Students' Narratives, Negotiations, and Choices

Doctoral Dissertation

Henriette Tolstrup Holmegaard

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A longitudinal study of Danish students' transition into higher education science, engineering and mathematics

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This dissertation is dedicated to the students whom I followed from upper secondary school and through their journeys into STEM higher education study programmes. Thank you for sharing your lives; joys and disappointments with me, for your sincerity and not least for taking your time to meet with me again and again and again. I hope all of you will find a meaningful pathway in life.

Contents

Abstract

This Dissertation is based upon a longitudinal qualitative study in which 38 students' choices of higher education in general, and science, engineering and mathematics (STEM) study programmes in particular, are investigated. More specifically, 20 of the students who encountered a STEM study programme are followed in their transition process into their first year. Narrative psychology provides a platform for understanding students' choices, transition and decisions of staying or leaving as a social continuous process of constructing an attractive identity. This approach highlights the importance of contextualising students' choices as rationalised narratives in time. The analysis shows how some of the students find it difficult to match their expectations of higher education STEM with their ideas of an attractive identity. As a result they choose not to continue studying it after upper secondary school. The students who do choose to study STEM at higher education all encounter a gap between their expectations and their actual experiences. In particular, some find it hard to make sense of and relate to the academic content and the teaching and learning activities they are presented for. In this process some of the students struggle with finding it meaningful to stay. In the general discussion and conclusions, implications for higher education institutions are considered in terms of how to support students in making meaningful STEM identities.

II   Henriette Tolstrup Holmegaard

Summary

This Dissertation is about a group of upper secondary students' choices of higher education in general, and science, engineering and mathematics (STEM) in particular. It is about their transition into higher education STEM study programmes and why some of them stay whilst others eventually leave. Finally, it is about their narratives, negotiations, and choices as they move into first year. The Dissertation consists of four papers of which one has been published, one accepted and two have been submitted to international peer reviewed journals[1].

The first paper aims to show how students make meaning of their higher education choices at the end of upper secondary school. The paper offers three main contributions to the research field. First, the study shows how choice of study is a *process* of identity work which includes the on-going negotiation of the students' perspectives of their future as well as their past. Second, the students perceive the choice as a personal task they need to handle alone. As a consequence, they manage complex considerations alone although their social network is used as tacit knowledge that informs their choice-narratives. Here, these narratives are tried out and adjusted in accordance with whether their choice is recognised as a legitimate identity match. Finally the choice of study is a negotiation of finding a study programme that embeds present interests whilst at the same time finding a proper match with ideas of an attractive life in general and working life in particular.

The second paper investigates students' STEM-choices. In particular, the focus is on the upper secondary school students who did not consider choosing STEM at higher education despite pointing to a STEM subject as one of their favourites. The analysis shows how these students do not expect higher education STEM to meet their interest in STEM. Moreover, they do not see STEM as an attractive platform for constructing an attractive identity, and in particular they find that choosing STEM would require them to submit themselves to strict rules, methods, and procedures with little room for self-

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[1] At the time of the publication of the dissertation three of the papers were published or accepted for publication and one was still under review.

development. When comparing the students who did not consider choosing STEM, even though they liked it, to first-year students' actual experiences with meeting higher education STEM, there are quite striking similarities. The first-year students do not meet the STEM they thought they opted in for. Rather what they meet is similar to what the upper secondary school students who did not consider choosing STEM expected of STEM namely strict rules, methods, and procedures with little room for self-development.

The third paper is a review of STEM higher education study programmes. The review highlights how most of the research focuses on overcoming deficits in students' prior knowledge, but also that a more specific focus on identities as an analytical framework is emerging. There is a call for research to move away from considering drop-out as a student's problem alone and instead move towards approaching retention as a *relation* between the student and the institution. Research that addresses identities as culturally embedded is pointed out to have promising perspectives as a way forward to study this relation.

