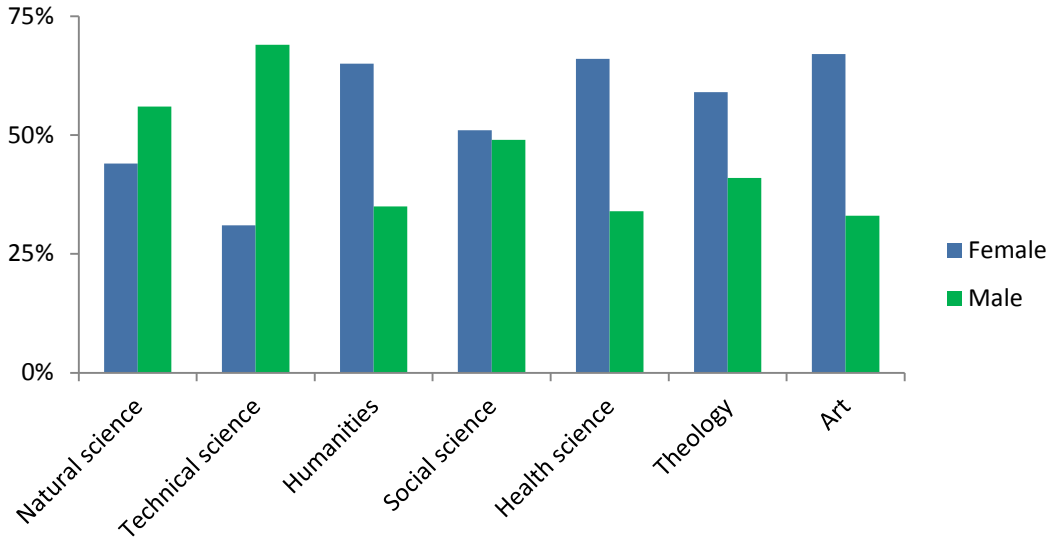

Figure 4 Gender distribution of bachelor enrolment in 2016. Based on numbers from Ministry of Higher Education and Science (2016b).

The overall completion rates of bachelor programmes have been increasing slightly since 2004 from approximately 69% to 73% in 2014 (Universities Denmark, 2015). In this period, the time to complete a university degree has fallen from an average of 6.43 years in 2006 to 5.88 years in 2013 (Universities Denmark, 2016). This is to be viewed upon in the light of a high political focus on time-to-degree (and financial incentives for the universities). The Higher Education DropOut and Completion in Europe (HEDOCE) study recently reviewed higher education policies of a number of countries and list Denmark among the countries viewing time-to-degree as a key indicator of student success (Vossensteyn et al., 2015).

The first year drop-out rate in Danish bachelor programmes is approximately 17% and after five years the accumulative drop-out is approximately 32% (Ministry of Science, Innovation, and Higher Education, 2013). However, a large portion of these students switch to another study programme; 29% of the students who dropped out in 2010 had enrolled in another tertiary study programme within a year (Ministry of Science, Innovation, and Higher Education, 2013).

4.1.1 Danish students' choice of study programme

Three elements are important to Danish students when considering in which study programme to enrol; interest, job prospects, and capability to succeed (summarised by Ulriksen, 2014). A longitudinal study illustrated the complexity of the choice processes of STEM interested Danish students (Holmegaard et al., 2014a). In spite of their interests, some opted out of a STEM career because they

could not 'see themselves' in a STEM job or as a STEM student. The study also illustrated that the choice process does not close with the student getting enrolled in a study programme; the choice is continuously re-evaluated during the first year(s) of studies. Furthermore, the study found that the majority of students experience a gap between expectations and actual experiences when entering their STEM programme (Holmegaard et al., 2014a). This has implications for the educational institutions; the study programmes risk student drop-out if the students are not convinced in their study choice from the beginning and if they are 'disappointed' with e.g. the content of the study programme. Ulriksen (2014) emphasize that interest in the subject remains the decisive factor for Danish students when choosing a study programme, but the relative importance of job prospects differs among students from different study programmes (which is investigated in outline I) and among students with different backgrounds.

4.2 Student population at the Faculty of Science, SDU

The Faculty of Science, SDU, holds approximately 2,100 students in nine bachelor programmes and 11 master programmes (Faculty of Science, 2016). In addition, approximately 150 students are enrolled in doctoral studies. The enrolment in bachelor programmes has been steadily increasing since a low point in 2008 (Figure 5). However, the portion of students enrolling at SDU in relation to the total enrolment in Danish science and engineering programmes has remained fairly consistent with a small increase in the SDU-portion from 12% to 15% in the years 2007-2015.

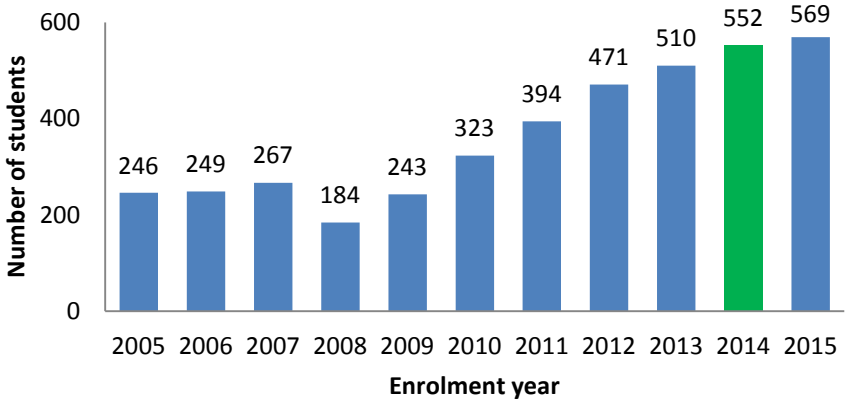

Figure 5 Enrolment at the Faculty of Science, SDU, from 2005 to 2015. Numbers obtained from SDU's internal statistics (whitebook).

In 2014 (the primary year in focus of the present research), 552 first year students (49.5% females and 50.5 % males) were distributed across the enrolment units and study programmes as shown in Table 2. When more than one study programme is in the same enrolment unit, it means that students are enrolled into the unit (as opposed to the specific study programme). In principle, the students are free to switch to another programme within the same unit within a specific timeframe. These study programmes have the first semester (or even longer) in common with regards to all aspects of teaching (same courses and joint lecturing) which make switches possible without study delay. From 2016 enrolment in all study programmes is specific, and enrolment units do no longer exist at the Faculty of Science, SDU.

Enrolment unit	Study programme	No of students (F/M)	Drop-out (first year)
Science	Biochemistry and molecular biology (BMB)	41 (68%/32%)	27%
	Biomedicine	156 (63%/37%)	15%
	Chemistry	18 (78%/22%)	0%
	Physics	27 (15%/85%)	19%
	Nanobioscience[b]	5 (80%/20%)	21%
Pharmacy	Pharmacy	86 (72%/28%)	8%
Biology	Biology	78 (56%/44%)	26%
Computer science	Computer science	76 (8%/92%)	22%
Mathematics	Applied mathematics	20 (35%/65%)	20%
	Mathematics	17 (47%/53%)	12%
Math-Economy[a]	Math-Economy	28 (25%/75%)	32%

Table 2 Number of students enrolled in bachelor programmes at the Faculty of Science, SDU, in 2014. F: female, M: Male. [a]The Math-Economy study programme is shared with the Faculty of Business and Social Science, colloquially it is not considered a science programme. [b]Enrolment in the nanobioscience bachelor programme was shut down after 2014. Numbers obtained from SDU's whitebook.

Table 2 also includes the gender distribution of each study programme in the 2014 cohort. The gender distribution was fairly equal in the biology and in the

mathematics programme, males outnumbered females in the study programmes: computer science, physics, applied mathematics, and math-economy, and females outnumbered males in the study programmes: biochemistry and molecular biology (BMB), biomedicine, chemistry, nanobioscience, and pharmacy.

At the end of the first year of studies (spring semester 2015), a total of 101 students had formally left their science programme. Thus, the official drop-out rate was 18 % (the national average within science and technology was 17 %). However, the actual drop-out rate is likely to have been higher. Often students who voluntarily leave their study programme neglect to notify the university. Therefore, they are still formally enrolled in the programme until a faculty check-up reveals study inactivity, absenteeism from multiple exams, or unexplainable prolongation of studies. At that point, the 'student' is contacted and asked to respond within a certain timeframe. If they do, their case will be brought up in the study council, and if they do not, their admission will be annulled. When the latest completion rates were calculated (summer 2015), the completion rate of students completing their (three-year) science or engineering programme within four years was 53%; 33% had formally dropped out and the remaining 14% were still registered as active students. As evident in Table 2, the first year dropout rates vary among study programmes. For the 2014 cohort, the highest drop-out rates were observed in math-economy (32%), BMB (27%), and biology (26%).

4.2.1 Social tutors, mentors and teaching assistants

A large quantity of older students (more than 150) are involved in the first year either voluntarily as social tutors or by employment as study group mentors or teaching assistants. Social tutors are responsible for the social study start. They plan multiple social events, welcome the first year students on their first day of studies, and handle first year students' practical issues the first days. Study group mentors are part of the academic study start (described in section 4.3.3). Papers III and IV reports on the Study Group Concept in which the study group mentors constitute an essential element. Teaching assistants teach laboratory and class exercises in large enrolment courses (which make up all first year courses). This group of older students (social tutors, study group mentors, teaching assistants, etc.) who have a working relationship with the science faculty are the subject of research in paper V.

4.3 Educational development at the Faculty of Science

In January 2011 the Faculty of Science hosted a seminar titled 'Future Search' (Faculty of Science, 2011). The aim was to identify 'prouds and sorries' of the study programmes and to agree on focus areas for future development initiatives. Among other things, a sentiment for changing the existing first year of studies - the Science Year - was present. The structure of the Science Year is provided in appendix 3. The Future Search seminar constituted a momentum, and since then many initiatives have been implemented. The most prominent changes relevant to the research presented in this dissertation are mentioned below. Ultimately, these changes also led to the announcement of the PhD position resulting in the present dissertation.

4.3.1 Implementation of a new first year of studies

Succeeding the sentiment of the Future Search seminar, a new structure of the first year of studies was developed and implemented in September 2012. As described in Michelsen and Dyrberg (2014), seven key principles guided the development work: academic identity, interdisciplinarity, coherence lengthwise and crosswise, formative assessment, activating teaching, focus on understanding rather than passing, and transparency. The objective was to structure the first year of studies in a way that supports students' academic identity within the chosen field of study, ensures deep understanding, and at the same time makes clear relations and draw perspectives to other academic disciplines.

The structure of the new first year of science studies at SDU is illustrated in Figure 6. The structure fully applies to students in the study programmes of biomedicine, BMB, and chemistry. The main part of the first year is also followed by students in physics, biology, nanobioscience[2], and pharmacy; whereas students in computer science, mathematics, and applied mathematics have another more field specific first year of studies.

The new first year is structured around two large 20 ECTS courses which jointly embrace the traditional core disciplines of the natural sciences: I) P*hysics and mathematics: methods and models*, and II) *Chemistry, biology, and molecular biology: the empiric experimental science*. These two courses are the topic of investigation in paper I.

[2] The bachelor programme in nanobioscience stopped for enrolment in 2015.

<table>
<tr><th colspan="4">Chemistry, BMB, and Biomedicine</th></tr>
<tr><td rowspan="3">First semester

Second semester</td><td colspan="3">Introduction to Subject, Research and Community of Practice (5 ECTS)</td></tr>
<tr><td colspan="2">Chemistry, Biology, and Molecular biology:
the Empiric Experimental Science
(20 ECTS)</td><td>Physics and Mathematics:
Methods and Models
(20 ECTS)</td></tr>
<tr><td colspan="2">The First Year Project
(10 ECTS)</td><td>Subject specific course
(5 ECTS)</td></tr>
</table>

Figure 6 Structure and content of the first year of studies. This specific structure applies to the study programmes chemistry, BMB, and biomedicine. Main parts also apply to the study programmes physics, nanobioscience, pharmacy, and biology.

An introduction course: *Introduction to subject, research and community of practice* (5 ECTS) kick-starts the first year. It formalises the induction activities of the academic study start containing for example a mandatory laboratory safety course, study group activities, introduction to study skills and learning styles, and the students' first exam. The first year ends with the First Year Project (10 ECTS) and a course specific to the chosen study programme (5 ECTS), i.e. *Human Diseases* for students in BMB and biomedicine, *Electromagnetism* for physics students, and *Introductory inorganic chemistry* for chemistry students. The First Year Project was one of the identified 'prouds' at the Future Search-seminar. Thus, it was kept in the new first year. The First Year Project is the topic of paper II.

4.3.2 Implementation of the 'Three Phase Model'

The Three Phase Model is the model for teaching and learning at the Faculty of Science, SDU. It was fully implemented in the first year of studies in 2013 and is in the process of being implemented in the courses in the remaining years of studies. However, as teachers interpret the model in various ways, the practical implementation has taken multiple forms. Especially the study phase of the model is more or less explicit in different courses. In the first year of studies the study phase is formalised with scheduled time for study phase activities.

A detailed description of the ideas behind the Three Phase Model and the initial experiences with it is provided in Michelsen and Dyrberg (2014). Figure 7 provides an overview of the model.

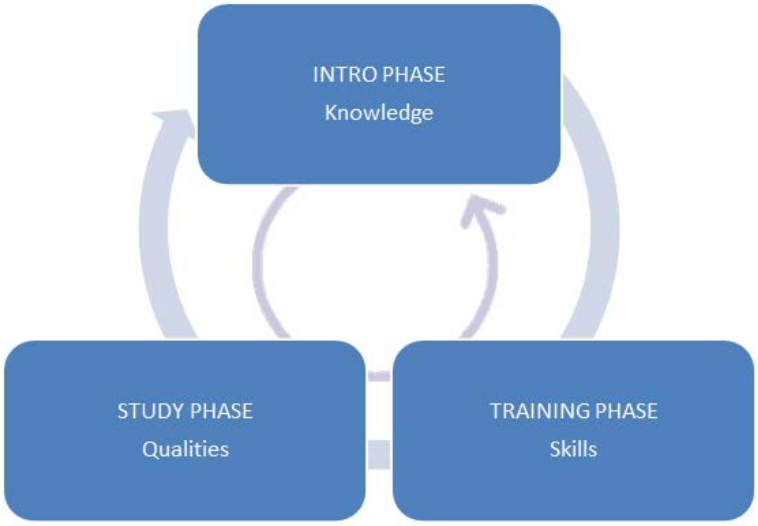

Figure 7 The Three Phase Model. A version of the figure appear in Michelsen and Dyrberg (2014).

In short, the Three Phase Model views teaching and learning processes as occurring in three phases: the introduction phase, the training phase, and the study phase. In the first phase students are introduced to knowledge of the subject matter in terms of theories, models etc. The introduction face typically takes place as more or less student-engaging lectures. In the second phase students utilise their newly acquired knowledge in the training and development of skills in e.g. problem solving. These exercises are led by a teaching assistant – an older student. In the third phase (which typically takes place in a study group) students dig deeper into the subject matter, apply multiple perspectives, relate former knowledge to new knowledge, discuss applicability of e.g. models and formulas in different contexts etc. In this phase the students develop the competences required to succeed in their studies, e.g. critical thinking, communicating science, and cooperation. In the first year of studies, study groups exist across courses and a study group mentor is affiliated to each group (see below).

4.3.3 Implementation of the Study Group Concept

In September 2012 the Study Group Concept consisting of pre-defined study groups with affiliated study group mentors was implemented. The concept has been under continuous development. Adjustments have been made in congruence with students' evaluations as well as the study group mentors' and first year teachers' suggestions. The developmental process, the practical design, and the first years of experiences with the concept are reported in papers III and

IV. In short, all first year students at the Faculty of Science are divided into classes of approximately 28 students, and these classes are furthermore divided into three study groups (Figure 8). A study group mentor is affiliated to each study group, and the three mentors affiliated to the same class constitute a team of mentors who support and cover for each other when needed.

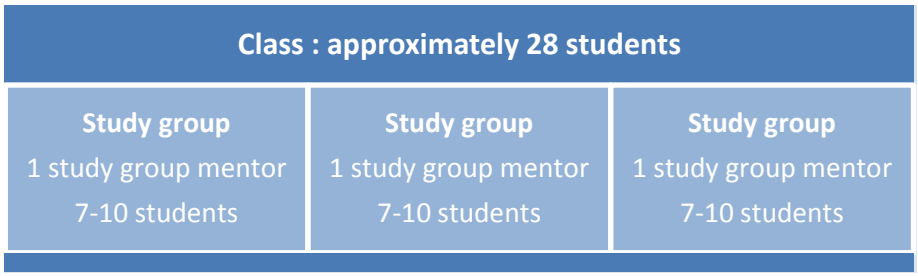

Figure 8 Organisation of study groups at the first year of science, SDU.

The study group mentors facilitate productive group work, act as role models, and introduce the first year students to the student life. The study group mentors meet the first year students during weekly sessions in the first semester. Although the study group mentors deal with many aspects of the induction of first year students, social tutors are still responsible for the social induction and the first welcome of first year students. The tutors handle practicalities the first day and arrange multiple social activities with greatest intensity during the first three weeks.

5 Research Design

Specific methodological details concerning the individual contributing papers are provided in each paper. Therefore, the present section is devoted to an overview of the overall data collection process, general methodological reflections and choices common to the conducted studies, as well as methodological details that extend the scope of a conventional research paper.

5.1 General considerations

The studies presented in the contributing papers and the paper outlines are largely independent – though some are overlapping in respondents and others in their topic of investigation. Thus, the empirical work presented in this dissertation should not be viewed as one large coherent study, but rather as a set of individual, yet coherent studies that approach the overall topic of being a science student (with a special focus on motivation) from different angles and different study elements at different levels from concrete courses to the overall study environment.

Under the heading of what Robson (2011) calls 'Real world research', the research contains elements of evaluation research (papers III and IV), action research (papers III and IV), and descriptive research (papers I, II, and V). Robson (2011, pp. 522-531) describes/defines these categories according to their purpose:

Real world research	Applied social research, often seeking answers to current problems.
Evaluation research	Research which focuses on determining the worth or value (effect and effectiveness) of some real world intervention or approach.
Action research	Research oriented towards bringing about change (improvement of practice). Researchers are actively involved in the situation or phenomenon being studied.
Descriptive research	Research concerned with providing descriptions of phenomena.

During my doctoral research, I have I) evaluated existing study elements, II) been an active participant in evaluating, implementing, and adjusting new study elements (interventions), and III) described students' experiences, attitudes, and motivation associated with study elements where I was not involved.

The approach has been explorative, descriptive, and confirmatory; parts have not been guided by a theoretical framework applying an inductive approach (papers III and IV) whereas other parts have been theory-driven utilising a deductive approach (papers I, II, and V). In these parts, hypotheses derived from theory were tested and the intention was to establish the prevalence of an identified phenomenon.

The conducted research has generally applied a fixed, non-experimental, cross-sectional research design. However, as the same respondent group (the first year students) received multiple questionnaires, the data have potential to foster longitudinal studies as well (outline II). Furthermore, the study described in outline I is retrospective; it concerns students' considerations about choosing a science programme, and data were collected during the respondents' first weeks of studies.

It was a part of my practical (and consequently methodological) considerations that the applied methods should be manageable for me to prepare, to collect data, and to analyse alone as I was the only researcher connected to the studies. Before turning to the concrete methodological approaches, three issues of importance and of more personal nature are discussed: choosing the academic year 2014/2015 as centre for my research, my dual role as both a researcher and practitioner, and my background in science.