The fourth paper contributes to existing research by developing an analytic approach to understanding the various negotiation strategies students apply in their transition process into a higher education STEM study programme. The paper shows how all students encounter a gap between what they expected their higher education STEM study programme to be like and their actual experiences when meeting it. Therefore all students need to negotiate their choice-narratives and expectations to cope with the gap. Five negotiation strategies were identified and these differed in terms of the size of the gap, the strategy used to bridge it, and whether the students managed to renegotiate their narratives in few steps or whether the renegotiation occurred continuously through the first and even the second year.

1. INTRODUCTION

1.1. Navigating the dissertation

This dissertation presents the main elements of the research work that I have conducted as part of my PhD study. The dissertation consists of four papers, two of which have been accepted for publication in International peer reviewed journals (Paper I and III), and two are currently undergoing review (Paper II and IV)[2].

Three of the papers (Paper I, II, IV) are based on the same longitudinal study, but they investigate different aspects of that study. The underlining methodology of the three papers is elaborated in this general introduction, but a number of theoretical aspects that pertain to the individual papers are elaborated within the respective papers. One paper is a literature review (Paper III), and the method for conducting this review, is explained in the paper.

This dissertation consists of this general introduction where the overall research aim is presented and a literature review sets the scene for how I position my research. The review is followed by a methodology where the overall theories and methods are presented and discussed. After this section, the four papers are presented as the heart of the dissertation. And finally I present a general discussion in which the papers are tied together and discussed in relation to the general research aim and each other.

The purpose of this dissertation is to present the overall background, aim, framework, discussion and conclusion for the general empirical study in which three of the contributing papers are based (Paper I, II and IV), and to provide a point of departure for understanding the coherence across the papers. Of course the papers can be read separately, but the general introduction and discussion seek to

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construct a foundation in which the papers can be embedded. Whilst I have sought to limit reiterations from the papers in the general introduction and discussion, the few reiterations that were unavoidable are duly referenced.

1.2 Framing the problem

Throughout history, politicians have been aiming at increasing the population of students in certain areas. Particularly the student choice of opting into science has been and still is highly prioritised on the political agenda. This is so because of a general concern that Europe is facing a shortage of engineers and scientists (European-Commission, 2004; OECD, 2008). This debate is repeated now and then due to the political concern, but also due to a concern anchored in science education. Here, a large amount of research has aimed at finding the reasons for the leaking pipeline; an expression covering why upper secondary school students do not continue pursuing their interest in science, engineering and mathematics (STEM) into higher education (Alper, 1993; Jenkins & Nelson, 2005; Schreiner & Sjøberg, 2007).

But even though there seem to be an agreement of students not following their STEM interests into higher education, it is questioned whether or not we in the future are facing a shortage of engineers and scientists. Osborne and Dillon argue how it is 'morally questionable' to encourage young people to train to work in a sector without any evidence that there will be enough jobs for all of them (2008), and it is doubtful whether higher education is facing a swing from the sciences in general; however, few science subjects face shifts in popularity (E. Smith, 2010).

The concern of a future lack of engineers and scientists is also present in Denmark. An example is a career-counselling homepage made by the Ministry of Children and Education. (Uddannelsesguiden, 2012). Here calculations show how we are facing a shortage of scientists, mathematicians and engineers in the nearer future. Furthermore, in parts of the public discourse, students are encouraged to consider the 'effect' of the study they are about to select and hereunder choose a study programme that gives access to future profitable jobs, like in science and engineering (Confedatation of Danish Industry, 2010).

During primary school, an aim for the career counselling is to help students make a *personalised* choice combined with their *abilities* and *interest* in a career path (The Ministry of Children and Education, 2009). Furthermore they are encouraged to continue studying after upper secondary school without wasting too much time on gap-years; as a result of a gap of more than two years their grades lose their value. Moreover, restrictions are implemented to ensure students finish as fast as possible (The Ministry of Science; Innovation and Higher Education, 2011).