5.1.1 Choosing the academic year 2014/2015

Choosing the academic year 2014/2015 as the primary year to collect data was a matter of practicality. I began my doctoral studies in September 2013; in the study start of the academic year 2013/2014. Therefore, in order to have time to select topics of investigation, identify relevant theory, and prepare the data collection process, I chose to focus on the academic year 2014/2015 which began with the arrival of newly enrolled first year students at the beginning of September and ended with the summer exams at the end of June 2015. By doing so, I also had time to analyse data after the last data collection point before handing in my dissertation in September 2016. However, cycles of development, evaluation, and adjustments (hopefully, improvements) regarding the Study Group Concept and other elements of the study start have not been confined for the academic year of 2014/2015. Rather, these action research or 'design-based or action research'-cycles have run continuously throughout my three years of doctoral research (and before) and the 'Study start evaluation 2013' provided data for paper III.

5.1.2 Researcher and practitioner

Throughout my doctoral studies, I had a dual role as both researcher and practitioner working to implement first year initiatives and participating in the continuous development hereof. This has implications for both me as a researcher and my respondents. The first year students and the older students who were not employed as study group mentors may not have been aware of this, and thus my dual role has probably not affected their questionnaire responses. However, the study group mentors were aware of it. In cooperation with the study start coordinator I was responsible for the hiring and training of the mentors. About half of the mentors had their job interview with me and another colleague. Furthermore, I was one of the daily contact persons for the mentors who stopped by the office whenever they had questions or wanted to share experiences. Although we worked to create a casual atmosphere in the communication with the study group mentors with special focus on acknowledgement and openness to e.g. suggestions for improvement, the study group mentors might have been affected by this working relationship when answering my questionnaires.

5.1.3 Science background

As a science graduate from SDU and later as staff at the Faculty Secretariat, I began my doctoral research process with prior understanding of the faculty's educational programmes and the students enrolled in them. This could both be an advantage and a disadvantage. My extensive prior knowledge of the study programmes, the students, and the educational development at the faculty has enabled me to identify focus areas early on in the research process and to understand the mind-set of the students and aided interpretation of their responses. On the other hand, I had to take care not to let my prior understanding blind me in the sense that I would overlook important or interesting aspects or that my interpretation of findings would be biased by preconceptions. My own experiences as a biomedicine student have affected my personal motivation to improve science education in general and to conduct the chosen investigations in particular. As a biomedicine student I too experienced motivational challenges during my first year of studies and I too experienced my sense of belonging rising (although I would probably not have phrased it like that at the time) when I was employed in student positions and joined a volunteering association operating at the Faculty of Science. Both of these topics are central themes in the contributing papers of the present dissertation. As such, my background in science has been a driving force as well as a reason for caution when conducting my research.

5.2 Quantitative approach

It was evident from the literature review in section 2.2 that the methodological traditions within the field of first year experience and motivation are primarily quantitative. However, the Danish research involving university students (especially when concerning STEM students) has predominately been qualitative (e.g. Holm, Laursen, & Winsløw, 2008; Holmegaard et al., 2014a; 2014b; 2015; Poulsen, 2016; Johannsen, 2012). Contrasting the Danish tendency and in compliance with the international tradition, the methodological approaches informing the research in this dissertation are primarily quantitative. The objectives have generally been establishing the extent to which a phenomenon exists rather than trying to understand and explain the complexity of the phenomenon. Whereas the former objectives call for quantitative approaches, the latter calls for qualitative approaches that are better able to exemplify, deepen and nuance findings. Furthermore, with a background in natural science, I am affected by the methodology employed within these fields. Although I acknowledge the value of qualitative studies, my core methodological preference is quantitative. Robson (2011) sums up the factors influencing the choice of research strategy like this:

> *"The overall message is that, while the research questions help in deciding research strategy, much is still dependent on your own preferences and on the type of design and data which are going to speak most strongly to the stakeholders."* (p. 80)

The stakeholders of my project almost exclusively have a background in or are active natural scientist. I dare to presume that numerical data in general and statistics in particular will provide the strongest arguments in their opinion. Therefore, considering the above, my methodological approach has primarily been quantitative using questionnaires as data collection method. However, occasionally the findings have been supplemented qualitatively with students' comments from open questions in the questionnaires.

The use of students' comments when presenting findings has often been a communicative and explanatory grip to underpin the findings obtained by quantitative measures. A qualitative narrative is often easier or, in the words of Daniel Kahneman, faster to grasp for the reader than statistics. In his book 'Thinking, Fast and Slow', Kahneman (2011) describes how humans desire to make sense of the world through stories rather than numbers; it is easier to infer the general (statistics) when presented with the particular (examples of comments). When highlighting this, I do not mean to diminish qualitative nor quantitative

studies. I rather put forward the idea that quantitative studies could be communicated more effectively with a qualitative touch. I concur with the general perception of quantitative studies being appropriate to investigate prevalence of phenomenons (breadth – how much? how many? who? when?) and qualitative studies being appropriate to understand the complexity of phenomenons (depth – how? why?) (Brinkmann & Tanggard, 2015).

In the studies, general tendencies and group averages rather than individual differences are investigated. The quantitative approach allows one to quantify phenomena in the calculation of mean scores and to use statistical tests for significant differences among groups of students, e.g. students enrolled in different study programmes or between two groups of students defined by other characteristics such as employment status.

Quantitative research is often associated with long periods of preparation (Robson, 2011). In order to perform quantitative research, the researcher must have a solid understanding of the investigated topic; knowing what to ask for and which options to include for responses to closed questions. A pilot study can aid the determination of these response options, and pilot studies are generally recommended prior to conducting the primary (fixed) data collection (Robson, 2011). Due to time restrictions, most of the studies presented here were not piloted in the traditional sense. However, having been deeply involved in the first year (design and execution of the academic study start) and having completed multiple evaluations of the study start, the first year of studies in general, and of the first year courses, I had a solid understanding of the first year students' challenges prior to data collection.

5.2.1 Mixed methods research

Whether or not my research approach resembles mixed methods research (or multi-strategy research) can be discussed. Robson (2011) claims that quantitative research can include the collection of small amounts of qualitative data, whilst multi-strategy research encompasses substantial elements of both quantitative and qualitative approaches. On the other hand, Johnson and Onwuegbuzie (2004) provide a very broad definition of mixed methods research which could include my approach:

> *"… the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study."* (p. 17)

In spite of this broad definition, I hesitate in labelling my overall research approach as mixed methods. However, I do acknowledge that I position myself in an interface between mixed methods and quantitative approaches. Paper I is an example of a study that might be characterised as mixed methods research. Here data that were both quantitative and qualitative in nature were included and analysed with statistics and content analysis, respectively. In this paper, student comments were systematic analyses using a qualitative approach (Braun & Clarke, 2006), but still, these qualitative findings were used to underpin and nuance the main (quantitative) findings. Papers II, III, and IV lie in the interface between mixed methods and quantitative research. They take on a quantitative approach, but the findings are exemplified with student comments. However, these comments were not systematically analysed using a qualitative analytical method. Paper V is purely quantitative. Students' responses were analysed purely with statistics and no comments were included.

5.3 Questionnaires

Questionnaires have been the general data collection tool. One of the advantages of using questionnaires as method of data collection is that large quantities of data from many respondents can be collected and analysed in relatively short time compared to other more qualitative oriented methods (Robson, 2011). Thus I was able to collect data regarding various subjects from most (potentially all) first year students in a simple and straight forward approach, especially since I used e-mail distributed, self-completion questionnaires. Had I, on the other hand, chosen a qualitative approach, I would to a greater extent have been able to follow up on ambiguous comments or interesting aspects that had not been considered previously. This is a limitation to the questionnaire approach; the researcher knows which responses were written or chosen, but has no opportunity to clarify what exactly was meant or to nuance the responses. Therefore, the questionnaire must be designed in order to reach a satisfactory amount of information which is rich enough for the purpose to be fulfilled. In other words: questionnaires must be carefully designed, once they have been distributed, no changes in the data input can be made.

As described above, the questionnaires were digital and distributed by e-mail to the students' SDU-mail which the university encourage them to check regularly. The questionnaires were managed with the survey programme SurveyXact (IBM, 2015). An overview of the specific questionnaires, their content and their subsequent use in studies is presented in section 5.4 about the data collection

process. Below, considerations and concerns about the questionnaire method in general and the use of measures in particular are examined.

Robson (2011) raises some concerns when it comes to using self-completed, internet-based questionnaires, e.g. discouragement of respondents that are poor readers or writers and respondents' potential non-access to the internet. However, with the respondent group that was studied here - Danish university students - these concerns were deemed irrelevant. All respondents hold an upper secondary degree and in the unlikely event that they do not own a computer with internet access, there are computers available to students at the university campus. Concerns are also being raised about potentially low response rates, poor control of the response situation, and variable quality of the responses (Robson, 2011). These were noticeable concerns. In section 5.4.1, steps to encourage students' (quality) participation are described.

A questionnaire consists of a set of predefined questions which the respondents answer. The questionnaires developed in connection with the research presented in this dissertation have generally consisted of a mixture of open questions (responses formulated by respondents), closed questions (pre-defined response options), and items (statements with pre-defined response options). The structure of questionnaires and the phrasing of components have followed conventional wisdom on the subjects as summarised by Krosnick and Presser (2010) in Handbook of Survey Research. For example, when phrasing the questions and response options one should use familiar and neutral words, a simple syntax, and exhaustive and mutually exclusive response options. Regarding the structure of the questionnaire, the first line of questions should be easy and pleasant to answer. Questions of a sensitive nature should be placed later in the questionnaire, and questions on the same topic should be grouped together.

Also, respondents should not be presented with questions that are not relevant to them. This is easily avoided when using digital questionnaires. Filter options make it possible to activate/deactivate questions on the basis of the individual respondent's answers to previous questions. This particular function was utilised to a great extent in the questionnaires collecting data for studies forming the papers. For example, in questionnaire 3 (Table 4) questions about the position as a study group mentor was only visible to respondents who in the beginning of the questionnaire indicated being employed as a study group mentor.

The questionnaires' open questions were primarily comment boxes used to provide the respondents with an opportunity to express opinions that in their opinion were not sufficiently covered or nuanced in the preceding closed

questions or items. These comment boxes were typically placed at the end of a line of questions concerning a specific topic and before turning to a new topic. Krosnick and Presser (2010) support this use of open questions when stating that open questions e.g. as follow-up questions can add a richness to survey results that is (almost) impossible to obtain with closed questions. The closed questions were most often demographic questions and response options were determined according to the specific question. Items were most often answered in a 7-point responding format (see details in section 5.3.2).

5.3.1 Likert scales/measures

The research presented in papers I, II, and V makes use of Likert scales (in this dissertation the Likert scales are referred to as measures). A Likert scale (or a Likert-type scale) is a series (cluster) of statements (items) expressing a range of expressions, opinions, views, sentiments, or claims (both positive and negative) about an 'attitude object' – an underlying construct/factor. Each statement is considered an indicator of the underlying (or latent) construct which is an affective characteristic that cannot be directly observed (McCoach et al., 2013). For example, in paper V the underlying construct of university belonging is assessed using multiple items concerning different aspects or elements of university belonging e.g. experiencing a friendly attitude from other students and feeling proud to be a part of the Faculty of Science, SDU. Compiling the responses to all these items provides a score which indicates the students' sense of university belonging. Respondents respond by choosing within a symmetrical range of options indicating different intensity of agreement and disagreement.

In some cases the underlying construct is divided into sub-constructs or dimensions which are assessed with subscales. In paper I students' motivation to learn in their courses is investigated. Theory suggests that the motivation to learn can be assessed by determining the level of autonomous and controlled motivation (Ryan & Deci, 2000) and a scale with two subscales was constructed accordingly. Other scales assess even more complex phenomena. Here the number of underlying sub-constructs can be (more or less guided by theory) explored with statistics (exploratory factor analysis). Conversely, a pre-determined division of items can be consolidated by a confirmatory factor analysis.

Likert scales are also called measures, construct measures, instruments, indexes, or simply scales. The measures that have been used in the research presented in this dissertation were either made with inspiration from other researchers' measures or translations with minor adaptions of other researchers' measures. However, when utilising measures developed (and validated) in other countries or

with other respondent groups (e.g. differing age), one must be aware of possible deviations in how the respondents understand/interpret the individual items and in their general response-behaviour. For example, Lee, Jones, Mineyama, and Zhang (2002) found that Americans were more likely to indicate positive emotions than the Chinese and Japanese respondents (who more often chose the midpoint), and that the Chinese respondents more frequently skipped questions than the others. This issue of variation between countries became evident in paper I where a measure towards motivation in specific courses was utilised. An exploratory factor analysis based on the Danish respondents revealed that a few items loaded into another subscale than in the original measure.

The measures utilised in the contributing papers (and outlines) are listed in Table 3 along with a description of the measures and their origin. When available and deemed appropriate to the purpose and context, a measure developed and validated by other researchers was used. Measures were used in papers I and V and outlines I and II.

5.3.2 Likert response format

As mentioned above, scale items were answered with a 7-point Likert responding format. Carifio and Perla (2007) advocate using the term 'Likert response/ responding format' instead of the commonly (mis)used 'Likert scale' when describing response options. Likert himself also originally made the distinction of scales (collection of items) versus response format (response options ranging from one attitude extremity to the other) (Likert, 1932). The use and abuse of Likert scales are discussed with controversy (e.g. Carifio & Perla, 2007; 2008; Jamieson, 2004; Norman, 2010; Murray, 2013). A full account of this extensive discussion is beyond the scope of this dissertation. However, a few elements of the discussion are brought out below.

The number of points most often used in Likert scaling is five, but *"there appears to be no standard"* (Krosnick & Presser, 2010, p. 268). The Likert response format used in the contributing papers had seven points and defined extremes (end-points): 1: fully disagree/does not apply to me – 7: fully agree/often apply to me. The mid-categories 2-6 were not defined in order to encourage respondents to interpret the distance between each response option as equal (Cummins & Gullone, 2000). However, this may add to the cognitive processing needed to respond to the items, as respondent themselves must translate their response to a number (Krosnick & Presser, 2010).

Measure	Description and origin	Used in
Task-value and expectancy of success	Investigation of student's retrospective considerations with choosing their science programme. Self-developed measure with five subscales. Phrasing of items inspired by Glynn, Taasoobshirazi, and Brickman (2008), Tuan, Chin, and Shieh (2005), and Bøe et al. (2011). - Attainment value: 7 items, Cronbach α=0.78 - Intrinsic value: 7 items, Cronbach α=0.82 - Utility value: 7 items, Cronbach α=0.82 - Cost beliefs: 6 items, Cronbach α=0.70 - Self-efficacy beliefs: 7 items, Cronbach α=0.86	Outline I
Motivation to learn in specific courses	Investigation of students' motivation to learn in two specific first year courses. The measure has two subscales and is a translated and adapted version of the 'Learning Self-Regulation Questionnaire (LSRQ) as used by Black and Deci (2000). The measure is based on the original 'Self-Regulation Questionnaire' (Ryan & Connell, 1989). - Autonomous: 4 items, Cronbach α=0.73 and 0.88 - Controlled: 8 items, Cronbach α=0.76 and 0.80	Paper I
Fulfilment of basic needs	Investigation of the fulfilment of basic needs with a theoretical foundation in Self-Determination Theory. The measure has three subscales and is a translated and adapted version of Deci and Ryan's' Basic Psychological Needs Scales', specifically 'The Basic Need Satisfaction at work scale'. The scale has been used by other researchers (e.g. Deci, Ryan, Gagné, Leone, Usunov, & Kornazheva, 2001). The measure was administered to students twice during their first year of studies; at the end of first and second semester. - Feeling of competence: 7 items, Cronbach α=0.61 and 0.69 - Sense of autonomy: 6 items, Cronbach α=0.62 and 0.60 - Sense of relatedness: 8 items, Cronbach α=0.84 and 0.89	Outline II
University Belonging	Investigation of students' sense of belonging to the science faculty, SDU (university belonging). The measure has one scale. It is a translated and adapted version of Goodenow's 'Psychological Sense of School Membership (PSSM) Scale' (1993) which was developed with junior high school students as respondents. Others have used the measure on college students (Pittman & Richmond, 2007; 2008; Freeman, Anderman, & Jensen, 2007). - University belonging: 18 items, Cronbach α=0.94	Paper V

Table 3 Measures used to assess motivational constructs in the studies forming the contributing papers and paper outlines.

To prevent distortion of the mean due to undecided respondents a 'don't know' or 'not-applicable'-option was also included (Kulas, Stachowski, & Haynes, 2008). The rationale behind this was that respondents would be less tempted to use the mid-point (4) as a 'dumping ground' when in doubt about what to answer. The presence of a midpoint was also deliberate in order to provide a neutral response option to those genuinely having a neutral attitude towards the question. O'Muircheartaigh, Krosnick, and Helic (2000) found that respondents chose a response option at one side of the middle at random when a midpoint was omitted, thus hampering the reliability of the scale.

The appropriate number of points on Likert scales has been the topic of research in several papers, and advocates for both few and many points (some up to 10 or more) exist. Hofmans, Theuns, & Mairesse (2007) concluded no impact on linearity and sensitivity of scales using 5, 7, 10 or 15 response points. After discussing their results in relation to other researchers', they (like Krosnick & Presser, 2010) end up recommending seven response options. After evaluating different numbers of response categories ranging from 2-11 in accordance to reliability, validity, discriminating power, and respondents preferences, Preston and Colman (2000) concluded that 7, 9, or 10 response options is optimal. They also commented that the popularity of the 5-point scale does not seem justified. Bandura (2006) provided a reasonable argument against too few response options that perfectly sums up the reasoning behind choosing a 7-point response scaling in the present studies:

> *"Scales that use only a few scale points should be avoided because they are less sensitive and less reliable. People usually avoid the extreme positions so a scale with only a few steps, may in actual use, shrink to one or two points. Including too few points loses differentiating information because people who use the same category may differ if intermediate steps were included."* (p. 312)

5.3.2.1 Alternatives to Likert scales

There are alternatives to be used when evaluating students' attitudes, but Likert scales are by far the most common (McCoach et al., 2013). Two examples of alternatives are the Thurstone scale and the Osgood semantic differential scale (Norton, 2009). The Thurstone scale provides two response options to a statement, e.g. true/false, yes/no, agree/disagree. Because there is no differentiation in the response options when using this type of scale, many statements are required in order to conduct a thorough investigation.

The Osgood scale has a set of differentiated response options (like the Likert scale). But instead of responding to one statement at a time, the Osgood scale includes two contrary statements. The respondents then choose how close their attitude to one of the statements (and thereby also how far away their attitude is from the other statement). Norton (2009) describes a disadvantage of this approach to be that it may be difficult to phrase the two contrary statements *"without getting impossibly wordy"* (p. 95). Likert scales were deemed to be the best choice for the purpose and were chosen for the studies in the contributing papers. Likert scales are also the type of scale most commonly used in educational research and therefore comparisons to other studies are made easier.

5.4 Data collection

The main focus of the studies has been to monitor the first year students beginning their studies in September 2014. Therefore, the primary research data have been collected with questionnaires throughout the first year of studies in the study year 2014/2015.

Secondarily, input to the research has been given through various non- or less formalised channels. For example, during the first semester study group mentors stopped by the office almost daily to report on experiences with the first year students in their study groups or to clarify questions regarding their position. This provided valuable information about the first year students as well as the study group mentors. An overview of the questionnaires that have been distributed in connection with the doctoral studies is provided in Figure 9. The names of the questionnaires refer to the 'study age' of the responding student.

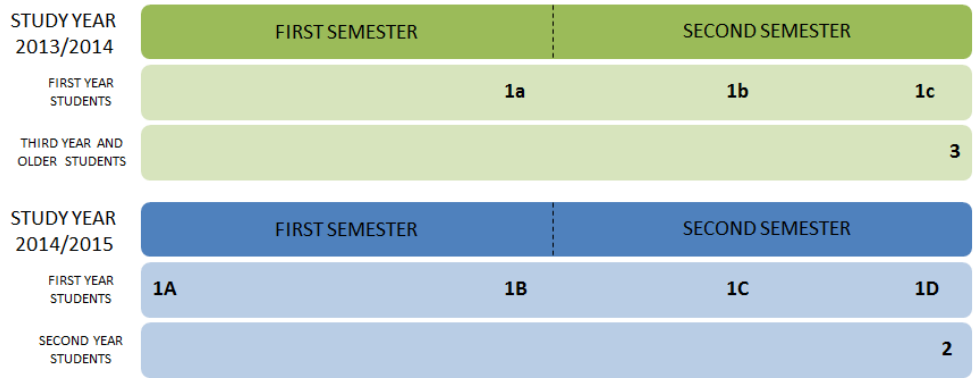

Figure 9 Overview of questionnaires distributed in connection with the doctoral research. Questionnaires 1a, 3, 1B, and 1D provided data for contributing papers. Numbers refer to the 'study age' of students: 1=first year students, 2=second year students, and 3=third year or older students.