In this dissertation I am interested in understanding how the upper secondary school students construct their educational choices in a field with many competing discourses of what a 'proper choice' should be like – some even being contradictory. The students are required to balance who they expect to become if choosing a particular study programme (Illeris, Katznelson, Simonsen, & Ulriksen, 2002; Schreiner, 2006) with societal discourses of what a proper choice is   (Hsu, Roth, Marshall, & Guenette, 2009). In particular, this dissertation is about the choices which relate to choosing or not choosing STEM and why some students who are interested in science, technology and mathematics in upper secondary school choose *not* to continue studying it at their higher education programme.

Over the years an extensive amount of research has investigated students' choices in general, and STEM choices in particular (Bergerson, 2010; Boe, Henriksen, Lyons, & Schreiner, 2011; Paulsen, 1990). But students' choices are not only interesting research objects in themselves, more extensively they seem to inform the research in student retention. When trying to understand why some students leave higher education, some of the explanations found in the international literature indicate a relation to the students' constructions of their educational choices. For example, poor choice-making seems to be related to students leaving their study programme before finishing (Yorke & Longden, 2008); and there are indications that students who leave did not make as proactive choices as the students staying (Ozga & Sukhnandan, 1998).

The above studies relate students' choices of higher education to the difficulties students face when meeting their higher education study programme. These studies have asked students retrospectively about their reasons for leaving higher education. But this raises an important question: what can we learn about students' choices in

upper secondary school from these students' retrospective considerations about leaving their higher education study programmes? To understand the relation between students' upper secondary school choices and higher education retention, there seem to be a methodological challenge of capturing the significance of time.

Hutters, in a Danish context, argues (2004) that in order to understand students' trajectories and choices, they must be studied as trajectories over time, developing as new conditions interacts with them.

Another methodological challenge is whether stayers and leavers are two different groups before some of the students decide to leave. Seymour and Hewitt find more similarities than differences between the students staying and the students leaving higher education, and they suggest to approach retention differently (1997). Instead of explaining why some students fail to stay while others do stay, further emphasis needs to be put on the difficulties students *in general* meet when encountering their STEM study programme, and particularly the coping strategies they engage with to overcome them.

Against this background, I aim at contributing to this field of study by employing a longitudinal methodology to explore this relation of, on one side, students' higher education choices and, on the other side, their transition into the first year on STEM study programmes.

Overarching aim

The overall aim with this dissertation is:

- To understand Danish students' choices of what to continue studying after upper secondary school and in particular how their perceptions- and expectations of STEM higher education relate to their choices.
- To explore the relation between students' STEM-choices, their experiences of the transition process into higher education and their considerations of leaving and staying.

With this research aim, I intend to inform the scholarly discussion about students' choices of – and transition into – higher education

STEM study programmes. The aim will be discussed below according to my theoretical framework and operationalised in my methodology.

The general research aim calls for a longitudinal method to follow students' transition process from upper secondary school and into their higher education study programme. Before unfolding the methodology, I will inform my research position by conducting a literature review of existing longitudinal research on students' transition into higher education in general and science, engineering and mathematics in particular.

1.3 Positioning this longitudinal research

Each of the three empirical papers (Paper I, II, and IV) contains a literature review and Paper III is a review of previous research into students leaving STEM higher education study programmes. During the research process I came across various longitudinal studies which have informed my research position. The aim of the present review is to give a *systematic overview* of the diverse field of longitudinal studies into student transition. As will be shown below, previous longitudinal studies into students' transitions thematise multifarious issues and adopt a variety of investigatory approaches. The sheer diversity of these studies makes it difficult to identify a firm and unified footing. Nevertheless, it is possible to identify and delineate areas in the body of previous research that seem to be essential for future studies to pay attention to. The following section identifies these areas and points out how I in this dissertation position myself in relation to the existing literature.