In connection with the 1B-questionnaire at the end of first semester, representatives from each first year class were invited to focus group interviews about their own and their classmates' attitude towards various aspects of the first semester: the inductions day, the Study Group Concept, and the first courses. The interviews were carried out by the study start coordinator and me in order to get input and suggestions on how to further develop the social and academic induction period, hereunder the Study Group Concept. However, the interviews have not been analysed systematically and are not included in any studies. They will not be described further.

Additionally, I had been part of the science faculty's annual 'study start evaluation' since my employment as study phase coordinator. Therefore I had in-depth knowledge of the well-being and attitudes of first year students from the study years 2012/2013 and 2013/2014. In the academic year 2014/2015, the study start evaluation was combined with the research measures for the doctoral studies. Together the study start evaluation and the measures formed a comprehensive questionnaire (1B). One lengthy questionnaire was chosen over two separate questionnaires in order to reduce the number of questionnaires to be answered by the first year student that year.

As the above example illustrates, the distributed questionnaires had differing purposes: I) questionnaires 1A, 2, and 3 purely served as data collection for research, II) questionnaires 1a, 1c, 1B, and 1D had dual purposes of collecting data for both research and for the faculty's general (annual) evaluations of the first year, and III) questionnaires 1b and 1C purely served as the faculty's evaluation of courses. Details on the individual questionnaires are provided in Table 4. Questionnaires 1B and 3 are included in full length in appendix 4 and 5, respectively. These two questionnaires collected most of the data for the contributing papers, and questionnaire 1B is an extended version of 1a.

Questionnaire 1b and 1C are not included in Table 4 as they did not provide data for any studies. They both served as mandatory course assessments evaluating student's attitude towards the courses. I was involved in the development, distribution and data analysis of 1b in the study year 2013/2014 and served as consultant for the corresponding questionnaire (1C) the subsequent year. The two questionnaires are included into Figure 9 to provide a truthful insight in the number of questionnaires distributed to the first year students with the Faculty Secretariat as sender.

Questionnaire	Topic(s) of investigation	Responses (response rate)	Description	Data used in
1a	Study start: social and academic induction	353 (75.9%)	The science faculty's annual 'Study start evaluation' evaluating the first year students' experiences with the faculty's induction activities, the Study Group Concept, and reasons for choosing SDU.	Paper III and Dyrberg and Kromann (2014)
1c	First Year Project	179 (48.2%)	Investigation of students' experience' with the 'First Year Project'. The questionnaire included both general (course) evaluation questions and items concerning needs satisfaction and subjective task value.	Poster at SRHE2014 (appendix 6)
3	Student employment University belonging	161 (46.5%)	Investigation of older students' sense of belonging to the Faculty of Science, SDU with the measure: *University Belonging*. The experiences of students who were or had been employed in a student position at the faculty were also assessed using general questions about their employment and specific questions regarding possible benefits from employment.	Papers IV and V
1A	Choice of study	298 (53.6 %)	Investigation of newly enrolled students' considerations when choosing their study programme. The questionnaire consisted of demographic questions and the measure: *task-value and expectancy of success*.	Outline I
1B	Study start: social and academic induction Motivation for learning in the first courses Fulfilment of basic needs	417 (76.1%)	The questionnaire was composed of two parts: A) The science faculty's annual 'Study start evaluation' as in questionnaire 1a. B) Two measures of motivation within the framework of Self-Determination Theory: I) *motivation to learn in specific courses*, and II) *fulfilment of students' basic needs (general)*.	A) Dyrberg and Kromann (2015) B) Paper I and outline II
1D	First Year Project	195	The questionnaire was composed of two parts:	A) Paper II

Questionnaire	Topic(s) of investigation	Responses (response rate)	Description	Data used in
	Fulfilment of basic needs	(46.1 %)	A) Investigation of the First Year Project as in questionnaire 1c and a measure: *fulfilment of basic needs and value-perceptions of the first year project*. B) The second part consisted of the same measure for *fulfilment of basics needs (general)* as the one utilised in questionnaire 1B.	B) Outline II
2	Labster (virtual laboratory)	73 (57.9%)	Students' experiences and attitudes towards the virtual laboratory programme Labster were investigated within the theoretical framework of Expectancy-Value Theory and Self-efficacy.	Dyrberg et al. (2016).

Table 4 Overview of questionnaires distributed in connection with the doctoral studies. Parts of the questionnaires were only relevant to students in specific study programmes and only visible to them.

5.4.1 Encouraging students to answer questionnaires

In the distribution e-mails, the objectives of the questionnaires were stated along with an assurance of confidentiality. Furthermore, a statement about the importance of each student's participation and that the answers would be used to advise on educational development at the faculty was included. A deadline for answers was also given, and after this deadline a reminder was sent to all students who had not yet answered the questionnaire. Another reminder was sent about a week later providing the students a last chance to participate.

In addition to the e-mail contact, the first year students were encouraged to answer the different questionnaires in multiple other ways. Each year before semester start in September, all newly enrolled students receive a 'Science guide' – a booklet with important information about the Faculty of Science, the induction activities, and the first year of studies in general. One page titled 'The chosen year group' was included in the Science guide 2014. This page included a text about my doctoral research, a play on the proudness to be included in an 'actual' research project, and a presentation of me as a former science student and as a researcher. Specifically, the text encouraged students to participate in the ongoing questionnaires that they would receive throughout their first year of studies. The text was written in a personal tone and included a picture in the hope that the students would feel an obligation to me personally to answer the questionnaires. The page in the 'Science guide' is included in Appendix 7.

Furthermore, the study group mentors were asked to encourage their study group members to participate in the questionnaires. Additionally, when questionnaires 1a and 1B were distributed, time was reserved in the students schedule to answer the questionnaires. This partly explains the increased response rates of these questionnaires compared to the others. With regard to questionnaire 2, the teachers of the two courses under investigation personally encouraged their students to answer the questionnaire. And concerning questionnaire 3, a separate e-mail was sent to the study group mentors from their daily contact persons (the study start coordinator and me). In that study I had a specific interest in the study group mentors and my close contact with them enabled me to reach out to them.

5.4.2 Consent form

The questionnaires that were distributed with me in my researcher role as sender contained consent forms. The consent form assured anonymity, informed that the consent could be retracted at any time, and provided my contact details in case further information was desired. For the questionnaires 1A, 1B and 1D, the first question constituted the consent form ("I consent to my anonymous responses being used for research purposes" or "I do not consent"). Respectively, two,

thirteen, and five respondent did not give consent in these questionnaires. For questionnaires 2 and 3 the first page posed a text which informed that answering the questionnaire implied consent for the responses to be used for research purposes.

5.4.3 Additional questionnaires

It was the irony of fate that the SDU Rectorate chose 2014 as the year to introduce a 'Study start assessment' for all faculties at the university. Therefore, in addition to the Faculty of Science's annual (and this year very comprehensive) 'Study start evaluation', the first year science students also received another questionnaire (however, much shorter in length) on the same topic only a week after receiving questionnaire 1B.

From experience, we (my colleagues and I) know that students – especially first year students – generally do not make a distinction between information (or in this case: questionnaires) from the institution SDU in general and their specific faculty. Therefore, the distribution of these two questionnaires at basically the same time from what would appear to be the same sender would seem odd (or in worst case unprofessional) to the students. We tried to remedy this by sending another e-mail clarifying differences between the two evaluations.

In the same year of studies (2014/2015), an assessment of the study environment at SDU was also due and a comprehensive questionnaire was distributed to all SDU students - including the first year science students. In total, the majority of first year students enrolled in 2014 received six questionnaires during their first year of studies. The low response rate of questionnaire 1D might partly be explained by the students simply being bored or irritated with the number of questionnaires they received that year.

5.5 Analytical approach

Different types of data were obtained from the questionnaires. Therefore, the methods of data analysis differed based on what was deemed appropriate with the given data. However, most data were numerical and therefore treated statistically. The focus below will therefore be on the statistical considerations. The specific analysation methods utilised in the individual papers are described in the papers. Aside from quantitative statistical analyses, papers I and IV also feature qualitative analyses of student comments with a thematic analytic approach as described by Braun and Clarke (2006) and Hsieh and Shannon (2005).

5.5.1 Statistical analysis

Statistical analyses were performed in the Statistical Package for the Social Sciences (SPSS Statistics 23.0) (IBM, 2015). The applied statistical techniques were descriptive (describing data) and inferential (drawing conclusion from data). Generally, background or demographic data and non-scale-data were treated descriptively and were not subject to further analysis (papers III and IV).

Inferential statistics were used on scale-data to test hypotheses and provided findings for correlational studies (papers I, II, and V). These techniques mainly consisted of tests for correlations (detecting associations) and tests for differences in means (group comparisons). Robson (2011) warns not to overdo data analysis with complicated statistical techniques (that will be hard for readers to see through) when less advanced techniques are able to illustrate the same point. In compliance with this, the employed statistics have been simple and to the point at all times and still sufficient to fill the purpose of descriptive and correlational research.

Had I sought to establish causality, more advanced techniques would have been appropriate. However, in paper I a multivariate technique, an exploratory factor analysis, was used to sort individual items into subscales. The inferential methods that were utilised in the contributing papers are listed below along with a short description of their applicability (covered in details by e.g. Field, 2013).

As evident in the list, the tests used to detect differences in mean (*t*-tests) are parametric (opposed to non-parametric). These tests treat data as continuous data (interval or ratio) and assume homogeneity of variance and a normal distribution.

Chi-square test (paper V)	Tests if the observed distribution of categorical data is different from the expected if the null hypothesis of equal distribution is true. Also written as χ^2-test or called χ^2-distribution test.
Independent *t*-test (papers I and V)	Compares two means stemming from two different (independent) groups of respondents e.g. students from two different study programmes. Also called independent-measures *t*-test, independent-samples *t*-test, and independent-means *t*-test.
Dependent *t*-test (paper I)	Used to determine if there is a difference between two dependent variables, e.g. the same variable from the same group of respondents at different times (could be pre- and post-test scores). Mathematically, the method compares means of differences to zero. Also called paired-samples *t*-test and matched-pairs *t*-test.
One-sample *t*-test (paper II)	Compares a mean score with a pre-determined target or reference value e.g. a criterion for success.
Pearson's correlation (paper V)	Measures the linear co-variation/association/ relationship/correlation between to variables. Provides a correlation-coefficient (r). A positive r indicates a positive correlation; when one variable increases the other does too. A negative r indicates a negative correlation; when one variable increases the other decreases. If r=0: no correlation, and if r=±1: perfect correlation. Can be used as a measure of effect size, r=±0.1: small effect, r=±0.3: medium effect, and r=±0.5: large effect.
Exploratory factor analysis (paper I)	Explores the number of underlying/latent factors (constructs) that the collective pool of items measure. Used to reduce a large number of variables (individual items) into a smaller number of variables (subscales) to be used for further analysis. A confirmatory factor analysis is performed, if the purpose is to confirm the 'sub-scale-belonging' of individual items if these are pre-determined.

If the assumptions for parametric tests are not meet, there are non-parametric equivalents e.g. Wilcoxon and Mann-Whitney tests. However, these tests do not provide the statistical power that parametric testing do (Norman, 2010), and some social science statisticians, e.g. Field (2013), do not recommend non-

parametric testing if avoidable. Concerns on whether Likert scale data can be assumed to fulfil the requirements of parametric testing is raised in section 5.5.1.1 below.

Concurrent with general convention, a significance level of 5 % (0.05) was used as the maximum accepted probability (p-value) in order to reject the null-hypothesis and accept the alternative hypothesis. The alternative hypothesis is the hypothesis that is put forward on the basis of theory, literature and/or experience – the one the researcher believes or guesses to be true. In addition to calculations of p-values in the tests, effects sizes (r) have been calculated whenever *t*-tests gave a statistical significant result. The *t*-test's p-value is the probability that a difference which is at least as big as the observed difference would be observed by chance if there really is no difference in the population (a true null-hypothesis); it indicates whether or not the null hypothesis should be rejected. It does not indicate the size (importance/effect) of these differences.

It is an ongoing discussion among researchers within (social science) statistics that the p-value should not stand alone; it should always be accompanied by some indication of the effect size (Field, 2013; Robson, 2011). Researchers calling for this put forward the fact that statistically significant differences (even small differences) can easily be detected with large sample sizes whereas the effect size measures are independent of sample size. Logically, the true effect or difference in population means is also independent of how many respondents answered the questionnaire. It also follows that a large or a moderate difference is more significant (understood in the non-statistical meaning of the word) than a small difference. But the significance test indicates whether or not it is reasonable to assume that there is a difference in the first place.

5.5.1.1 Statistical analysis of Likert scales

Carifio and Perla (2008) describe the ongoing discussion about how to analyse Likert scale data as a battle between the 'ordinalist' and 'intervalist' position. They argue that researchers who view the data as ordinal and therefore advocate non-parametric testing fail to acknowledge the abundance of empirical research demonstrating that Likert scale data can be considered interval in nature. Therefore, parametric testing can and should be used to obtain *"the richer, more powerful and more nuanced understanding they produce"* (Carifio & Perla, 2008, p. 1151). Examples of researchers supporting this notion are Glass, Peckham, and Sanders (1972), Murray (2013), and Norman (2010). The argument for Likert scale data to be interval in nature is that the act of compiling items transforms the individual (nominal) score data to a total (interval) score. Empirical research has

confirmed this (Carifio & Perla, 2007). The present dissertation also takes the intervalist position and analyses the data obtained from Likert scales using parametric testing (after the distribution of data is judged to be approximately normal).

Besides the ordinalist-intervalist discussion, concerns are often being raised about a number of other issues, e.g. violating assumptions of non-normality. Often data will be more or less skewed towards one side, but Bortz (2005) argues that the *t*-test is quite resistant to such violations, and that data generally can be assumed from a normal distributed population even with small sample sizes. After reviewing the concerns of violation of the parametric test-assumptions in relation to existing empirical and theoretical research, Norman (2010) came to the conclusion:

> *"Parametric testing can be used with Likert data, with small sample sizes, with unequal variances, and with non-normal distributions, with no fear of "coming to the wrong conclusion". These findings are consistent with empirical literature dating back nearly 80 years. The controversy can cease (but likely won't)."* (p. 631)

The calculation of Cronbach α-coefficient has been used consistently to evaluate the internal reliability/consistency of scales/subscales. Values higher than 0.7 (Field, 2013) or 0.6 (Jensen & Knudsen, 2014) are considered acceptable.

5.6 Validity, reliability, and generalisability

The trustworthiness and value of studies are indicated by their validity, reliability, and generalisability (Robson, 2011). Reflections concerning these constructs are presented below.

5.6.1 Validity

Sirkin (2006) defines validity as *"the extent to which the concept one wishes to measure is actually being measured by a particular scale or index* (p. 73)". This is what Robson (2011) defines as construct validity. Generally, the scales that were developed have sought to be congruent with generally accepted definitions of the concepts being assessed. Table 3 lists the scale measures that were utilised in the studies along with a description of their theoretical framework. This theoretical foundation supports construct validity.

There could be a concern that a question or item is misunderstood by the respondents (or that the respondents and the researcher simply understand the

question in their own way). To decrease this risk, a colleague and I went through the phrasing of all questions, items, and assisting text. In cases of (identified) ambiguity a third party (and sometimes more) was invited to join the discussion of phrasing.

In the case of translation of scale items, maintaining the meaning is essential, so here an English specialist was consulted. The use of comment fields at the end of a series of questions or items on the same topic constitutes a form of triangulation of the findings and would reveal if the students did not feel that their experiences relevant to the topic were captured in the preceding questions/items.

Another type of validity, internal validity, refers to the plausibility of the study to be able to demonstrate causality (Robson, 2011). As the conducted studies primarily were non-experimental, correlational studies, the objective was not to infer causal relationships. However, in paper V a possible causal relationship between (formal and informal) involvement in the study environment and the level of university belonging is discussed. Here, a positive feedback loop among the two factors is hypothesised based on correlational findings and previous educational research. But it cannot be ruled out that a third factor really causes both increased involvement and increased university belonging.

5.6.2 Reliability

Reliability refers to the consistency or stability of a measurement (Robson, 2011). Reliability is necessary, but not sufficient for a measure to be valid. Therefore, reliability can be considered an aspect of validity. A reliable scale measures the same aspect in a consistent way for all respondents, and items belonging to the same subscale will be positively correlated (internal consistency). As described earlier, the internal consistency of all scales and subscales were evaluated with Cronbach's α which provides a measure of the level of inter-item correlation. There has not been performed inferential statistics on individual items. Such testing would be less reliable than testing of scale (multiple-item) scores because a person's attitude can deviate on individual issues in spite of an overall (e.g. conservative) attitude.

Robson (2011) lists four types of threats to reliability: participant error and bias, and observer error and bias. The latter two, observer error and bias, are not relevant to this study as all data stem from computer-based, self-completed questionnaires. Participant error refers to respondent's response fluctuations which can occur due to external factors such as fatigue. When answering a questionnaire the respondents go through the process of comprehension (of the

question), retrieval (of relevant information from memory), judgment (integrate information to form a judgment), and response selection (translate judgment into a response option) for each question (Krosnick & Presser, 2010). This process requires mental effort, and as respondents' motives to participate with answers to the questionnaires can vary greatly, there is a risk that some […]:

> *"[…] may agree merely to provide answers, with no intrinsic motivation to make the answers of high quality. Other respondents may satisfy whatever desires motivated them to participate after answering a first set of questions, and become fatigued, disinterested, or distracted as a questionnaire progresses further"* (Krosnick & Presser, 2010, p. 265)

This risk is considered prominent in the case of the first year students. They recurrently received questionnaires during their first year of studies, and questionnaire 1B was comprehensive. The concern was also raised in section 5.4.1 where the initiatives to encourage students to respond were described.

Besides encouraging participation, considerations regarding the questionnaire design were also made. The number of open questions was generally minimised as it would take more time and effort for respondents to formulate answers themselves than to choose a predefined answer. Also, students were generally not forced to answer these open questions by an automatic notice of missing answers. In the closed questions or items this notification would show, but here there was a 'don't know' or 'not applicable' response option to choose.

Participant bias is the result of factors internal to respondents. Examples are social desirability bias (respondents answering what they believe to be the socially accepted rather than the true answer) and recall bias (respondents find it hard to remember relevant information and might only remember positive or negative aspects). These concerns are not believed to affect the studies to a great extent. The respondents are treated anonymously throughout the whole process which allows them to be more frank than they would otherwise be (Robson, 2011), and the events that the students are asked to recall are generally recent ones.

5.6.3 Generalisability

The generalisability (or external validity, Valentine & Cooper, 2005) of a study refers to the extent to which the findings can reasonably be claimed to be generally applicable. Do the findings apply to other contexts, other persons, and at other times than the specific context, participants, and time of study?

Generalisability is often challenged when conducting research involving human beings, due to their complex nature and the multiple factors influencing attitude and behaviour (Valentine & Cooper, 2005). What works in one context may not have the same effect in another context. Determining if the study's sample (the respondents) is representative for the population is an important part of assessing the generalisability. High response rates and large sample sizes will generally increase the probability of obtaining generalisable findings. The response rates in the different questionnaires (46.1-76.1 %) have generally been acceptable. A response rate above 70 % is ideal, but researchers should expect a response rate at 35-40 % when distributing the questionnaire to a large number of people (Hansen & Nørregaard-Nielsen, 2008). Whether such a response rate is acceptable in specific studies, is a matter of rational judgement in these individual studies. In a meta-analysis of 1607 organisational research studies, a mean response rate of data collected from individuals was 52.7% with a standard division of 20.4 (Baruch & Holtom, 2008).

In the studies presented in this dissertation there are multiple layers of possible generalisation. Do the respondents constitute a representative sample for (science) students at SDU?, in Denmark?, in the Nordic countries?, ect. These questions refer to context- and participant-dimensions only. Adding a time-dimension allows for additional layers of possible generalisations. Will the findings apply a year from now? In five years? In ten years? The answers to these questions can only be indicated with a high degree of uncertainty. For example, differing and shifting policies at educational institutions and in countries will significantly reduce a study's generalisability.

Since the academic year 2014/2015 a dimensioning (limit of enrolment) of selected study programmes has been implemented. For the science programmes at SDU this meant that the life science programmes introduced an upper limit to their enrolment of students. Admission was hereafter based on grades or performance in admission tests (the latter will be implemented in 2017). With the continuous increase of students applying for enrolment in these study programmes the lack of 'open' admission will gradually alter the composition of students.

Another feature of political interest in Denmark is the focus on study programmes' utility value. Upper secondary graduates are encouraged to consider job prospects when choosing their study programmes (e.g. Confederation of Danish Industry, 2010). The latest enrolment numbers indicate that the young people have taken this aspect into account. This also implies that students' motivation to choose their study programme is changing.

The results presented in this dissertation concern Danish tertiary science students and are not directly transferable to other countries or other educational settings. However, the findings presented in paper I resonate Danish studies (Holmegaard et al., 2014a; 2014b; Johannsen, 2012) and the benefits of the Study Group Concept had similarities with international studies (e.g. Arco-Tirado et al., 2011). Furthermore, the Danish educational system has many similarities with the other Nordic countries (Börjesson, Ahola, Helland, & Thomsen, 2014) which support the generalisability of the conclusions.

It should be noted that parts of the conducted research is evaluation and action research. The objective is to gather knowledge of the science students at SDU and what works in their specific and concrete context. Therefore, a high degree of generalisability has not necessarily been an overall concern.

PART 3: CONTRIBUTING PARTS

6 Contributing Papers

The five contributing papers constitute the main findings of the doctoral research performed during these last three years of PhD studies. Three papers (I, II, and III) concern first year students, and the remaining two papers (IV and V) concern older students who are involved with the first year through a student employment position.

A summary of each paper and their implications is provided in the following sections. Then, the manuscripts of the contributing papers are included in their entirety followed by the outlines of two additional future papers. Joined together the contributing papers and the paper outlines demonstrate the width of the research which has been conducted during the three years of PhD education. Below, the full titles of the contributing papers are listed.

Paper I	Motivational Patterns in STEM Education - A self-determination perspective on first year courses
Paper II	Supporting Students' Motivation in Large Enrolment Courses – A case study of the First Year Project
Paper III	Studiegrupper og Studiegruppevejledere på Naturvidenskabelige Universitetsuddannelser
Paper IV	Mentoring First Year Study Groups – Benefits from the mentors' perspective
Paper V	University Belonging - Relation between students' sense of belonging and being a student employee at the university

6.1 Paper I: Motivational Patterns in STEM Education

Full title	Motivational Patterns in STEM Education - A self-determination perspective on first year courses
Authors	Nadia R. Dyrberg and Henriette T. Holmegaard
Status	In review with *International Journal of Science Education*
Data source	Questionnaire 1B

Paper I takes its starting point in the general concern of high attrition rates in tertiary STEM education and the realisation that students' first year experiences are critical for their academic success. Following the recommendation from Tinto (2006; 2016), attention is turned to the classroom – specifically, the paper focuses on students' meeting with their first courses and their motivation to learn in these courses. Previous Danish research has shown that STEM students often experience a gap between their expectations and the actual content of their first year of studies (Holmegaard et al., 2014a). Especially, the students struggle to realise the relevance (and are surprised by the extent) of mathematics courses.

The reported study investigates 173 first year students' experiences with and motivation towards learning in two large enrolment first year courses: a course in physics and mathematics and a course in chemistry, biology, and molecular biology. The students were enrolled in BMB, biomedicine, or physics studies. These three science programmes were chosen because the programmes are subject to the exact same first semester. The students are enrolled in the same courses and participate in joint lectures. Hence, there is basis for comparisons of students' motivational patterns in two similar programmes (BMB and biomedicine) and one programme that significantly differs from the others (physics).

Within the theoretical framework of Self-Determination theory, students' levels of autonomous and controlled motivation towards learning in the two courses are investigated with a two-sub-scale measure. Quantitative analysis of this measure provides the main findings which are supplemented and exemplified with a qualitative content analysis of student comments to the multi-disciplinary structure of their first year of studies.

The findings suggest that students display significantly higher levels of autonomous motivation when courses clearly relate to their chosen study programme. For example the biomedicine students display higher levels of autonomous motivation to learn chemistry and biology than to learn physics and mathematics. Statistically significant differences are detected between physics

students and both BMB and biomedicine students, but no differences are uncovered between BMB and biomedicine students.

In congruence with previous findings, student comments confirmed that the first year science students struggle to understand why they are presented with a multidisciplinary first year of studies – some even to the extent that they reconsider their choice of study programme. With the current structure of the first year of studies, there is a critical need to aid the students' realisation of the relevance of their course content. If not, the risk of drop-out is eminent (and perhaps unnecessary). A number of comments point to the phenomenon of deferred gratification; roughly put, these students simply endure the first year and wait for the 'exiting' courses to begin.

The scholarly contribution made by paper I consists of knowledge regarding students' motivation in different courses in a multidisciplinary first year of studies and thereby input to the discussion of how to present multi- and interdisciplinarity to students. The study is of importance to teachers, curriculum planners, and head of studies and points to implications for both the overall curriculum design and the content of individual courses. In order to plan effective teaching and learning activities, teachers must be aware of the motivational range which is present in courses followed by students from multiple study programmes.

6.2 Paper II: Supporting Students' Motivation in Large Enrolment Courses

Full title	Supporting Students' Motivation in Large Enrolment Courses – A case study of the First Year Project
Author	Nadia R. Dyrberg
Status	Manuscript in preparation
Data source	Questionnaire 1D

Paper II provides a concrete example of a large enrolment science course that successfully fosters students' motivational needs. The First Year Project is a large-scale project-based course located at the end of the first year of science studies at SDU. The students conduct 'real' research projects in groups of three to six students and communicate their knowledge in a poster session. Family and friends are invited to the poster session and three posters are rewarded with prizes: the scientific prize, the innovation prize, and the audience prize.

With inspiration from the theory of communities of practice and the motivational theories Self-Development Theory and Expectancy Value Theory, the study evaluates 188 students' experiences with the First Year Project in the spring semester of 2015. The findings suggest that the First Year project supports students' basics needs of competence, autonomy and relatedness and students' subjective task value. Furthermore in accordance with the ideas of communities of practice, the First Year Project can be viewed as student's first step in becoming legitimate participants in the scientific research community.

The scholarly contribution made by paper II consists of a concrete example of a large enrolment course that successfully fosters students' motivation. The motivational claims are made within the frameworks of theoretically recognised constructs of motivation. It was evident from the literature review that studies reporting on concrete initiatives often claim that the initiatives motivate students, but rarely investigates motivation within a theoretical framework.

The manuscript is prepared as an 'instructional article' to International Journal of Teaching and Learning in Higher Education which aims to *"explain and describe innovative higher education teaching methods. Instructional articles, while grounded in the literature on higher education pedagogy, focus on the detailed explanation of tentative, emerging, or alternative teaching methodologies rather than the reporting of empirical data."*(IJTLHE, 2016).

6.3 Paper III: Studiegrupper og Studiegruppevejledere

Full title	Studiegrupper og Studiegruppevejledere på Naturvidenskabelige Universitetsuddannelser [Study Groups and Study Group Mentors at Tertiary Science Programmes]
Authors	Nadia R. Dyrberg, Camilla G. Kromann, and Claus Michelsen
Status	Published in *Matematik- og Naturfagsdidaktik (MONA) 4*, 44-46, 2015
Data source	Questionnaires 1a and 3

The topic of paper III is the Study Group Concept at the Faculty of Science, SDU, which has the objective of aiding students' social and academic integration and the establishment of effective study habits. The key elements of the concept is pre-defined study groups with affiliated study group mentors, scheduled study group sessions, and teacher-assigned material based on cooperative learning. The study group mentors are older students who facilitate productive group work and act as role model for the newly enrolled students. The paper evaluates 353 first year students' experiences with the Study Group Concept through an explorative inductive approach. Secondarily, the perspectives of 43 study group mentors are also included. The findings suggest that first year students' benefit from the Study Group Concept on multiple levels with regard to e.g. social integration, academic competences, and development of effective study techniques. The students also mention a sense of obligation to the group which motivated them to 'get things done' and 'get out of the door'. Less positive aspects of the study group are varying commitment and level of ambition among group members, large group sizes, and (perceived) lack of relevant assignments. A finding of particular interest was that the study group mentors also seem to benefit from the experience of acting as mentors in terms of increased study competences.

The paper positions itself as evaluation research and provides communication on an educational development project. The paper provides the rationale behind the concept along with enough details on the practical implementation for others to take inspiration and adapt the concept to their own context. The paper was written in cooperation with Camilla G. Kromann and Claus Michelsen. Camilla is the primary contact person for the study group mentors. Camilla and I have been responsible for the implementation, evaluation, and continuous development of the Study Group Concept. Claus was vice dean of education at when the Study Group Concept was implemented. In cooperation with the study board, he developed the theoretical starting point of the concept. In order to reach both decision-makers and practitioners, the paper was published in the leading national journal within science education.

6.4 Paper IV: Mentoring First Year Study Groups

Full title	Mentoring First Year Study Groups – Benefits from the mentors' perspective
Authors	Nadia R. Dyrberg and Claus Michelsen
Status	In review with *European Journal of Science and Mathematics Education*
Data source	Questionnaire 3

Like paper III, paper IV also revolves around the topic of the Study Group Concept. However, this paper has a sole and more detailed focus on the experiences of the older students employed as study group mentors. The point of departure is the widespread use of student employees at universities and colleges throughout the world. Initiatives involving experienced students mentoring less experienced students are extensively reported. But often, these studies focus on the mentees' benefits. This paper takes on the mentors' perspective and investigates if they too benefit from their experiences as study group mentors.

In total, 128 students are included in the study. Of these, 43 students were current or former study group mentors. The remaining 85 students had never been employed at the science faculty. The findings indicate that the study group mentors perceive their task as important and believe that they are able to make a difference for the individual first year student. The majority of mentors indicated that they had increased their network and their consciousness of own study habits. A noticeable portion of the mentors (40%) also believed to have increased their academic competences. The study also found that the students serving as mentors constituted a group of highly engaged students. For example, 37% of the mentors were involved in volunteer work at the faculty compared to 5% of the non-employed students. This high level of engagement combined with a proudness of being selected for the self-perceived important task of being a study group mentor may partially explain why study group mentors (and other employed students) display higher levels of university belonging than non-employed students (paper V).

In contrast to paper III, paper IV is targeting an international readership. Hence, paper IV also provides details of the Study Group Concept and encourages others to take inspiration from the concept. In addition, decision-makers are encouraged to include mentors' benefits in the equation when considering new initiatives towards younger students. Paper IV puts forward the idea that benefits may go beyond the student life in terms of increased employability. Thus, serving as a mentor can benefit students both during their studies and after graduation.

6.5 Paper V: University Belonging

Full title	University Belonging - Relation between students' sense of belonging and being a student employee at the university
Author	Nadia R. Dyrberg
Status	In review with *Educational Psychology*
Data source	Questionnaire 3

Paper V concerns third year and older students' sense of belonging to their university (university belonging). Researchers have argued that sense of belonging is a key factor for student success in a higher education – but research in the field is still limited. However, an association between university belonging and informal (voluntary) involvement in the study environment has been established. This study investigates whether such association also exists with another more formal type of involvement – student employment. In the light of higher education institutions' extensive use of student employees, it is important to know more about associations between student employment and factors that positively affect student success and prevent drop-out.

Using a measure for university belonging, the paper investigates the level of university belonging among 152 third year or older students. Of these, 79 students had never been employed at the science faculty (non-employed), and 73 had been employed in a student position at the faculty. Statistically significant differences in the mean level of university belonging are found when comparing I) volunteering versus non-volunteering students, II) employed versus non-employed students, and III) students employed in one position versus multiple positions. The findings suggest that formal as well as informal involvement at the educational institution is associated with higher levels of university belonging. The fact that differences in the level of university belonging could be detected among science students in this small-scale study add to the strength of the conclusion because science students traditionally spend many hours at the university and already are in relatively close contact with other students and teachers.

The paper provides knowledge of university belonging from a new context (Denmark) and with a focus that has not been investigated before: student employees. This is important because research in the construct of university belonging is only now emerging. The paper findings have implications to practice as the use of student employees is already ubiquitous. With knowledge about the relation between university belonging and involvement (and assuming a causal effect from involvement to sense of belonging), educational institutions may even use the involvement of older students strategically.

PAPER I

MOTIVATIONAL PATTERNS IN STEM EDUCATION – A SELF-DETERMINATION PERSPECTIVE ON FIRST YEAR COURSES

Dyrberg, N.R. and Holmegaard, H.T. (2016).

Submitted to *International Journal of Science Education*.

Note: The manuscript can be acquired by contacting the author.

PAPER II

SUPPORTING STUDENTS' MOTIVATION IN LARGE ENROLMENT COURSES – A CASE STUDY OF THE FIRST YEAR PROJECT

Dyrberg, N.R. (2016).

In preparation.

Note: The manuscript can be acquired by contacting the author.

PAPER III

STUDIEGRUPPER OG STUDIEGRUPPEVEJLEDERE PÅ NATURVIDENSKABELIGE UNIVERSITETSUDDANNELSER

Dyrberg, N.R., Michelsen, C., and Kromann, C.G. (2015). [Study Goups and Study Group Mentors at Tertiary Science Programmes]. *Matematik- og Naturfagsdidaktik (MONA)*, 4, 44-64.

Note: The manuscript can be acquired by contacting the author.

PAPER IV

MENTORING FIRST YEAR STUDY GROUPS – BENEFITS FROM THE MENTORS' PERSPECTIVE

Dyrberg, N.R. and Michelsen, C. (2016).

Submitted to *European Journal of Science and Mathematics Education.*

Note: The manuscript can be acquired by contacting the author.

PAPER V

UNIVERSITY BELONGING – RELATION BETWEEN STUDENTS' SENSE OF BELONGING AND BEING A STUDENT EMPLOYEE AT THE UNIVERSITY

Dyrberg, N.R. (2016).

Submitted to *Educational Psychology*.

Note: The manuscript can be acquired by contacting the author.

7 Paper Outlines

Data from two other studies than the ones presented in papers I-V have been collected, but are yet to be thoroughly analysed and compared/contrasted to literature. Therefore, in addition to the contributing papers, the outlines of two papers are presented below to illustrate the potential of the collected data. The outlines present main ideas in the form of preliminary title and abstract, research hypotheses, method overview, and preliminary findings.

7.1 Outline 1 – Choosing Tertiary Science

The outline below revolves around science students' retrospective considerations about choosing their study programme. Data for this forthcoming paper were collected with questionnaire 1A a few weeks after study start.

Preliminary title

Choosing Tertiary Science – An Expectancy-Value analysis of students' retrospective considerations about enrolling in Danish science programmes

Preliminary abstract

Being aware of students' motivation to pursue tertiary science is essential to support their motivation after enrolment. Within the theoretical framework of expectancy-value theory the study examines the motivational patterns of newly enrolled science students in different science programmes. The study was conducted in Denmark where undergraduate science studies are quite fixed. Especially, the first year of science studies offers joint courses for students from multiple study programmes and little opportunity for students to make adaptations in accordance to their individual motivational orientations. With a quantitative research design a questionnaire was distributed to all first year science students a few weeks into their first semester of studies. The questionnaire items constituted five subscales with good internal consistency: attainment value (Cronbach's $\alpha=0.78$), intrinsic value ($\alpha=0.82$), utility value ($\alpha=0.82$), cost beliefs ($\alpha=0.70$), and self-efficacy beliefs ($\alpha=0.86$). Differences were revealed between males and females in mean utility value ($p=0.010$, $r=0.17$) and mean cost beliefs ($p<0.001$, $r=0.28$) – in both cases females scored higher than males. Differing patterns of motivational orientations among students enrolled in different study programmes ($p>0.001$) was also detected. The implications of the findings are discussed in relation to literature on student persistence. It is concluded that students would benefit from courses that explicitly relate to students motivational orientations.

Research hypotheses

The aim of the study was to investigate science students' considerations about choosing their specific field of studies. Researchers have indicated that different groups of students value different aspects and hold varying self-efficacy beliefs. Therefore, a difference in motivational patterns between genders and among students from different study programmes is expected. Two research hypotheses (H1 and H2) were constructed accordingly:

> *H1: The motivational patterns to study tertiary science differ between males and females.*
>
> *H2: The motivational patterns to study tertiary science differ among students enrolled in different science programmes.*

The findings will advise the educational institution on how to foster students' motivation to study tertiary science with respect to the motivational orientations of specific groups of students.

Method

Approach: Quantitative, with a self-completed questionnaire distributed a few weeks after study start in the fall semester 2014.

Respondents: 298 first year science students in the academic year 2014/2015. Response rate was 53.6%. However, 15 were excluded from analysis; they 1) did not give consent for their responses to be used for research (2), or 2) did not response to the measure-items (13). The analysis included 283 students.

Measure: Self-developed measure of task value and self-efficacy beliefs with inspiration to phrasing of items from Glynn et al. (2008), Tuan et al. (2005), and Bøe et al., (2011). The measure has five subscales and utilised a 7 point response format.

- Attainment value: 7 items, Cronbach's α=0.784
- Intrinsic value: 7 items, Cronbach's α=0.820
- Utility value: 7 items, Cronbach's α=0.823
- Cost beliefs: 6 items, Cronbach's α=0.704
- Self-efficacy beliefs: 7 items, Cronbach's α=0.856

Statistical analysis: Independent *t*-tests were used to test for differences in mean scores of each subscale between genders. MANOVA to test for differences among students from different study programmes.

Preliminary findings

Total scores:

Attainment		Intrinsic		Utility		Cost		Self-efficacy	
M	SD	M	SD	M	SD	M	SD	M	SD
5.00	1.15	5.72	0.97	3.93	1.19	4.53	1.13	4.96	1.10

Pairwise dependent *t*-tests revealed that the score for intrinsic value was significantly higher than both attainment value ($p<0.001$) and utility value ($p<0.001$), and that attainment value was significantly higher than utility value ($p<0.001$). This indicates that intrinsic value is the most important value construct followed by attainment value and then utility value when Danish science students choose what to study.

Differences between males and females (independent *t*-test):

	Males		**Females**		**p-value**
	M	SD	M	SD	
Attainment	4.88	1.22	5.12	1.07	0.106
Intrinsic	5.71	0.96	5.73	0.99	0.861
Utility	3.71	1.23	4.12	1.13	0.010*
Cost	4.20	1.15	4.83	1.02	0.000**
Self-efficacy	5.00	1.19	4.92	1.02	0.571

Significant differences between males and females are detected in utility value (effect size (r) = 0.17) and cost beliefs (effect size (r) = 0.28). This indicates that when considering what to study, the females have considered the utility of the chosen field of study to a greater extent than the male students. The females are also more worried about the costs than the male students. No differences in the degree to which attainment value and intrinsic value are considered were detected nor was a difference in self-efficacy beliefs detected. Thus, the first hypothesis was partially supported.