The review was carried out by a literature-search in the database ERIC and supported with an additional search in Google scholar and Web of Science, to ensure that no studies were left out by mistake. The search was conducted for reviewed literature in the period from 2000 until March 2012. Searching for the keywords: longitudinal studies, transition, higher education; 203 results were found in ERIC and a few studies were added from Google Scholar and Web of Science. Some of these studies did not fall under the purview of this dissertation. For instance studies focusing on the transition from higher education to employment, studies that focused on daily

smokers or early motherhood and transition. These studies were weeded out, and in total, 89 studies were left for review. Only four studies within STEM came out of the search.

I will give a short review of the tendencies in the international research literature. This will serve as a point of departure for explicating my own research position and methodology. I categorised the results of the search in three groups; 1. Studies concerned with how groups of students with various backgrounds interacts with social structures at higher education institutions. 2. Studies aiming at understanding how the educational setting in general, and concrete educational initiatives in particular, interacts with students' strategies. 3. Studies concerning how students relate themselves to higher education culture and their identity-work and coping strategies in the transition process. These categories represent three longitudinal approaches to study students' transition to higher education: a macro, meso and micro level. The studies that fell under the macro level (1) were given the generic label *Sociology* since these studies are concerned with how social variables as gender, ethnicity and social-economic background interact with social structures at higher education. The studies categorised as meso (2) were labelled *Pedagogy* since these studies are concerned with how the educational construct and concrete educational initiatives set the scene for students' strategies. Finally studies identified as micro level (3) were labelled *Psychology* – these included studies that aim at understanding students' identity-formation and coping strategies when meeting higher education culture. Within each category, I constructed clusters of studies to provide an overview of the field.

Studies within sociology

The primary sociological interest of studying students' transition into higher education from a longitudinal approach has been to gain knowledge of student diversity. With an increasing uptake of students' into higher education, new types of students have entered into university studies. Researchers within sociology discuss whether the tendency that a more varied student population receives an academic degree, implies that society is moving towards increased *inclusion* in terms of students getting access to better positions in society in general (Shavit, Arum, & Gamoran, 2007). Or rather, whether this tendency is a process of a new *diversion* in the sense of

an increased hierarchical differentiation of the tertiary system – this could be manifested in the fact that some universities admit students with various social backgrounds where other universities only does that to a limited extend. The social rankings of universities are related to the capitals the students' access through their choosing a particular university; hence the value of their degree (Bathmaker & Thomas, 2009; Thomsen, 2008). This schism seem to be a pivotal point within the literature of students transition into higher education when studying diversity in the student population and how students due to their social profile meet Academia in different ways.

Social background

The longitudinal literature concerning the role of students' social background for their transition into higher education has, in particular in a UK context, been inspired by the work of Bourdieu (See for example Bourdieu, 1984; 1986). One focus has been on students' social background and how students with non-traditional backgrounds choose less prestigious higher education institutions than students from traditional academic backgrounds (Ball, Maguire, & Macrae, 2000; Reay, Davies, David, & Ball, 2001). Another focus has been on how students with non-traditional backgrounds struggle with understanding the rules of governing practices within academia as the high-value status of linguistic capital (Watson, Nind, Humphris, & Borthwick, 2009).

Also, a number of US-based studies document that first-generation students are more likely to attend public comprehensive institutions instead of research universities, and that they are more likely to leave higher education than those with at least one parent who has a bachelor degree. However, these differences were erased in the group of first-generation students who attended high school classes with advanced science (biology, chemistry and physics), four years of mathematics and three years foreign language (Choy, 2001; Warburton, Bugarin, & Nunez, 2001). Furthermore, in a large review of mainly North American quantitative research on how college affects students, it is concluded that one parent having a degree is a stronger factor than factors such as race-ethnicity, family income, college qualifications or other factors associated with educational attainment (Pascarella & Terenzini, 2005).

The schism of whether a more varied student population produces *inclusion* or *diversion* within higher education is also present in a Canadian study stating how the pervasive public discourse about the benefits of attending higher education influences young working class people in choosing to study at a university. Entering higher education, the new culture and new demands however, are often fraught with uncertainty, why working class students are led to strong vocational orientation which is not a pathway that is welcomed by academia (Lehmann, 2009).

Ethnic backgrounds

A number of longitudinal studies have been carried out focusing on the inclusion of students with various ethnic backgrounds (Hall, Cabrera, & Milem, 2011; Hurtado & Ponjuan, 2005; Nunez, 2009). Reay, David and Ball argue how social variables need to be understood in intersection with each other; they show that while gender inequalities are reduced when a student enters higher education, social class and ethnicity inequalities are reinforced (Reay, David, & Ball, 2005). A different conclusion is reached in a study in which it is found that higher education aspirations are higher in students from visible minority Canadian immigrants than for native born and not a member of a visible minority group. One explanation given is that higher education has high value among migrant parents. Furthermore the study shows how the social mobility is also higher within the group of visible minority Canadian immigrants (Krahn & Taylor, 2005). Similar findings are found in a non-longitudinal study of Hispanic students attending a Hispanic Serving Institution in the US. The results show how the students in particular were attracted towards STEM, and that STEM in the future could be a point of departure for recruiting more students with varied ethnic backgrounds (Crisp, Nora, & Taggart, 2009).

Gender

Within longitudinal research on students' transition into higher education carried out in STEM, a particular interest has been on the gender imbalance in some study programmes. This has led to research focusing on the differences between girls and boys and an aim of detecting the typical "female" and "male" interest in science, with the

result of suggested adjustments to be made to science education, that is to cater for these interests (for a discussion see Sinnes & Løken, 2012). Recent feminist research has been inspired by post structuralist thoughts of marginalised positions within science and how certain gendered positions seems to be included and others not (Sinnes, 2006). Two examples are longitudinal studies carried out on younger students' attitudes, interests and engagement in science i.e. the work of Brickhouse, Lowery and Schultz (2000) and Archer and colleagues (2010). Both studies show how students' engagement and interest in science are strongly related to their identities and perceptions of themselves as a 'kind of person who engages in science or not'. Furthermore, the studies show how the overlap of their personal identity with school science identities affects their relation to science (Archer, et al., 2010; Brickhouse, et al., 2000).

Also, elsewhere identity is suggested to be a theoretical point of departure to approach the variety of students. Since not all students are alike, it is important that we understand their identity development process rather than make overly generalised statements about group membership. Moreover, if higher education is sincere about creating positive learning environments for all students, then each person who works with diverse populations must also value these diverse developmental issues (Torres, Howard-Hamilton, & Cooper, 2003).

To understand the complexity of how diverse students meet higher education institutions, the cross field of sociology and psychology is suggested as a way for research to move forward. More specifically, taking a point of departure in students' identities can be a way of gaining new knowledge of how various students undergo the transition process to higher education.

Studies within psychology

The category of longitudinal studies of students' transition to higher education within psychology can be divided into (a) studies concerning students with disabilities, (b) studies that perceive transition to higher education as a part of the larger transition in life in general and adolescence in particular, and finally (c) studies that perceive transitions as an underlying condition of subjectivity.

Disabled students

An extensive amount of literature has been carried out in order to gain knowledge about how students with various disabilities manage the transition process into higher education (Flexer, Daviso, Baer, McMahan Queen, & Meindl, 2011; Madriaga & Goodley, 2010; Newman, Wagner, Cameto, Knokey, & Shaver, 2010). Special attention has been paid to support disabled students in their transition process; in particular, professional staff have assisted students in finding their own goals and desires as a point of departure for writing transition plans (Willams-Diehm & Lynch, 2007). Also, attention has been paid towards preparing students to enter higher education; to teach students to become self-directed learners already when entering upper secondary school and to integrate students in what they perceive to be their future pathway before having to walk it (Rusch, Hughes, Agran, Martin, & Johnson, 2009).