Differences among study programmes (MANOVA):

	Attainment		**Intrinsic**		**Utility**		**Cost**		**Self-efficacy**	
	M	SD	M	SD	M	SD	M	SD	M	SD
Biology	4.99	1.10	5.78	0.76	3.33	1.19	4.56	1.16	4.80	1.26
Pharmacy	5.22	1.35	5.76	1.13	4.69	1.01	4.76	1.06	5.15	0.99
Computer science	4.32	1.29	5.27	1.02	4.08	1.27	4.27	1.21	4.88	1.07

	Attainment		Intrinsic		Utility		Cost		Self-efficacy	
Biomedicine	5.09	1.07	5.59	1.07	4.11	1.15	4.82	1.02	4.86	1.10
BMB	5.05	0.99	5.96	0.85	3.77	1.10	4.74	1.11	4.81	0.97
Chemistry	5.16	0.62	6.20	0.50	4.09	0.96	3.63	1.02	4.95	1.35
Physics	5.22	0.79	6.10	0.68	3.35	0.71	4.16	1.00	4.98	1.10
Nanobio-science	6.33	0.66	6.62	0.33	5.10	1.01	5.00	1.26	5.29	1.22
Mathematics	4.84	1.31	5.85	0.91	3.57	1.22	3.85	1.37	5.91	0.60
Applied mathematics	4.74	1.01	5.68	1.08	3.25	1.05	4.15	0.95	4.95	1.28

The MANOVA indicated that the study programmes indeed differed in their motivational patterns ($p>0.001$). Thus, the second hypothesis is also supported. Additional analysis will reveal wherein these differences lie.

Another interesting finding:
Student who have been enrolled in another tertiary study programme prior to their current enrolment display higher self-efficacy beliefs ($p=0.017$, $r=0.20$) and higher importance of attainment value ($p=0.022$, $r=0.19$).

7.2 Outline 2 – Students' Needs for Competence, Autonomy, and Relatedness

The second outline is about students' needs satisfaction. Within the theoretical framework of Self-Determination Theory, the outline examines development of students' feeling of competence, sense of autonomy, and sense of relatedness during their first year of studies. Data for this future paper were collected with questionnaires 1B and 1D which were distributed at the end of the first and the second semester.

Preliminary title
Students' Needs for Competence, Autonomy, and Relatedness – An analysis of the fulfilment of science students' basic needs during the first year of studies

Preliminary abstract

Supporting students' motivation is an essential part of fostering student persistence. According to self-determination theory, fulfilment of three basic inherent needs for competence, autonomy, and relatedness is a prerequisite for students' intrinsic motivation. With a quantitative pre-/post-test research design, this study examines the development of needs fulfilment among science students (n=164) during their first year of studies. The three-subscale measure 'Basic Need Satisfaction at work' was adapted to higher education studies and yielded acceptable to good internal consistencies (Cronbach's α from 0.6 to 0.89). A small increase in students' feeling of competence was detected (p=0.045) but students' sense of autonomy and relatedness remained stable during their first year of studies. The findings are discussed in relation to the structure of the first year of studies and suggestions on how to support students' motivation on the overall level of curriculum design are derived.

Research hypotheses

The aim of the study was to investigate science students' needs satisfaction during their first year of studies. The first year of science studies at SDU comprise a substantial change in structure and content of courses from the first semester which is dominated by introductory courses within all fields of science to the second semester where students take their first study programme-specific course and conduct a research project within a topic of their own choice. Therefore, a change in the level of needs satisfaction was expected from time 1 (T1): end of first semester to time 2 (T2): end of second semester. Three research hypotheses (H1-3) were constructed accordingly:

H1: The students' feeling of competence changes from T1 to T2

H2: The students' sense of autonomy changes from T1 to T2

H3: The students' sense of relatedness changes from T1 to T2

The findings will advise the educational institution on where to focus future initiatives to support students' motivation.

Method

Approach: Quantitative pre-/post-test design, self-completed questionnaires were administered twice during the first year of studies, T1: end of first semester and T2: end of second semester.

Respondents: First year science students in the academic year 2014/2015. Response rates were 76.1% (T1) and 46.1% (T2). A total of 164 pre-post matches (99 females and 65 males).

Measure: The 'Basic need satisfaction at work' used by e.g. Deci et al. (2001) was adapted to the 'job' of being a university student. The measure has three subscales and utilised a 7 point response format.

- Competence: 6 items, Cronbach's α(pre)=0.61 and α(post)=0.69
- Autonomy: 7 items, Cronbach's α=0.62 and α(post)=0.60
- Relatedness: 8 items, Cronbach's α=0.84 and α(post)=0.89

Statistical analysis: Dependent *t*-tests were used to test for statistically significant differences in pre- and post-test scores, independent *t*-tests were used to test for differences in need-development between genders, and one-sample *t*-tests were used to compare the subscales to the pre-determined criterion for success. A score on five was set as criterion for success.

Preliminary findings

Descriptive statistics of the subscales are shown below:

	Competence		**Autonomy**		**Relatedness**	
	M	SD	M	SD	M	SD
Pre	5.10	0.90	4.35	0.89	5.44	1.01
Post	5.18	0.91	4.25	0.83	5.46	1.16

The difference in pre/post-test scores was statistically significant for the competence scale (p=0.027), but not for the competence (p=0.292) and relatedness scales (p=0.268). However, the detected development in the feeling of competence was small with a mean difference on 0.17 (SD=0.83). Thus, the investigated science students display relatively stable needs satisfaction during their first year of studies and the only the first hypothesis was supported.

Only one difference was detected among males and females, this was in the post autonomy subscale where females scored 4.15 and males scored 4.41 (p=0.045). On the overall level males and females display minimal differences in the need satisfaction at the end of first seemster and no difference at the end of second semester.

To evaluate if the educational insitution successfully foster student needs satisfaction the subscale scores were tested in accordance to the chosen criterion for success: a score above 5. However, it is noted that factors beyond the control of the educational institution also affect the level of needs satisfaction. The pre-

competence subscale score was statistically equal to 5 ($p=0.210$) whereas the post-scale score was significantly higher ($p=0.010$). Both the pre- and post-autonomy subscale scores were significantly lower than 5 ($p<0.001$), and both the pre- and post-relatedness subscale scores were significantly higher than 5 ($p<0.001$). This indicates that the content and structe of the first year of science studeis at SDU do not sufficiently support students' sense of autonomy, whereas their sense of relatedness is sufieciently supported.

Further analysis will consist in an exploratory factor analysis to examine the subscales' constituion of items. The reliability analysis indicated that the reliability of some subscales could be increased by removed individual items. A cluster analysis will be performed to uncover clusters of students with similar motivational patterns. The high standard deviation of the mean pre/post difference indicated that the development pattern may be more complex than what the mean difference is able to reveal.

8 General Discussion

The studies presented in this dissertation contribute to the understanding of how specific first year associated study elements affect students' motivation to study (or rather continue studying) tertiary science. Knowledge of individual study elements' motivational potential is essential in order to design study programmes that foster student's motivation and create the best possible conditions to hinder drop-out. Centred on both first year students and older students interacting with the first year students, motivational aspects of a selection of study elements have been investigated. These study elements occur at different levels of the tertiary study experience:

Level	Study element
Specific courses	- A physics and mathematics course - A chemistry, biology, and molecular biology course - A project-based course: the First year Project
Cross-courses learning activities	- The Study Group Concept
Study programme	- The multi-disciplinary first year of studies
Study environment	- Student employment

The selected study elements constitute a small, but multi-faceted sample of what students will experience (or have the opportunity to experience) while being a student at the Faculty of Science, SDU. Because these experiences are shared among the students following the same study programmes, a predominantly quantitative research approach which enabled investigations of groups of students collectively was deemed appropriate. Therefore, in contrast to other Danish doctoral studies in tertiary STEM education (e.g. Holmegaard, 2012; Johannsen, 2012; Poulsen, 2016) the main conclusions have been made on group level about students from different study programmes and with differing employment status.

The first year of science studies at SDU is for most students characterised by a common structure, joint lecturing in large enrolment multi-disciplinary courses, the First Year project, great emphasis on study groups, and a high level of involvement from older, more experienced students. Joined together, the five papers provide context-specific insight into these key features.

Paper I investigated how the first year students' motivation is supported and challenged when meeting their study programme. The paper revealed how first year students enrolled in the study programmes BMB, biomedicine and physics possess different patterns of autonomous and controlled motivation towards learning in the same courses. Thus a profound challenge was exposed. In order to plan effective learning activities, teachers of first year multi-enrolment courses must respond to a wide range of motivations. Furthermore, student comments revealed an urgent need for explicit clarification of the meaning behind the multi-disciplinary content of the first year courses.

Paper II reported on a first year course called the First Year Project - a project-based course followed by all students enrolled at the Faculty of Science, SDU. The course successfully fosters fulfilment of students' basic needs for competence, autonomy, and relatedness and possesses high subjective task value for students. Positive experiences with the First Year Project were, however, highly dependent on the relation between the supervisor and the students and among the group members.

Papers III and IV both took on the topic of the Study Group Concept which concerns all first year science students at SDU. The students are members of pre-determined study groups and an older, experienced student is mentor and role model for the group. Paper III concerned both the mentee and mentor experience whereas paper IV solely took the mentors' perspective and investigated possible benefits from being employed as a study group mentor.

Paper V concerned the overall study environment in the investigation of third year and older students' sense of university belonging. Students who were employed in a student position and/or were engaged in voluntary activities at the university were found to possess significantly higher levels of university belonging than non-employed/non-volunteering students.

The dissertation has sought to add to the fields of knowledge about theoretically founded motivational constructs applied in new contexts as well as make contributions to practice with a highly practice-oriented perspective. Specifically, the dissertation has provided two examples of concrete motivation-supporting initiatives that others with advantage can take inspiration from: the First Year Project and the Study Group Concept.

In this general discussion, three overall themes are reflected upon across the individual papers. Section 8.1 reflects on three overall topics emerging from the conducted studies: structure of the first year of science studies, the Study Group

Concept, and involvement of experienced students in the first year of studies. In this section papers III and IV, which were explorative and non-theory driven, are discussed in relation to motivational theories. Hereafter, section 8.2 asks the question: "Which other studies will paint the full picture?". The general discussion is closed with methodological considerations in section 8.3. Discussions which are specific to the individual contributing papers are part of these papers and will not be repeated here.

8.1 Topics emerging from studies

Below, three overall topics or issues emerging from the contributing papers are brought out and reflected upon across the papers.

8.1.1 Structure of the first year of studies

The first year of science studies (at Danish universities) is often composed of a large amount of introductory and supportive courses. A Danish professor in science education described the rationale behind the traditional structure of tertiary science programmes as follows:

> *"The natural sciences are very 'concept-heavy'. Many have considered it necessary to know and understand the basic concepts before moving on to the more complex (and perhaps more motivating) issues. […] the ability to master formulas and do calculations takes up a lot of the curriculum"* (Dolin, 2013, p. 254, author's translation)

One of the main themes and recommendations emerging from paper I was that from a motivational point of view, first year students would benefit from being able to recognise their chosen subject from the beginning of their studies and throughout their first year of studies. First year courses which represent other fields of science than the chosen subject needs to clarify the relevance of the courses and make explicit relations to the chosen subject. This may seem intuitive, but it is at present not the case in the investigated study programmes of BMB, biomedicine and physics at SDU (paper I), nor did the STEM students from other Danish universities in Holmegaard et al. (2014a; 2014b) always understand the structure of their first year of studies. Especially, the presence of extensive mathematics was surprising to the students, and one student even described the first mathematics courses as a sorting process to *separate sheep from goats* (Holmegaard et al., 2014b, p. 205). Similarly, Johannsen (2012) investigated Danish physics students' experiences during their first year of studies and identified the phenomenon of deferred gratification: the students endured the

first year courses in order to get to the 'exciting' courses. The First year Project (paper II) located at the end of second semester seems to be perceived as both meaningful and exciting by the students (paper II). Maybe a course such as this could be located earlier in the first year of studies and provide students with a taste of what their chosen field of studies consist of.

8.1.1.1 Risk of drop-out

In the perspective of retention, the above mentioned struggles pose a significant risk of student drop-out. Danish studies have shown that students continuously re-evaluate and doubt their choice of study programme during their first years of studies (Holmegaard et al., 2014a; Herrman, Troelsen, & Bager-Elsborg, 2015). In a large-scale quantitative study, Herrman et al. (2015) found that one third of the students (first year as well as fifth year students) at Aarhus School of Business and Social Sciences, Aarhus University, had doubts about their choice of study programme. These doubts were especially widespread among students who did not perceive their courses interesting or relevant, had low academic confidence, and/or had obtained low grades at the university so far. From a motivational perspective, this can be interpreted as students with low autonomous motivation, low intrinsic value, low utility value, and low self-efficacy.

From Herrman et al. (2015) it is also noteworthy that the portion of study choice doubters was roughly equal at each year of studies. This implies that students might need motivational support beyond the first year of studies; initiatives to decrease students' doubt about having chosen the 'right' study programme should not be confined to the first year alone.

8.1.1.2 A new structure

Constructing a first year of science studies that fully satisfies students' motivational needs is challenging. First, students are different – various orientations of motivation at different intensities are present within the student population (outline I; Ulriksen, 2014). Secondly, the science programmes often possess a hierarchical structure of knowledge (Dolin, 2013) and changing this would be to revolutionise the study programmes.

Nevertheless, as the final pages of this dissertation are written (September 2016), new and more field-specific structures of the first year of studies are implemented in most study programmes at the Faculty of Science, SDU. The exceptions are the study programmes of computer science, mathematics, and applied mathematics where field-specific first year of studies already existed. The new first year of studies are composed of larger portions of courses directly related to the chosen field of studies along with a smaller portion of supportive courses that are

adapted specifically for the individual study programmes. For example biology students will take a course called *Mathematics for Biology*.

The rationale behind these changes has been multi-faceted, but concerns regarding first year students' motivational struggles have played an important role. These struggles have been evident in the faculty's annual study start evaluations (Dyrberg & Kromann, 2013; 2014; 2015) and the research presented in this dissertation (paper I). Furthermore, teachers, teaching assistants, and especially study group supervisors have continuously made observations supporting the roughly put notions that many first year students I) felt that their chosen subject constituted a neglected part of the first year content, II) failed to understand the meaning behind the course composition, and III) did not recognise or feel a taste of their chosen subject. It will be interesting to evaluate the experiences of the newly enrolled first year students with the new first year structures and thereby investigate if these challenges have been remedied. It will also be interesting to know if the reduced extent of basic knowledge within other science fields possesses challenges. For example, one could imagine altered inclinations to enter interdisciplinary collaborations.

The First Year Project (paper II) has been a key component of the first year of science studies at SDU for many years and continues to be included in the newly implemented first year of studies as a joint course for all science students.

8.1.2 The Study Group Concept

The Study Group Concept held a central position of the doctoral research and preliminary findings have throughout the research period provided input to the simultaneous and continuous development of the initiative in successive action research cycles. Papers III and IV provided detailed information about the design of the Study Group Concept and investigated the experiences of both the first year students (the mentee) and the older students (the mentors). It was concluded that both mentors and mentees benefit from the initiative in various ways including motivational support (elaborated below). However, cautions should be made when using older students as mentors. Poulsen (2016) raised the concern that especially mentors, with whom the mentees do not identify, risk discouraging the mentees. These observations were made from a recruitment or clarification-of-study-choice perspective but in the light of first year students' continuous re-evaluation of their choice of study programme the concern is still highly relevant.

In the Study Group Concept, the three study group mentors affiliated to the individual classes constituted a mentor team. The coordinators (the study start

coordinator and me) deliberately assembled diverse mentor teams. As far as possible, different personality types, genders, ages, interests, levels of academic achievement, and study programmes were represented in each team as a precautionary measure to ensure that all students would identify with at least one study group mentor in the mentor team. Aside from study group mentors, the first year students also meet older students and possible role models in the form of social tutors and teaching assistants.

8.1.2.1 Motivational aspects of the Study Group Concept

Papers III and IV were explorative and non-theory driven. Therefore, the following reflects on the Study Group Concept in relation to the four motivational components brought out in Figure 3: sense of relatedness, sense of autonomy, feeling of competence, and subjective task value.

Sense of relatedness

Supporting the sense of relatedness is the most obvious motivational potential of the Study Group Concept as the first year students are brought together in small working/learning communities with weekly meetings centred on cooperative learning activities. Furthermore, the associated study group mentors are encouraged to share their first year experiences in the hope that the study group mentors will be viewed as role models by the newly enrolled students. As described above, precautionary means are taken to ensure that all first year students meet at least one older student with whom they can identify.

Both the first year students and the study group mentors report social benefits from the Study Group Concept. At both levels, the students describe that the Study Group Concept caused them to talk with others with whom they would not normally have come in contact with. The first year students also describe their mentor as a person they look up to, and the majority (72%) are satisfied or highly satisfied with their mentor. The study group mentors do not only form relations with first year students and other mentors; they also have regular contact with faculty staff and among other things they feel that the daily coordinators are interested in their experiences. It is suspected that this feeling of acknowledgement is a contributing factor to the study group mentors' elevated sense of university belonging (paper V).

Sense of autonomy

The potential support of the first year students' sense of autonomy primarily lies in experiencing that the study group mentor adapts working methods and procedures to the specific group. At the mentor training days, it is continuously emphasised that as study group mentors they will become the authority figure

who knows the first year students best. With regard to the specific content of the study group sessions, assignments are provided by the teachers (lecturers) responsible for the individual courses and the mentors are expected to facilitate productive group work when solving these assignments. Within this framework, it is the mentors' responsibility to plan study group sessions in accordance with what they believe will suit their group members best. Hence, the mentor task possesses extensive freedom of choice and their sense of autonomy is also likely to be supported.

In a study with Israeli middle school students', different autonomy-enhancing teacher behaviours were tested, and somewhat surprising the findings indicated that *choice is good, but relevance is excellent* (Assor, Kaplan, & Roth, 2002, p. 261). Hence, if the study group sessions foster a general feeling of relevance and meaningfulness of assignments and working procedures, this feeling will positively affect students' sense of autonomy as well. The relevance of the course contents and group assignments is discussed below with regard to task value. The first year students' perceived relevance of working methods and procedures employed in the study group sessions (typically cooperative activities) have not been assessed directly. However, in the annual study start evaluations it has been noted that students often perceive the development of cooperative skills (especially in relation to future employment) as one of the main arguments for working in study groups.

Feeling of competence

In the annual study start evaluations (Dyrberg & Kromann, 2013; 2014; 2015) the first year students list a number of academic benefits of the Study Group Concept. A growing number of these can be interpreted as support to students' feeling of competence. For example, some students underline that the opportunity to explain the subject matter to other group members strengthens their own understanding as well as train them in scientific communication. Others emphasize that sometimes it is easier to understand the subject matter when another student (as opposed to the lecturer) explains it. Others again describe how the groups' cooperation led them to solve problems that they do not believe they would have been able to solve on their own. The study group sessions also provide the opportunity for students to compare themselves to others. Thus, the Study Group Concept offers opportunity for all three types of experiences believed to influence self-efficacy beliefs (reviewed by Koballa and Glynn, 2007): mastery experiences, vicarious experiences, and social persuasion.

Furthermore, the study group session may be especially advantageous in the development of female students' self-efficacy beliefs. Zeldin, Britner, & Pajares

(2008) studied the origin of self-efficacy belief among successful males and females in STEM careers and concluded that while mastery experiences constituted the primary source of self-efficacy beliefs for males, relational episodes of vicarious experiences and social persuasion were more important to females. Depending on group dynamic and the concrete experiences in the study groups, the Study Group Concept holds potential for both positive and negative contributions to students' feeling of competence.

Of the study group mentors, 40% reported development of academic competences (papers III and IV). However, several mentors point out that they do not consider the developed competences to be strictly academic. Instead, in their opinion the type of competences developed through the mentor experience primarily relates to communication and cooperation.