Transition as a life phase or condition of subjectivity

Inspired by developmental psychology, one way to approach the transition between upper secondary school and higher education is not just as a transition in between institutional cultures and demands, but as a transition in life phases in general (Salmela-Aro, Aunola, & Nurmi, 2007; Syed & Azmitia, 2009). A review of adolescent identity formation from 2000-2010 (Meeus, 2011) finds an expansion of the literature throughout the past ten years, and concludes how the dynamics of identity formation has been overrated in previous studies. The author underlines how the results might be related to the research design not being able to embrace dynamic identity formations, and call for future studies to approach adolescent identities with a narrative identity framework and use multi-wave longitudinal designs (design with multiple empirical collections) to include more dynamic aspects of identities.

This conclusion is supported by transition researchers within psychology who use narrative methodology and poststructuralist theories to argue how transitions must be studied as an underlying condition of subjectivity, in which fragments are linked together in new ways that sets the scene for identities to transform in new ways too (Ecclestone, Biesta, & Hughes, 2010). To understand transitions

from one institutional context into another, a focus on students' abilities to navigate in the new cultural norms through a perspective on their identity-work is crucial, and hereunder to understand the process of how students strive to become students in higher education:

> Numerous studies show how transitions combine turning points, milestones or life events with subtle, complex processes of 'becoming somebody' personally, educationally and occupationally (Ecclestone, et al., 2010, p. 7)

Many researchers argue that in order to understand transitions, researchers must adopt a focus on identities together with an account of how these are shaped, constrained and related to the conditions and expectations of higher education (Ecclestone, et al., 2010).

Thus there is a strong call for future studies to approach students' transition into higher education from a perspective of identity development, and in particular narrative identity studies. This dissertation takes this exact approach.

Studies within pedagogy

The studies I categorise within pedagogy relate to students' transition in terms of their academic preparation and retention, but also research in specific pedagogic interventions and initiatives are found within this category.

Preparation

Studies have, in different ways, been concerned with students' preparation to enter higher education. One perspective has been on how students without proper preparation struggle when they enter higher education and continue to lag substantially behind more prepared students in the transition process (Roksa & Calcagno, 2010). A longitudinal study made by the US Department of Education (Adelman, 2006) consisting of a nationally representative cohort of students from high school into postsecondary education, shows how students' first year at higher education is the year in which their

preparation is most tested and in particular college-level mathematics serve as an indicator of that preparation. Furthermore it is argued, both in the report and elsewhere, that dual enrolment in which the students already in high school take higher education courses, has great potential. Dual enrolment has previously addressed a relatively small number of higher achieving students, but has the potential to ease the transition to higher education for a broader range of students by letting them gradually get to know higher education by participating in courses already when in high school (Adelman, 2006; Bailey, Hughes, & Karp, 2002).

Intervention and initiatives

Other studies have been concerned with how different initiatives seem to ease the transition, like career development in upper secondary school (Lapan, Aoyagi, & Kayson, 2007), summer bridge programmes (Walpole et al., 2008) and first-year seminars (Keup & Barefoot, 2005). In a UK study, students who managed to stay through their study, reported how their preferred support was through academic tutors and peers, but also friends and family outside higher education. To reach the students with more professional support the initiatives needed to be integrated in the students' academic network (Walsh, Larsen, & Parry, 2009). Students experience entering higher education as a time of heightened distress, and support must enable them to negotiate the transition to university to ensure successful completion (Bewick, Koutsopoulou, Miles, Slaa, & Barkham, 2010).

Elsewhere it is argued how a transition perspective is necessary to understand how students perceive the demands when entering higher education. In particular, it is important to understand their coping strategies when handling these demands to provide an appropriate transition support programme: *the presenting concerns of students need to be explored in the context of the idiosyncratic meanings attached to demands by students. Different people find the same situations demanding for different reasons* (Arthur & Hiebert, 2011, p. 9). The results show that in order to support students' difficulties in the transition process, it is crucial to take their concerns and their strategies for coping with these concerns as an expression of sincere effort. Counsellors must support students' existing coping strategies rather than providing additional demands for students who are already facing enough difficulties. In transition to higher education,

researchers and counsellors must pay attention to students' coping repertoires. Such repertoires are not always appropriate for entering a new institutional setting: *students will be most successful if they can identify the specific aspects of their situation that produce the demands and consider alternative coping strategies to manage transition in post-secondary education* (Arthur & Hiebert, 2011, p. 102).