Subjective task value

The subjective values students ascribe to the study group sessions have not been explicitly assessed and will vary greatly among individual students. A central feature of the group assignments is putting the subject matter into perspective. Through such assignments, it is the hope that students will be able to realise the relevance (mainly utility value) of the first year courses to their chosen field of studies. However, from paper I it was evident, that a large portion of the first year students did not acknowledge the relevance of their all their courses. Thus, it seems that the Study Group Concept is not (yet) successful in clarifying the relevance of the courses. However, it is still part of the concept's vision that the study group will provide a safe place to discuss such issues and that the mentor will be able to clarify relevance.

The intrinsic and attainment value attributed to the study group sessions by the individual student depend on whether or not the student generally enjoys group work and considers herself/himself to be a (good) cooperating group member, and whether or not the student finds the subject matter interesting and personally meaningful. The subjective cost beliefs about the study group sessions also depend on the individual student's general preferences. The mental costs of the study group sessions may be higher for a student who generally prefers to work alone or with limited experience with group work than for a student who generally enjoys group work. Also, ensuring that all group members understand the subject matter and discussing multiple perspectives from different group members is a time-consuming process. The overall task value therefore depends on whether or not the individual student believes that the invested mental and time costs are worthwhile.

For the mentors, other considerations may contribute to the value of being a mentor. Utility value could be associated with the payment and adding a job to the CV. Paper IV showed that the study group mentors believed that they perform an important task in the induction of first year students. In the daily contact with the mentors, the coordinators of the Study Group Concept listen to episodes which have been both joyful and frustrating for the mentors. Together, these feelings and experiences add up to the collective value composed of attainment, intrinsic, and utility value.

In conclusion, initiatives such as the Study Group Concept hold great potential to foster students' motivation to persist in their studies in general and to learn in the individual courses in particular.

8.1.3 Involving experienced students

Another central feature of the first year of science studies at SDU is a high level of commitment from older, experienced students. These experienced students are involved in volunteer or payed work as social tutors, study group mentors, teaching assistants, or representatives of student organisations. Papers IV and V provided some explanation as to why the older students choose to commit themselves to the first year students – they too benefit from the experience both during their own studies and perhaps also after graduation. It is suspected that working as a student employee (or volunteering in a student organisation) provides experiences which develop generic competences that go beyond the student life. The volunteering experience was not evaluated in the present research. But it is a subject that would be highly relevant to investigate further. Arco-Tirado et al. (2011) identified positive changes in both learning strategies and social skills among a group of experienced students serving as mentors. I put forward the notion that engaging experienced students in tutoring and mentoring programmes such as the Study Group Concept could be considered a way to care for students' talents. Such caring for talents would provide an alternative to traditional elite talent programmes for students aiming at an academic career path.

Paper V both supported and extended the findings of Hurtado and Carter (1997) and Strayhorn (2012). Like them paper V found that students who are engaged in voluntary activities at the university possess a higher sense of university belonging. It is thereby concluded that the previous findings also apply to the Danish university context. The field of knowledge is furthermore expanded with the finding that employed students possess similar elevated levels of university belonging. However, the importance of university belonging in relation to student success is yet to be investigated within European contexts and the research field

needs further studying in general. At present, the research field of university belonging is still emerging and inferences are often drawn on research on school belonging (e.g. Anderman, 2003; Goodeknow, 1993; Osterman, 2000). Besides correlational studies as paper V presents, knowledge is needed to determine if the findings on school belonging apply equally to university students and if the concept is of importance across cultures. Furthermore, explorations of causality are called for.

8.2 Which other studies will paint the full picture?

The present dissertation paints a picture of students' motivation to study tertiary science. This is, however, a fragmented picture. Although the contributing papers touch upon various topics, students' motivation is also affected by other factors and other experiences than the ones presented. The following examines some of the factors that must be considered and studied further in order to come to a fuller understanding of students' motivation to continue studying tertiary science; studies which are needed in order to paint the full picture – or at least a fuller picture.

8.2.1 Background variables

The present dissertation has focussed on students experiences at their study programme. Background factors such as prior achievement, socio-economic status, being a minority, and age have generally not been considered. These are factors that are outside the control of the universities. The present dissertation focussed on the factors that are within the control (if not fully then at least partly) of the educational institutions. However, including background variables could have contributed to a fuller understanding of student motivation to study tertiary science and the findings should generally be interpreted in relation to knowledge of the influence of background variables. For example, university belonging seems to be especially important for minorities (e.g. Gummadam, Pittman, & Ioffe, 2016; Hurtado & Carter, 1997; Strayhorn, 2012) and *gender is still the major factor differentiating students' attitudes toward science* (Scantlebury & Baker, 2007, p. 272). Furthermore, low social-economic status is continuously being associated with higher drop-out rates (reviewed by Larsen, Kornbeck, Kristensen, Larsen, & Sommersel, 2013). However, in an analysis of Danish culture and the SU system in relation to studies concerning drop-out, Troelsen and Laursen (2014) have indicated that students' financial situation has no significant effects on Danish students' decision to leave their studies.

8.2.2 Danish culture

As indicated above, another feature of possible influence on students' motivational orientations is the Danish culture. Troelsen and Laursen (2014) suggested that in the Danish individualistic culture it is especially important for students to find their courses personally meaningful and findings from Holmegaard et al. (2014) support this notion. From a motivational perspective, this personal meaningfulness can be interpreted as attainment value. Paper outline I included attainment value in the investigation of students' study-choice motivation and the preliminary findings indicate that attainment indeed is important to Danish science students.

Another hypothesis was that the Danish culture renders students' degree of social integration less influential on students' decision to either stay or leave their studies (Troelsen & Laursen, 2014). The studies they reviewed both did and did not support this hypothesis. Within a STEM context, a study investigated former mathematics students' study experiences and reasons for drop-out (Holm et al., 2008). Here, not 'fitting in' in the social and/or academic study environment was the most cited reason for drop-out which indicates that the social context is important. By extension Troelsen and Laursen's (2014) hypothesis can also apply to the concept of university belonging. As mentioned earlier, additional knowledge about university belonging is needed in order to establish the importance of this concept in a Danish context in relation to drop-out, achievement, etc.

8.2.3 Motivation to choose tertiary science

Students' motivation to choose tertiary science and subsequently enrol in a science programme is the topic of outline I. These motivations are related to students' expectations of studying tertiary science – the expectations the students bring along to the study programme (Ulriksen, 2014). Holmegaard et al. (2014a; 2014b) showed how STEM students often experience a gap between their expectations and the reality they are faced with when encountering the study programme. Such gaps cause frustrations which can be interpreted as motivational struggles. Therefore, besides knowledge of how study elements affect students' motivation (as provided in the contributing papers), it is also important to be aware of the motivations which led to the choice of pursuing tertiary science and the expectations of the students when they enrol at the university.

8.2.4 STEM, science, or individual disciplines?

Paper I investigated motivational patterns among students from three specific study programmes and found significant differences between physics students and students in BMB and biomedicine. This illustrates that motivation differs from one study programme to another and that distinguished programme-specific

initiatives may be necessary to foster students' motivation. From a socio-economic perspective, insight into the motivation of physics and computer science students may be of special interest. Graduates from these disciplines (along with similar engineering disciplines) are expected to be especially in demand in the in the next few years (Uddannelsesguiden, 2016). Shapiro et al. (2015) argue that the umbrella-term STEM is too general to be applied in the discussion of future shortage of graduates as these expected shortages only apply to specific disciplines. Hence, studies focusing on STEM in general may be too general and may therefore fail to make conclusions relevant to the specific disciplines.

8.2.5 Drop-out: re-selection or system departure?

The present dissertation has not made a distinction between formal and informal drop-out. Drop-out has been used to characterise both more and less voluntary drop-out and independently of students' further educational path. However, there is a fundamental difference between reselection: leaving one study programme in order to enter another, and system departure: leaving the higher educational system altogether (reviewed by Larsen et al., 2013). A Norwegian study found that motivational struggles were more associated with re-selection than system departure, whereas the opposite was true for background characteristics (Hovdhaugen, 2009). In this study, the re-selection/system departure distribution among drop-out students was 83%/17%.

From the above it seems that the motivational struggles detected in paper I primarily concern potential 're-selectors'. Some of the student comments also did indicate that selecting another programme or the equivalent study programme at another university were considerations that were more prominent than considering leaving higher education completely.

8.3 Methodological considerations

Reflections on data collection and data analysis methods, specifically the use of questionnaires and the use of Likert scale measures, are included in chapter 5 about the overall research design. Reflections on validity, reliability, and generalisability were also included (section 5.6). Therefore, the sections below concern the selection and de-selection of theoretical frameworks guiding the studies as well as the subsequent specific measures used to assess the chosen motivational constructs. Some closing reflections on study strength and limitations end the section.

8.3.1 Theoretical frameworks

Understanding students' motivation in (higher) education is vastly complex; multiple factors, which are both within and outside the control of the educational institutions, contribute to a student's motivational orientation and intensity. The chosen theories Self-Determination Theory, Expectancy-Value Theory, and Self-Efficacy Theory are to a high extent inclusive and supplementary. However, the selection of these theories also represents a deselection of other theories. With this dissertation it was never the intention to fully describe or understand the students' overall motivation. Instead it was the intention to provide knowledge of selected constructs known to be key factors in students' achievement motivation.

Drawing on the chosen motivational theories, motivation was viewed upon as:

> *"the overall collection of a range of constructs, which themselves are the continuously changing products (self-perceptions, beliefs, and feelings) of mental processing of experiences."* (Section 3.1)

It is these self-perceptions, beliefs, and feelings that are investigated in relation to specific study experiences in the contributing papers. Therefore, throughout the conducted studies, the motivational constructs have been assessed from the perspective of the students and through students' self-reported and subjective responses to questionnaire items and questions. Institutional data on e.g. attendance could have been included as an indicator of motivated behaviour, and inclusion of data on student achievement and persistence could provide insight into the relation between motivation and these outcome variables. But for now, the present dissertation provides knowledge of the motivational status among active science students in relation to specific study elements, and future studies will investigate the causal relationships between the nature of motivation (motivational orientations and intensities) and outcomes such as students' achievement and persistence.

It was evident from the literature review (section 2.2) that Danish (and Scandinavian) research within both first year experience and motivation in higher education is limited. Therefore, the research presented here has continuously drawn on international literature. The theoretical frameworks have primarily been developed in USA, and extensive literature on the American college freshman experience exists. In this respect it is important to be aware that the Danish and American education systems are not directly comparable. For example, first year students at American colleges are typically a few years younger than Danish first year university students and American and Danish undergraduate studies are structured quite differently.

Nevertheless, with regard to e.g. self-determination theory, studies have supported the theory's cross-cultural universal importance and application (e.g. Church et al. 2012; Deci et al., 2001), and in Scandinavian contexts, expectancy-value theory has been theoretical framework in the investigations of both Norwegian and Danish students' inclination to pursue tertiary STEM programmes (Bøe, 2012; Bøe et al., 2011; Poulsen, 2016).

Although this dissertation does not take upon itself to challenge and develop theory, a small comment on the continuum of extrinsic regulatory styles proposed in self-determination theory (Ryan & Deci, 2000) is made here. The continuum analogy suggests that a students' motivation can be pinpointed to a specific point at the spectrum. However, in expectancy-value theory (Eccles & Wigfield, 2002) the different value-orientations (which roughly translate to the intrinsic and the different categories of extrinsic motivation of self-determination theory) are considered simultaneous contributors to the overall task value. On these grounds, the controlled and autonomous motivation sub-scales were evaluated separately in paper I and viewed upon as two different orientations of motivation that exists in students simultaneously rather than counteracting each other. Researchers who consider the two orientations to be counteracting have calculated a single motivation score, a 'relative autonomy index', by subtracting the controlled motivation sub-scale score from the autonomous motivation sub-scale (e.g. Black & Deci, 2000).

8.3.2 Measures of motivation

The use of internationally well-established theories allows for comparisons of findings across countries. Such comparisons should, however, always be made with caution, and parts of the research presented here have tested the applicability of theories and measures to the Danish higher education context. An example is provided in paper I. Here a measure of autonomous and controlled motivation to learn in specific courses based on Self-Determination Theory was utilised. The utilised version was originally developed and used to evaluate students' motivation to learn in an organic chemistry course at an American university (Black & Deci, 2000). When exploring the Danish students' responses in paper I, the factor analysis revealed a division of items into two distinct sub-scales corresponding to an autonomous and a controlled subscale. However, a few items statistically loaded differently than in the American study, indicating that the students for some reason perceived these questions differently than the American students. These findings indicate that the theory of self-determination is indeed applicable in the Danish higher education context, but that the operationalisation

of individual constructs (in measures) may need adaption with respect to the Danish culture.

As described in section 5.3.1, measures developed by international researchers have been employed when deemed appropriate. At other times, measures have been developed in relation to the specific context and topic of investigation. Like the selection of a theoretical framework represents a deselection of another, so does a selection of a specific measure represent a deselection of (multiple) others. The literature review in section 2.2.1 provided examples of a few of these measures with the 'Academic Motivation Scale' (Vallerand et al. 1992; 1993) and 'Motivated Strategies for Learning Questionnaire' (Pintrich et al., 1993) as the most frequently cited. Different measures of self-efficacy and related constructs were also frequently used in different operationalisations.

Utilising other researchers' measures versus self-developed measures possesses advantages and disadvantages on both sides. On one hand pre-validated measures that have been used by others offer opportunities for comparisons and spare the researcher the rigorous and time-consuming process of developing and validating the measure. On the other hand, existing measures may fail to include or be sensitive to specific contextual features of the conducted studies. Contrasting to this, self-developed measures are developed for the purpose of the specific studies, but will lose the opportunity for direct comparisons. The extensive validation process may also be beyond the scope of many research projects. To my knowledge, many studies do not report on such a validation process. Like these studies, the self-developed measures of the doctoral studies presented here have not been rigorously validated with pilot studying, evaluation of individual items and subsequent testing of the final measure. The measure has however, been evaluated in terms of e.g. consistency (internal reliability) and face validity. Furthermore, all measures have been developed with inspiration from other (validated) measures.

8.3.3 Strengths and limitations

Throughout the duration of the doctoral research period, preliminary findings and subsequent recommendations have been included when discussing educational development initiatives at the Faculty of Science, SDU. In general, the research has been close to practice and main parts of the research have been conducted at 'action research'. This possesses both strengths and weaknesses. The recommenddations deduced from the research conclusions are easily applicable to the context and practice in which the studies have been conducted, but the general transferability (and thereby the external validity) may suffer. However, I argue that educational research and studies involving human psychology and behaviour

in general are challenged with regard to generalisability as there will always be contextual considerations to be taken into account.

Earlier studies involving Danish STEM students have mostly been qualitative. Therefore, I argue that my findings not only rediscover the motivational struggles uncovered by others. My findings also supplement and extend the qualitative knowledge with quantitative knowledge of the prevalence of the motivational phenomenons. A particular strength of the studies has been the ability to distinguish between different study programmes. Other doctoral students have either focused on a specific study programme (Johannsen, 2012) or on STEM programmes in general without the possibility of distinguishing between general STEM tendencies or tendencies specific to individual study programmes (Holmegaard, 2012).

Limitations of the conducted studies have been put forward and discussed when relevant in the contributing papers and in this general discussion. To sum up the general study limitations include (but are not restricted to):

- *The pre-dominantly quantitative approach* has allowed conclusions on the prevalence of motivational orientations and levels but does not contribute to the understanding of the nature of or the psychological mechanisms behind these motivational constructs. Likewise, causal relationships cannot be established from the conducted studies. Such questions call for further studies.

- *Background variables, prior experiences/motivations, and cultural influences* have generally not been included in the conducted studies (see section 8.2.1).

- *The studies have generally not been piloted.* This is, at least partly, remedied through extensive prior knowledge of the study programmes. Furthermore, self-developed measures have not been through a rigorous validation process, but their use was validated in other ways.

- *The studies were small-scale.* Questionnaires were distributed to the entire population of either first year students or third year and older students and even though the response rates generally were acceptable, the sample sizes were generally relatively small when considering individual groups of students. All existing differences among groups may not have been detected with the statistical hypothesis tests.

- *The studies were only conducted at one university.* There could be a concern with regard to generalisability as all studies were conducted within the same faculty at one university. Cultural differences may not only occur on the national level but

also between different universities. However, the findings presented in this dissertation generally echoes findings from other Danish studies conducted at other universities.

A possible limitation of the dissertation is the theoretical 'lightness'. Rather than developing and challenging theories, focus has been to apply existing (appropriate) theories to evaluate a spectrum of study elements and the student experiences associated hereto. The applied theories were chosen because of their inclusive and supplementary nature and because of their widespread use in educational science. The dissertation is not a contribution to psychological science but to applied educational science and the objective has been to make improvements to the higher educational practice. Therefore, the weight of the research is in the empiric findings and the strength is in the close relations to practice which the 'action research' approach has provided. I dare to state that my close relations to practice combined with a general theoretical foundation have enabled me to make feasible recommendations on how to make motivational improvements of the science programmes.

Furthermore, the dissertation holds a thorough section on methodological considerations. This was included because these considerations have been a great part of being a PhD student. The PhD research period is also an education with the objective of becoming a researcher. As a science graduate, a great part of my educational journey in the doctoral period has been to familiarise myself with the research methods in educational science.

9 Concluding Remarks

The European interest in the field of first year experience is growing and the present dissertation makes contributions hereto in the form of input to scholarly discussions about curriculum design, peer mentoring and the use of student employees as well as concrete implementable examples of practice. Students' first year associated experiences have been investigated within a theoretical framework of motivation and in relation to the overall challenge of student drop-out. Focus has been on science education and all questionnaire respondents were students enrolled in a tertiary science programme at the Faculty of Science, SDU. However, the motivational constructs under investigations are universal and relevant to all fields of education as well as multiple levels of education. Furthermore, the investigated and presented study elements are adaptable to other fields than natural science. For example, as the widely used term 'STEM' indicates, strong relations between science and engineering disciplines exist and parallels can easily be drawn.

The present dissertation constitutes the first example of a comprehensive educational developmental process taking place at a Danish university which throughout its development has been researched with continuous investigations. The presented research does not only point to challenges – it provides concrete examples of how handle to these challenges. Initiatives such as the First Year Project and the Study Group Concept hold great potential to support students' motivation and foster students' persistence and the papers on these initiatives provide enough details for others to take inspiration and make adaptations to their own context. Another recommendation, drawn from the research presented in this dissertation, is for educational institutions to actively ensure a high degree of involvement from older students in the first year(s) of studies and thereby exploit the benefits associated with such involvement for both the younger as well as the older students.

On the national level, the Danish Evaluation Institute (EVA) has just (two weeks prior to handing in this dissertation) announced the kick-start of a large-scale project that investigates the apparent paradox in the facts that on one side, 80% of the students are enrolled in their first priority study programme but on the other side, approximately 35% will eventually dropout (EVA, 2016). This underlines that the present dissertation is highly relevant and that further knowledge is needed on the topic.

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Appendix 1: Literature review

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Appendix 2: The Danish Education System

In Denmark, ten years of schooling is compulsory. This includes pre-primary education: grade 0 (kindergarten), primary education: grade 1-6, and lower secondary education: grade 7-9 + an optional 10th grade (Ministry of Education, 2010). About half of the students choose 10th grade (Ministry for children, Education, and gender Equality, 2016a). If students continue their education hereafter, they either enter vocationally oriented education/training or upper secondary education. In 2011-2013, approximately 67% of the youth cohort enrolled in an upper secondary programme within 15 months after graduating 9th grade (most had completed 10th grade in the meantime) (Ministry for children, Education, and gender Equality, 2016b).

The main educational institutions providing upper secondary education are: STX (gymnasium), HTX (higher technical examination), HHX (higher commercial examination), and HF[3] (higher preparatory examination) (Ministry for children, Education, and gender Equality, 2016c). VUC (adult education centre) also provides qualifications at upper secondary level to their (adult) students. Figure 10 provides an overview of the main progression line of the Danish education system.