Retention and students leaving higher education, the importance of time

Most of the above studies, carried out on initiatives to support students in their transition into higher education, aim at decreasing the number of students leaving their study programmes. But to study students' transition in relation to retention, the importance of time becomes evident; in an event-history longitudinal study of first generation students' attrition and completion, it is found that the risk of students leaving depends on different factors such as family income, high school academic attributes and that the effect varies for different groups of students *over time* (Ishitani, 2003). The importance of studies *over time* is also highlighted in a literature review of students' transition to college:

> Thus, we have a short window of time in which to observe initial enrolment, attendance patterns, and completion for students who delay initial entry into college. A better understanding of college transitions over the life course, particularly for non-traditional students, would be achieved if longitudinal datasets followed students for a longer period of time. In addition, it is becoming increasingly necessary that students be followed across school systems, and indeed across state lines, in order to gather complete data on their schooling trajectories. (Goldrick-Rab, Carter, & Wagner, 2007, p. 2471).

So as to gain knowledge of students' higher education retention, longitudinal studies that follow the students from upper secondary school and throughout their transition process into higher education are crucial. The design of the research carried out in this dissertation

is taking its point of departure in the knowledge provided by previous studies of how to approach retention.

Studies within science education

As shown above, some studies have been carried out with a particular interest in gender and participation in science (Brickhouse, et al., 2000; Fowler, 2010); and the participation of students with minority ethnic backgrounds in science (Hurtado et al., 2007); and in students' social backgrounds and attendance in science (Goyette & Mullen, 2006; Warburton, et al., 2001). One longitudinal study shows how students with university-educated parents made earlier decisions about future studies than other students, which proved to be an advantage when choosing science due to the requirement of focused trajectories in high school. Furthermore, it is concluded that science and mathematics are advantageous subjects for high school students even if they do not choose to study it at higher education:

> One key finding is that a background in mathematics and science at the high school level can be beneficial even for students who do not intend to follow scientific educational pathways. In the end, respondents—and especially the young women— may not have earned degrees in science or mathematics, but completion of these subjects in high school led to increased likelihood of attending a university and a much broader range of programme options at the post-secondary level. (Adamuti-Trache & Andres, 2008, p. 21).

The results are based on data from the late 1980s, and caution should be taken when transferring them to today. The study emphasises a shift in focus from students' science choices to include how STEM study-programmes also include and retain students in certain ways (Adamuti-Trache & Andres, 2008).

This request is taken in a longitudinal study of how physics students negotiate meaning and purpose over time. To cope in a setting of a traditional physics programme, which relies heavily on a vertical course structure, some students need to rely on an ability to defer their need for intellectual gratification. The study identified that the

need for intellectual gratification draws on aspects of deep learning approaches, and that the act of deferring this need is a type of learning strategy adaptation that gradually comes to resemble certain aspects of surface approaches (Johannsen & Rump, Under review). Similar results are found by Zeegers (2001) who found that students perceive university science study, and – in particular – the first year, as a survival course and that they adopt strategies suited to that task.

In particular, it is difficult to find longitudinal transition studies in science education that incorporate an identity perspective, as called for in the higher education transition literature. The studies found meeting this call all adapt a gender perspective. One example is Hasse (2002, 2008) who follows a group of physics students into their first year of higher education. She shows how the transition from newcomer to a full participant in a community of practice of physicists implies certain aspects of identities to be highlighted and others not; one is that doing university physics emphasises the ability to play with toys as an ability to think scientifically (Hasse, 2008).