After completing upper secondary education, students can apply for enrolment in a tertiary programme. However, traditionally a large portion of upper secondary graduates take one to two gap years of work and/or travels before enrolling in a tertiary study programme. The tertiary programmes include three-year bachelor programmes at universities, three to four-year professional bachelor programmes at university colleges (teachers, nurses, social workers, etc.), and two to three-year short-cycle higher education at business academies. A university bachelor degree provides access to two-year master programmes which in turn provides access to PhD programmes (three years). Most bachelor graduates enrol in Master programmes. Within the natural sciences approximately 84% do so (Statistics Denmark, 2015).

Entry requirements to tertiary programmes differ. In addition to an upper secondary degree, most tertiary programmes have requirements of A/B-level (advanced/intermediate level) in specific subjects. For example, all science

[3] Grade 10 is required to enrol in HF.

programmes require A-level mathematics and B-level English. Furthermore, programmes with restricted admission admit students based on their grade point average (quota one) and application/interview/test performance (quota two). Some tertiary programmes, e.g. some engineering programmes also offer enrolment of students with a vocational exam.

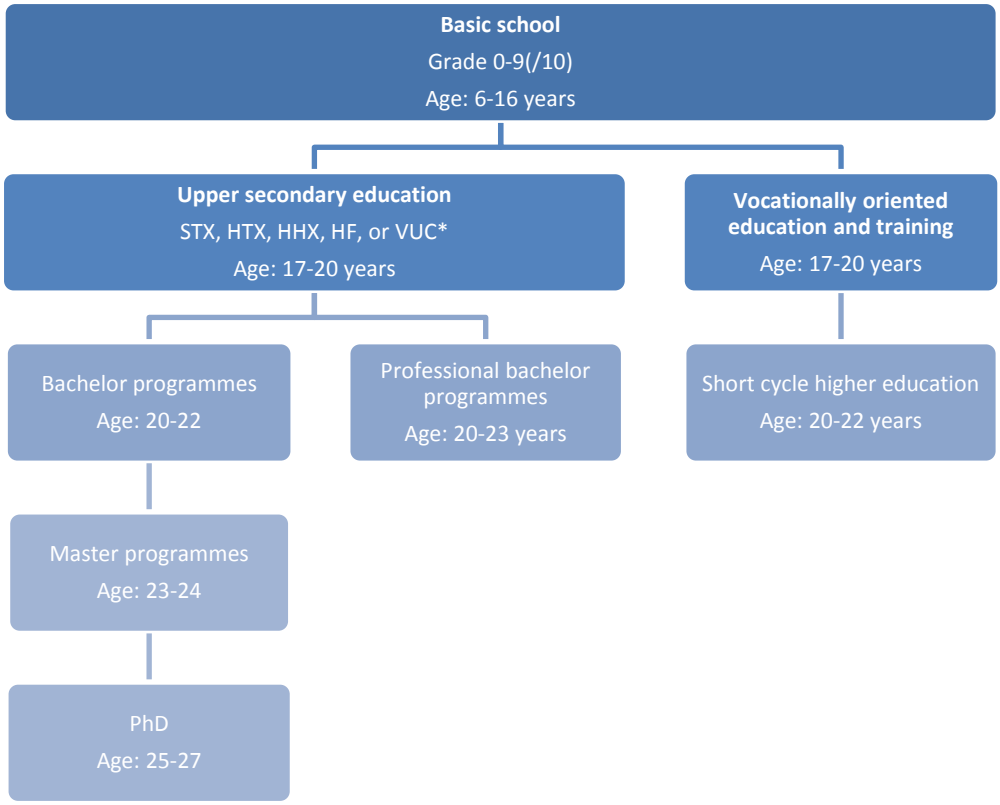

Figure 10 Main line of progression in the Danish education system. Crossovers are possible depending on the entry requirements of the individual programmes. The stated ages are approximate and under the assumption that students do not have gap years or prolong their studies. *VUC students are typically older. Figure inspired from The Danish Ministry for Children, Education and Gender Equality (2016d).

In Denmark, education is free of charge to students. However, at tertiary level students buy their own teaching materials (books, calculator, etc.). Furthermore, the state also provides financial support (SU: state education grant) to students enrolled in a SU-approved study programme. For students enrolled in a tertiary programme living away from the parental home the SU constitutes approximately 800 €/month before taxes (Ministry of Higher Education and Science, 2016c). If students need to borrow money, it is possible for them to obtain a government loan on fairly attractive conditions. It has been argued that the Danish SU system helps students to overcome negative social heritage (Troelsen & Laursen, 2014).

Appendix 3: The Science Year

The structure of the 'old' first year of studies: the Science Year which applied to all students enrolled at the Faculty of Science in 2011 or before with the exception of computer science students.

The course: NAT501 Naturvidenskabeligt Projekt is the First Year project which also is a part of the new first year of studies. No course at the Science Year is targeted a specific field of study; all courses are followed by students from multiple study programmes.

<table>
<tr><th></th><th colspan="3">1. år</th></tr>
<tr><td rowspan="2">2. semester</td><td colspan="2">NAT501
Naturvidenskabeligt Projekt (10 ECTS)</td><td>ST501
Science Statistik (5 ECTS)</td></tr>
<tr><td>BMB501
Biomolekylær Kemi (5 ECTS)</td><td rowspan="2">FY520
Grundlæggende fysikforståelse (10 ECTS)</td><td>MM502
Calculus II (5 ECTS)</td></tr>
<tr><td rowspan="2">1. semester</td><td rowspan="2">BB501
Biologi – fra molekyle til økosystem (10 ECTS)</td><td rowspan="2">KE501
Grundlæggende Kemi (10 ECTS)</td></tr>
<tr><td>MM501
Calculus I (5 ECTS)</td></tr>
</table>

The figure was retrieved from:
http://natfak.sdu.dk/studieforloeb/vis.php?cf=4cae0903&type=ba&optag=2010-09-01

Appendix 4: Questionnaire 1B

Questionnaire 1B was distributed to the first year students at the end of the fall semester 2014. The questionnaire served a dual purpose of being both the Faculty of Science's annual evaluation of the study start and data collection tool for the studies reported in paper I and outline II. The measure for *motivation to learn in specific courses* is marked with yellow (the measure was repeated for each course, below, only one course (FF502) is included) and the measure of *fulfilment of basics needs (general)* is marked with light blue.

Velkommen til spørgeskemaet "Studiestartsevaluering 2014"

Du har nu været studerende på Det Naturvidenskabelige Fakultet i nogle måneder.

For at kunne gøre den første tid på studiet endnu bedre fremover, er vi meget interesserede i at høre, hvordan du oplevede både den faglige og sociale studiestart. Med studiestarten menes fra da du modtog dit optagelsesbrev og indtil nu. Derudover har du mulighed for at bidrage til et forskningsprojekt om studiemotivation på naturvidenskabelige uddannelser. Du kan altså være med til at fremskaffe viden om, hvordan undervisere og andre ansatte på universitetet skaber et endnu bedre studiemiljø for dig og dine studiekammerater. Spørgeskemaet tager ca. 35 minutter at udfylde, og vi håber, at du vil bidrage med konstruktive kommentarer fx med forslag til forbedringer af studiestarten, undervisningen eller første studieår generelt.

Hvis du har spørgsmål til spørgeskemaundersøgelsen er du velkommen til at kontakte Camilla Kromann på cgk@sdu.dk eller Nadia Kristensen på nrdk@sdu.dk.

På forhånd tak for hjælpen!
Mvh.
Planlægningsgruppen for Førsteåret

For at kunne benytte besvarelserne fra dette spørgeskema til forskning, vil jeg bede om din accept på nedenstående samtykkeerklæring. Besvarelserne vil til enhver tid fremgå anonyme. Forskningspublikationer vil ikke indeholde identificerbare data, ligesom enkeltpersoner ikke på anden vis eller i anden kontekst vil kunne identificeres af andre end forskeren, Nadia Rahbek Dyrberg Kristensen, selv. Dine besvarelser vil ikke på nogen måde kunne påvirke dine karakterer på universitetet. Ønsker du flere informationer, før du giver dit samtykke, er du velkommen til at kontakte nrdk@sdu.dk. Du kan til enhver tid tilbagetrække dit samtykke ved at kontakte nrdk@sdu.dk.

(1) ❑ Jeg giver hermed mit samtykke til, at mine besvarelser indgår i forskning i anonymiseret form

(2) ❑ Jeg giver ikke samtykke

Studieretning

(1) ❑ Biologi

(2) ❑ Biomedicin

(3) ❑ Biokemi og Molekylær biologi

(4) ❑ Nanobioscience

(5) ❑ Kemi

(6) ❑ Fysik

(7) ❑ Farmaci

(8) ❑ Matematik

(9) ❑ Anvendt matematik

(10) ❑ Datalogi

Hvilken adgangsgivende eksamen har du?

(1) ❑ STX

(2) ❑ HTX

(3) ❑ HF

(4) ❑ HHX

(5) ❑ VUC

(6) ❑ Andet

Hvilket år afsluttede du din adgangsgivende uddannelse (fx STX eller HTX)?

(1) ❑ 2014

(2) ❑ 2013

(3) ❑ 2012

(4) ❑ 2011

(5) ❑ 2010

(6) ❑ Tidligere

Er du aktiv i en forening/et fagråd/frivilligt arbejde?

(1) ❑ Ja

(2) ❑ Nej

Har du et job ved siden af studiet?

(1) ❑ Ja

(2) ❑ Nej

Kendskab og kontakt til SDU

Har du inden dit studievalg hørt om eller fået kendskab til SDU via et eller flere af nedenstående forslag: (sæt gerne flere krydser)

(5) ❑ www.sdu.dk

(8) ❑ Facebook

(15) ❑ Omtale i pressen

(12) ❑ Besøg af en SDU-studerende på mit gymnasium

(16) ❑ Reklame i biografen

(17) ❑ Reklamespots i toget

(19) ❑ UG.dk

(20) ❑ SDU's uddannelsesguide

(21) ❑ Uddannelsesavisen NatXpressen

(18) ❑ Ingen af ovenstående

Har du inden dit studievalg haft kontakt til SDU via et eller flere af nedenstående forslag: (sæt gerne flere krydser)

(1) ❑ Åbent hus

(2) ❑ Studerende for en dag

(3) ❑ Studieretningsprojekt (SRP)

(4) ❑ Studenterbroen/Studiepraktik i uge 43

(6) ❑ Sommercamp

(7) ❑ UNF (Ungdommens Naturvidenskabelige Forening)

(9) ❑ Folkeskolepraktik

(14) ❑ Studievejledere på SDU

(15) ❑ Uddannelsesmessen - Uddannelse Uden Grænser

(16) ❑ Besøg med min klasse i SDU's laboratorier

(17) ❑ Besøg på SDU gennem ATU (Akademiet for Talentfulde Unge)

(13) ❑ Ingen af ovenstående

Skriv her, hvis du har haft kontakt eller fået kendskab til SDU på andre måder:

_____
_____
_____

I hvor høj grad har kontakten til SDU haft indflydelse på dit studievalg?
(1: ingen indflydelse og 7: høj grad af indflydelse)

1	2	3	4	5	6	7
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Valg af SDU

Hvad var de vigtigste årsager til, at du søgte ind og startede på netop denne uddannelse?

_____
_____
_____

Det første studieår

Var du bevidst om den høje grad af flerfaglighed på Førsteåret i dit valg af studium?

(1) ❑ Ja, jeg var helt bevidst om det

(2) ❑ Ja, jeg var delvist bevidst om det

(3) ❑ Nej, jeg kendte ikke til det

I hvor høj grad har det flerfaglige førsteår haft indflydelse på dit valg af studium?

(1: ingen indflydelse og 7: høj grad af indflydelse)

1	2	3	4	5	6	7
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Skriv her, hvis du har kommentarer til det flerfaglige førsteår:

_____
_____
_____

Scienceguiden

Hvor brugbar vurderer du "Scienceguiden"?
(1: meget lille brugbarhed og 7: meget stor brugbarhed)

1	2	3	4	5	6	7	Jeg har ikke læst/ kigget i den
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Kommentarer til scienceguiden:

Hvad var brugbart i scienceguiden? _____
_____
_____

Hvad kan tilføjes eller udelades i scienceguiden? _____
_____
_____

Scienceguiden blev udsendt i trykt form ca. 14 dage før studiestart og findes digitalt på nettet. Hvilken form foretrækker du?

(1) ❑ Den trykte udgave

(2) ❑ Den digitale udgave

(3) ❑ Begge udgaver

(4) ❑ Ingen

Den sociale studiestart

I hvor høj grad oplevede du, at tutorerne formåede at introducere dig til det praktiske omkring det at starte på studiet?
(1: meget lav grad - 7: meget høj grad)

	1	2	3	4	5	6	7	Jeg deltog ikke i introduktionen
IT og Blackboard	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

	1	2	3	4	5	6	7	Jeg deltog ikke i introduktionen
Organisering af Det Naturvidenskabelige Fakultet og dets institutter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Skemabegreber (fx SF, TE, U49 osv.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
At navigere og finde rundt på universitetet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

I hvor høj grad følte du dig taget godt imod af dine tutorer de første to dage (fredag d. 29/8 og lørdag d. 30/8 2014)
(1: meget lav grad - 7: meget høj grad)

1	2	3	4	5	6	7	Jeg deltog ikke
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

I hvor høj grad har tutorerne bidraget til at skabe en fællesskabsfølelse?
(1: meget lav grad - 7: meget høj grad)

	1	2	3	4	5	6	7	Jeg har ikke deltaget i arrangementer med tutorerne
På stamholdet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
På årgangen/på tværs af stamhold	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvordan vurderer du tutorernes indsats i forhold til at få alle inkluderet på stamholdet?
(1: meget lille indsats - 7: meget stor indsats)

1	2	3	4	5	6	7	Jeg har ikke deltaget i arrangementer med tutorerne
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvor vigtig vurderer du samlet set tutorernes rolle i din studiestart?
(1: ikke vigtig - 7: meget vigtig)

1	2	3	4	5	6	7
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Sæt nogle ord på tutorernes rolle for dig:

_____
_____
_____

Naturvidenskabelige Fakultet har en bevidst strategi omkring indtaget af alkohol i studiestarten, hvorfor en del af arrangementerne er alkoholfri. Hvordan oplevede du tilstedeværelsen af alkohol i studiestarten?

(1) ❑ For lidt alkohol

(2) ❑

(3) ❑

(4) ❑ Passende

(5) ❑

(6) ❑

(7) ❑ For meget alkohol

(8) ❑ Ved ikke

Kommentarer vedrørende tilstedeværelsen af alkohol i studiestarten:

_____
_____
_____

Deltog du i følgende arrangementer - hvis ja, kommenter venligst på arrangementet.

	Ja	Nej
Den første dag (fredag d. 29/8)	(1) ❑ ____	(2) ❑
Science-rally (lørdag d. 30/8)	(1) ❑ ____	(2) ❑
NAT-turen (lørdag d. 27/9)	(1) ❑ ____	(2) ❑

Den faglige studiestart

I hvor høj grad formåede studiegruppevejlederen at... (den studiegruppevejleder du havde, før gruppeomdannelsen i uge 43)
1: meget lav grad - 7: meget høj grad

	1	2	3	4	5	6	7	Ved ikke
... introducere dig til meningen med/bag studiegruppekonceptet?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
... forklare sin egen rolle som studiegruppevejleder?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
... forklare relevansen af gruppearbejde?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
... facilitere en konstruktiv arbejdskultur i gruppen?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
... facilitere arbejdet med faglige aktiviteter?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

I hvor høj grad formåede studiegruppevejlederen at dele sine egne erfaringer på en brugbar måde?
(1: ikke brugbart - 7: meget brugbart)

1	2	3	4	5	6	7	Ved ikke
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvilken type erfaringer har været gode at høre/ville du ønske at høre om?:

_____
_____
_____

Hvor vigtig vurderer du samlet set studiegruppevejlederens rolle i din studiestart?
(1: ikke vigtig - 7: meget vigtig)

1	2	3	4	5	6	7
(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Sæt nogle ord på studiegruppevejlederens rolle for dig:

_____
_____
_____

Kan du se relevansen af gruppearbejde?

Ja	Ja, delvist	Nej
(1) ❑	(2) ❑	(3) ❑

Uddyb din besvarelse ved at skrive kommentarer her:

_____
_____
_____

Nævn mindst en ting du synes godt om ved at arbejde i studiegrupper:

_____
_____
_____

Nævn mindst en ting du synes mindre godt om ved at arbejde i studiegrupper:

_____
_____
_____

I hvilken grad har du deltaget i SFV- og SF-timerne?

	Alle/næsten alle timerne	Mere end halvdelen af timerne	Mindre en halvdelen af timerne	Ingen af timerne
SFV-timer (med vejleder)	(1) ❑	(2) ❑	(3) ❑	(4) ❑
SF-timer (uden vejleder)	(1) ❑	(2) ❑	(3) ❑	(4) ❑

Hvad har været den primære årsag til manglende deltagelse for dit vedkommende?

_____
_____
_____

I hvor høj grad har SFV- og SF-timerne (timer med studiegruppen med og uden vejleder) bidraget til nedenstående?
(1: meget lav grad og 7: meget høj grad)

	1	2	3	4	5	6	7	Ved ikke
Forståelse af stoffet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Andre/nye vinkler på stoffet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Perspektivering af stoffet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Øvelse i at formidle/forklare viden for andre	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Har du oplevet at skulle forklare noget til din studiegrupper og først derved opdage, at du ikke helt havde forstået det alligevel?

(1) ❑ Ja

(2) ❑ Nej

Skriv her, hvis du har kommentarer angående det faglige udbytte af SFV- og SF-timer:

_____
_____
_____

Studiestartsopgaven

I hvor høj grad oplevede du at...
(1: meget lav grad - 7: meget høj grad)

	1	2	3	4	5	6	7
... have modtaget tilstrækkeligt med information omkring studiestartopgaven?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

	1	2	3	4	5	6	7
... studiestartsopgaven gjorde det tydeligt, hvad der kræves for at være en god studerende?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... studiestartsopgaven havde en passende sværhedsgrad?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... den studietekniske del var relevant?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... den faglige del var relevant?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... samarbejdsdelen (aflevering af gruppekontrakten) var relevant?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Kommentarer til studiestartsopgaven?

_____
_____
_____

Forventninger til studiet

Blev de forventninger du havde før studiestart indfriet i forhold til nedenstående?

	Mindre/lavere end forventet	Som forventet	Mere/højere end forventet	Jeg havde ingen forventninger
Det faglige niveau	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Tidsforbrug	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Socialt fællesskab	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Undervisernes tilgængelighed	(1) ❑	(2) ❑	(3) ❑	(4) ❑

Hvad har overrasket dig ved at være studerende i forhold til det, du forventede?

_____
_____
_____

Lidt mere om dig...

Hvor mange timer bruger du i gennemsnit hver uge på ...

	0-5 timer	5-10 timer	10-15 timer	15-20 timer	20-25 timer	>25 timer	Ved ikke
... at lave hjemmearbejde derhjemme alene?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... mødes med studiekammerater og lave hjemmearbejde?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
... at være på universitetet uden at lave faglige aktiviter (være til undervisning eller lave hjemmearbejde)?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Hvad har været sværest for dig i dit studium indtil nu? _____
_____
_____

Hvad har været det bedste for dig i dit studium indtil nu? _____
_____
_____

Evaluering af grunde til læring i de enkelte kurser

De følgende spørgsmål omhandler dine grunde til at gøre en indsats for at lære i de forskellige kurser. Det er forskelligt fra studerende til studerende, hvilke grunde man har for at gøre en indsats i de enkelte kurser. Du vil i det følgende blive præsenteret for en række udsagn, som du bedes angive, hvor sande er for dig.

Hvilke af disse kurser følger du?

(1) ❑ FF502: Matematik og Fysik

(2) ❑ FF503/FF504: Kemi, Biologi og Molekylær biologi

(3) ❑ FF506: Matematik, statistik og fysik for biologer og farmaci

(4) ❑ BB525: Zoologi og evolution

(5) ❑ KE527: Farmaci grundkursus

(6) ❑ MM536: Calculus for Matematik

(7) ❑ MM537: Introduktion til Matematiske Metoder

(8) ❑ DM549: Diskrete Metoder til Datalogi

(9) ❑ DM550: Introduktion til Programmering

Jeg gør en aktiv indsats i FF502: Fysik og Matematik, fordi…
(1: ikke sandt for mig – 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke
… jeg føler, at det er en god måde at øge min forståelse af stoffet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… andre vil nok tænke dårligt om mig, hvis jeg ikke gør det.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… jeg vil være stolt af mig selv, hvis jeg klarer mig godt i kurset.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… fordi en solid forståelse af fysik og matematik er vigtig for min intellektuelle udvikling.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Det er sandsynligt, at jeg følger undervisernes forslag til, hvordan man læser fysik og matematik, fordi…
(1: ikke sandt for mig – 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke
… jeg nok får en dårlig karakter, hvis jeg ikke gør, som underviserne foreslår.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… jeg er bekymret for, om jeg klarer mig godt i kurset.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… det er lettere at følge undervisernes forslag end selv at finde på	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

	1	2	3	4	5	6	7	Ved ikke
studiestrategier.								
… underviserne lader til at have den bedste indsigt i, hvordan man bedst lærer stoffet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Jeg arbejder hårdt for at udvide min viden inden for fysik og matematik, fordi…
(1: ikke sandt for mig – 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke
… det er interessant at lære mere om fysik og matematik.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… det er svært virkelig at forstå, hvordan man løser opgaverne.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… en god karakter i kurset vil være godt for mit gennemsnit.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… jeg vil have andre til at se mig som intelligent.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
… kurset er relevant for mine videre studier.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Evaluering af opfyldelse af basale behov

De følgende spørgsmål omhandler dine oplevelser med at være studerende på dit studium, dvs. dine oplevelser i dagligdagen som studerende på Det Naturvidenskabelige Fakultet. Du bliver præsenteret for en række udsagn, som du bedes angive, hvor sande er for dig.

Hvor sande er følgende udsagn for dig?
(1: ikke sandt for mig - 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke

	1	2	3	4	5	6	7	Ved ikke
Jeg oplever, at jeg kan komme med input til mit studieforløb.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg kan virkelig godt lide mine medstuderende.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg føler mig ikke særlig kompetent på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk giver udtryk for, at jeg er en god studerende.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg føler mig presset på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg kommer godt overens med folk på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg holder mig for mig selv, når jeg er på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvor sande er følgende udsagn for dig?
(1: ikke sandt for mig - 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke
Jeg har mulighed for at udtrykke mine ideer og mine meninger i forhold til studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg betragter mine studiekammerater som mine venner.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg har lært nye interessante ting på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
På studiet er jeg nødt til at gøre, hvad jeg får besked på.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
De fleste dage på studiet føler jeg, at jeg opnår noget.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

	1	2	3	4	5	6	7	Ved ikke
På studiet tages der hensyn til min personlighed.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
På studiet har jeg ikke mange muligheder for at vise, hvor dygtig jeg er.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvor sande er følgende udsagn for dig?
(1: ikke sandt for mig - 7: meget sandt for mig)

	1	2	3	4	5	6	7	Ved ikke
Folk på studiet bekymrer sig om mig.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Der er ikke ret mange personer på studiet, som jeg er tæt knyttet til.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg føler, at jeg kan være mig selv på studiet.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk på studiet lader ikke til at kunne lide mig ret meget.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg føler mig ofte inkompetent, når jeg studerer.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg har ikke ret mange muligheder for indflydelse på, hvordan jeg skal studere.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk på studiet er venlige mod mig.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Skriv her, hvis du har en sidste kommentar til studiestarten eller til første studieår generelt.

_____

_____

_____

Tak for hjælpen!
Hvis du har spørgsmål til spørgeskemaundersøgelsen eller yderligere kommentarer er du velkommen til at kontakte Camilla Kromann på cgk@sdu.dk eller Nadia Kristensen på nrdk@sdu.dk.

Appendix 5: Questionnaire 3

Questionnaire 3 was distributed to third year and older students at the end of the spring semester 2014. The questionnaire served as data collection tool for the studies reported in paper III, IV, and V. The measure of *university belonging* is marked in light blue.

Velkommen til spørgeskemaet: Relationer og tilknytning til Naturvidenskab

På Naturvidenskab øger vi fokus på studiemiljøet. Vi er derfor taknemmelige for, at du vil tage dig tid til at besvare spørgeskemaet. Besvarelserne bruges både til generel evaluering af relationer og tilknytning til Naturvidenskab og til et forskningsprojekt med dette fokus.

Ved besvarelse af spørgeskemaet giver du samtidig accept af, at dine besvarelser bruges i forskningsartikler i anonymiseret form.

Det vil tage 5-20 min. at besvare spørgeskemaet (afhængigt af om du har haft studiejobs, og i så fald, hvilke).

Dine besvarelser behandles anonymt.

Hvis du har spørgsmål eller kommentarer til undersøgelsen, er du velkommen til at kontakte Camilla Gundlach Kromann (cgk@sdu.dk) eller Nadia Rahbek Dyrberg Kristensen (nrdk@sdu.dk).

Har du hovedfag/centralt fag på Det Naturvidenskabelige Fakultet? (gælder også farmaci-studerende)

(1) ❑ Ja

(2) ❑ Nej

Studieretning

(1) ❑ Biologi

(2) ❑ Biomedicin

(3) ❑ Biokemi og Molekylær Biologi

(4) ❑ Farmaci

(5) ❑ Fysik

(6) ❑ Kemi

(7) ❑ Nanobioscience

(8) ❑ Matematik

(9) ❑ Anvendt matematik

(10) ❑ Datalogi

Har du skrevet bachelorprojekt?

(3) ❑ Ja, jeg er færdig med mit bachelorprojekt og er startet på kandidaten

(1) ❑ Ja, jeg er færdig med mit bachelorprojekt

(2) ❑ Jeg er i gang med mit bachelorprojekt

(4) ❑ Nej, jeg er ikke begyndt på mit bachelorprojekt

Årgang - Hvilket år startede du på Naturvidenskab?

(1) ❑ 2009

(2) ❑ 2010

(3) ❑ 2011

(4) ❑ 2012

Har du et sidefag som ligger uden for Naturvidenskab?

(1) ❑ Ja

(2) ❑ Nej

Etnicitet - Har en eller begge af dine forældre oprindelse uden for Danmark?

(1) ❑ Ja

(2) ❑ Nej

Hvilket land/hvilke lande?

_____

_____

_____

Har du været eller er du ansat i et eller flere af nedenstående funktioner?

(1) ❑ Tutor

(2) ❑ Studiegruppevejleder

(3) ❑ Instruktor

(4) ❑ Ansættelse eller ad hoc-opgaver på et naturvidenskabeligt institut

(5) ❑ Ansættelse eller ad hoc-opgaver på Det Naturvidenskabelige Fakultet

(6) ❑ Ingen af disse

Er du aktiv i et fagråd eller en forening der på anden vis bidrager til studiemiljøet?

(1) ❑ Ja

(2) ❑ Nej

Hvilke/hvilket?

_____

_____

_____

På en skala fra 1-7, hvor enig eller uenig er du i nedenstående udsagn?
1: helt uenig - 7: helt enig

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
Jeg føler mig som en del af Naturvidenskab på Syddansk Universitet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk på naturvidenskab bemærker, når jeg er god til noget	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Det er svært for folk som mig at blive accepteret her	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Andre studerende på Naturvidenskab tager mine meninger seriøst	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
De fleste undervisere er	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) ❑

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
interesserede i mig	❑	❑	❑	❑	❑	❑	❑	
Nogle gange føler jeg, at jeg ikke hører til her	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Der er mindst en underviser eller anden ansat her på Naturvidenskab, som jeg kan snakke med, hvis jeg har et problem	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk her er venlige mod mig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Underviserne er ikke interesserede i folk som mig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg deltager og/eller er involveret i mange aktiviteter på Naturvidenskab	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg bliver behandlet med lige så meget respekt som andre naturvidenskabsstuderende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg føler mig meget anderledes end de fleste studerende på Naturvidenskab	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg kan virkelig være mig selv her på Naturvidenskab	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Underviserne her respekterer mig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Folk her ved at jeg kan yde en god arbejdsindsats	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg ville ønske at jeg var på en andet universitet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg er stolt af at høre til Naturvidenskab på Syddansk Universitet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
Andre studerende kan lide mig, som jeg er	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Fysiske rammer

Hvor opholder du dig før og efter undervisning/lab-arbejde, og når du har mellemtimer? _____

Bruger du faciliteter på universitetet som ligger uden for Naturvidenskabs område (fx campustorvet, læsesalen, biblioteket m.m.)? - i så fald, hvilke og hvor ofte? _____

Bruger du oftest den store eller den lille kantine?

(1) ❑ Den store kantine

(2) ❑ Den lille kantine

(4) ❑ Jeg bruger begge kantiner lige meget

(3) ❑ Jeg bruger aldrig kantinerne

Hvor mange timer tilbringer du på universitetet om ugen udover dine skemalagte timer (og/eller laboratorietimer i forbindelse med et projekt)?

(1) ❑ ≤ 3 timer

(2) ❑ > 3 og ≤6

(3) ❑ > 6 og ≤ 9

(4) ❑ > 9 og ≤ 12

(5) ❑ > 12

(6) ❑ Ved ikke

Hvad passer bedst på dig?

Min omgangskreds består i høj grad af...

(1) ❑ ... andre studerende fra min studieretning

(2) ❑ ... andre studerende på naturvidenskab generelt

(3) ❑ ... studerende og ansatte på naturvidenskab

(6) ❑ ... andre studerende på SDU (uden for naturvidenskab)

(4) ❑ ... personer uden for SDU

(5) ❑ Ved ikke

Hvad passer bedst på dig?
Min omgangskreds på min studieretning består i høj grad af...
(2) ❑ ... andre studerende fra mit stamhold på Scienceåret (første studieår)

(1) ❑ ... andre studerende fra min egen årgang

(3) ❑ ... studerende fra blandede årgange

(5) ❑ Ved ikke

På en skala fra 1-7, i hvor høj grad har du kontakt til undervisere/forskere som ikke er tilknyttet dine kurser?
(1) ❑ 1

(2) ❑ 2

(3) ❑ 3

(4) ❑ 4

(5) ❑ 5

(6) ❑ 6

(7) ❑ 7

(8) ❑ Ved ikke

Dit job som studiegruppevejleder (SGV'er)

Hvad er det allerførste du tænker ved spørgsmålet? (svar din første indskydelse):
Hvem arbejder/arbejdede du for som SGV'er?

_____
_____

De følgende spørgsmål omhandler din funktion som tutor/SGV'er/instruktor. Da du har været i to eller alle tre af disse funktioner, vil du blive stillet de samme spørgsmål til begge/alle rollerne. Overvej nøje om det er de samme elementer, der gør sig gældende.

Kommentér med et par sætninger på nedenstående spørgsmål
Gennem dit job som **SGV'er** mener du da at have opnået...

... et udvidet netværk? (uddyb gerne) _____
_____
_____

... bevidsthed om egne studievaner? (uddyb gerne) _____
_____
_____

... øgede faglige kompetencer? (uddyb gerne) _____
_____
_____

Kommentér med et par sætninger på nedenstående spørgsmål
Gennem dit job som **tutor** mener du da at have opnået...

... et udvidet netværk? (uddyb gerne) _____
_____
_____

... bevidsthed om egne studievaner? (uddyb gerne) _____
_____
_____

... øgede faglige kompetencer? (uddyb gerne) _____
_____
_____

Kommentér med et par sætninger på nedenstående spørgsmål

Gennem dit job som **instruktor** mener du da at have opnået...

... et udvidet netværk? (uddyb gerne) _____
_____
_____

... bevidsthed om egne studievaner? (uddyb gerne) _____
_____
_____

... øgede faglige kompetencer? (uddyb gerne) _____
_____
_____

Dit job som SGV'er

På en skala fra 1-7, hvor enig eller uenig er du i nedenstående udsagn?
1: helt uenig - 7: helt enig

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
Jeg oplever, at kontaktpersonerne/koordinatorerne er interesserede i mine oplevelser/erfaringer som SGV'er	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Jeg oplever, at underviserne på Førsteåret er interesserede i mine oplevelser/erfaringer som SGV'er	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som SGV'er udfører jeg et vigtigt job	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som SGV'er udgør jeg en vigtig del af fakultetets introduktion til de nye naturvidenskabsstuderende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som SGV'er kan jeg gøre en forskel for den enkelte studerende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Dit job som tutor

På en skala fra 1-7, hvor enig eller uenig er du i nedenstående udsagn?
1: helt uenig - 7: helt enig

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
Jeg oplever, at ledelsen er interesserede i mine oplevelser/erfaringer som tutor	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som tutor udfører jeg et vigtigt job	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som tutor udgør jeg en vigtig del af fakultetets introduktion til de nye naturvidenskabsstuderende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som tutor kan jeg gøre en forskel for den enkelte studerende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Dit job som instruktor

På en skala fra 1-7, hvor enig eller uenig er du i nedenstående udsagn?
1: helt uenig - 7: helt enig

	1	2	3	4	5	6	7	Ved ikke/ikke relevant
Jeg oplever, at underviseren/underviserne er interesserede i mine oplevelser/erfaringer som instruktor	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som instruktor udfører jeg et vigtigt job	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Som instruktor kan jeg gøre en forskel for den enkelte studerende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Mange tak fordi du gav dig tid!

Det er vigtige informationer, som vi glæder os til at arbejde videre med.

Hvis du har spørgsmål eller kommentarer til spørgeskemaet er du velkommen til at kontakte Nadia Rahbek Dyrberg Kristensen, nrdk@sdu.dk.

Appendix 6: SRHE Poster

FACULTY OF SCIENCE - UNIVERSITY OF SOUTHERN DENMARK

Nadia Rahbek Dyrberg

UNIVERSITY OF SOUTHERN DENMARK

Participation in the community of scientific practice

- Motivational aspects of project work in large enrolment classes

Introduction

An increasing number of students enrolled at the universities every year results in a greatly diverse student mass. This poster introduces a study element **'The First Year Project'** from the University of Southern Denmark. This intensive project based course is designed to embrace several aspects of students' motivation as well as their **diversity and plurality.**

The 'The First Year Project' is popular among both students and teachers as it gives an **authentic glimpse of scientific research** complete with the subsequent dissemination of knowledge.

The First Year Project

The First Year Project is a mandatory 10 ECTS course at the end of first year of studies at The Faculty of Science. During three months the students conduct a (real) **research project.** The students prioritise projects from a broad selection of abstracts and are assigned projects in groups of three-six students. At the end of the course, the students hand in a group report and present their results in a **poster session.** Prizes are given for the best posters. The course is completed with an oral individual exam.

Mini-courses and mid-way seminar

The students are offered a range of mini-courses in e.g. 'writing scientific reports' and 'making posters'. A mid-way seminar with **peer feedback** on presentations of the projects' progression helps the groups taking stock on their project and getting inspired by the ideas of other groups.

Participants in 2014

In all **529 persons** were involved in the First Year Project in spring 2014: **371 students**, 83 main supervisors, 42 co-supervisors, 15 mini course teachers, 16 poster session judges and two administrators.

Course evaluation

The First Year Project was assessed by the students in a pilot study questionnaire covering several aspects including motivational elements. The response rate was 48 %. Selected results are seen in the box 'Students' experiences - a pilot study'.

Prioritise projects

Assignment of projects

Mini-courses

Mid-way seminar

Submit report

Poster session

Exam

Further research

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Publication

Motivational theories

With inspiration from Deci and Ryan's (1985) and Eccles and Wigfield's (1995) theories of motivation the objective is to create:

Sense of autonomy: Choosing subject and deciding course of action.

Feeling of competence: Using knowledge to perform actual research and convey this in a report and a poster.

Sense of relatedness: Group work and relations to supervisors and research groups.

Positive task value: Working with interests, doing authentic research and making contributions to an actual research project.

Sense of autonomy

Feeling of competence

Motivation

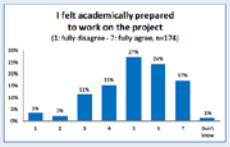
Positive task value

Sense of relatedness

Students' experiences - a pilot study

Generally the students felt that they could influence the project both as groups and as individuals. However, some felt dominated by other group members.

- *"My group was greatly free to shape the project."*
- *"...they stuck together in all decisions and outnumbered the rest of us..."*



Motivation

The groups generally established good relations to their supervisor and each other. Few had bad experiences that significantly affected work atmosphere.

- *"... I have never before experienced such good working relationship!"*
- *" We could almost never reach him [the supervisor]... he always seemed irritated"*

Community of practice

In compliance with the idea of legitimate peripheral participation (Lave and Wegner, 1991), the students are invited into the world of scientific research by their supervisor. Through The First Year Project the students are taking their first step towards membership of the scientific community of practice.

The project constitutes authentical research based teaching to a larger extent than teaching traditionally offers at undergraduate level.

A student describes

"The First Year Project is a great way to get a sense of what it is to do research and to focus on a specific subject. It is a really good way to finish the first year of studies..."

Conclusion and perspectives

The students' comments reveal a diverse range of mostly great, but also a few unfortunate experiences. The latter was often due to poor relations in the group or with the supervisor.

Students are **excited** to work with a project of their own choice and interest as well as the **opportunity** to influence the project work. Some students feel unsure and hence **insecure** of the supervisor's expectancies to their academic competences. Furthermore, differing interpretations of course guidelines can lead to some groups feeling unfairly treated. This might be a consequence of the large number of supervisors involved in the course.

Stressing the importance of **motivational elements** as well as inviting students into the science community, it is possible to foster students' motivation.

References

Deci, E.L. and Ryan, R.M., 1985. Intrinsic motivation and self-determination in human behavior. New York: Plenum.

Lave, J. and Wenger, E., 1991. Situated Learning: Legitimate peripheral participation. Cambridge University Press.

Eccles, J.S. and Wigfield, A., 1995. In the Mind of the Actor: The Structure of Adolescents' Achievement Task Values and Expectancy-Related Beliefs. Society for Personality and Social Psychology, Inc.

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Appendix 7: Science guide

Page in the 'Science guide' encouraging first year students to participate in the questionnaires.

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Den udvalgte årgang: 2014

Kære Førsteårsstuderende

Jeg er ph.d.-studerende på Det Naturvidenskabelige Fakultet. Mit forskningsprojekt omhandler "**Motivation på de første studieår af naturvidenskabelige uddannelser**", og jeg kommer til at følge din årgang af naturvidenskabsstuderende (studiestart i 2014) med spørgeskema- og interviewundersøgelser samt observation af undervisning.

Mine fokusområder er bl.a. oplevelse af studiegrupper, vurdering af kursers relevans og oplevelse af Førsteårsprojektet.

Du kommer altså til at bidrage til et forskningsprojekt gennem dine besvarelser, og jeg opfordrer dig til fyldestgørende at besvare de spørgeskemaer, du modtager på dit første studieår. Det er vigtigt, at jeg får kendskab til alles meninger og oplevelser, uanset om de er gode er dårlige, så jeg kan danne mig et reelt billede af livet som studerende på Det Naturvidenskabelige Fakultet.

Det første spørgeskema modtager du allerede i forbindelse med studiestart. Du modtager et link til spørgeskemaet på din nye studentermail.

Alle besvarelser behandles anonymt. Dine besvarelser kan altså ikke (på nogen måde) påvirke dine karakterer.

Jeg vil også i løbet af dit første studieår få brug for frivillige interviewpersoner til mere dybdegående interviews – overvej derfor allerede nu, om det kunne være noget for dig. Eventuelle citater vil blive gengivet i anonymiseret form, så det ikke er muligt at identificere dig.

Jeg glæder mig til at modtage dine besvarelser – du har indflydelse på at gøre studieoplevelsen endnu bedre for både dig og kommende naturvidenskabsstuderende!

Held og lykke med dine studier!

Venlig hilsen
Nadia Rahbek Dyrberg Kristensen

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