Few studies emerged from the literature search concerning students' transitions into STEM higher education study programmes. This is a surprise since STEM study programmes are among the ones the most students leave before completion (OECD, 2008), and the literature on retention calls for longitudinal approaches as a way forward to understand students' considerations of staying and leaving across institutions and time. In order to substantiate that there is indeed a lack of literature in the area of longitudinal studies of students' transition into higher education within science education, an additional literature search was made in 'Web of Science' and 'Google Scholar', but with the same results. Therefore my major finding in this review is that science education lacks longitudinal research within this area.

What do I learn from the review? Informing my position

The aim in this dissertation is to explore how upper secondary school students' choices relate to their actual first year experiences when entering higher education STEM study programmes. The above

review acts as a tool to inform the construct of my methodology to approach the aim. From the review, the major conclusions are:

- The literature review shows a clear lack of longitudinal studies of students' transition into higher education STEM study programmes.
- This is peculiar since STEM study programmes are among the programmes from which most students leave before completion. The retention literature highlights longitudinal approaches to study students' transitions as a way forward. Combining students' transition with retention, the importance of time turns out to be crucial to enable a research design to study the variety of students' consideration of staying and leaving.
- There is a call for future studies to approach students' transition into higher education from a perspective of *identity development*, and more particularly *narrative identity studies*. Such an approach is needed to understand how students relate themselves to the expectations and conditions of higher education.
- The studies categorised under Sociology highlight the importance of incorporating a focus on how social variables i.e. in particular how social background, gender and ethnicity interact with higher education transition.

These conclusions are important in my construction of a methodology. I will continue to unfold my methodological considerations in response to the above calls that emerged from the literature review. I will do so by choosing narrative psychology as a framework, and by designing a longitudinal qualitative study of students' transition from upper secondary school and into their STEM higher education programme. In this way, I wish to bring together students' identities, STEM higher education programmes and a longitudinal methodology to approach students' choices and retention. The importance of social variables is used as a point of departure for selecting students to participate in the study, but as pointed out above, my major interest is the complexity concerning how *diverse* students meet higher education institutions, rather than a focus on one social category such as gender.

With this study I wish to contribute to the limited knowledge in science education of students' transition into higher education STEM study programmes with a longitudinal approach. The design of my

methodology is informed by all three categories, i.e. Sociology, Pedagogy and Psychology; but I primarily position this research in the psychology category since my focus is on students' identities in the transition process to STEM higher education, and the theory I use to understand this process is rooted in social psychology. But the field that I enter when studying students' considerations of staying and leaving is situated in the pedagogy category. Finally I use the knowledge from the sociology category to inform the methods and in particular the selection of the students participating in the study.

2. METHODOLOGY

2.1 Approaching the problem with theory

In this dissertation I aim to understand upper secondary school students' STEM-choices and their transition process into higher education. Thus, the research object is upper secondary students – in their process of becoming higher education STEM students. The methodology is a longitudinal approach. Against the background of the review, the research aim is sought on the basis of a theoretical framework that enables an understanding of the complex process of how identities are shaped, constrained and related to the conditions and expectations of the higher education institution.

A key challenge to such a theoretical framework concerns the construction of the research objectives, i.e. how should students' identities be approached? I have been searching for a theoretical framework from various perspectives. One viable option would be discourse analytic approaches hereunder discourse psychology (Potter & Wetherell, 1987; Wetherell, 2007). Discourse psychology is useful in its ability to point out how students ascribe meaning to various discourses and use discursive practices to express themselves and their identities in certain kind of ways. Discourse psychology focuses on '*the verbal conceptualizations as flexible components of situated talk for situated purposes*' (Hsu, et al., 2009, p. 3). Employing a discourse psychological position could be useful for understanding the discourses that are available to the students in their choices of higher education; how they draw on these discourses in making themselves recognisable through applying language in certain ways when entering higher education; how new discourses are produced; and how it affects students' possibilities for articulating themselves. But I struggled with how to understand students' experiences over time or more precisely, how students' upper secondary school choices were related to their higher education experiences. How do students' considerations and expectations of how a particular study programme will be like affect their meeting and engagement with the study programme? I needed a framework that embraced the *relation* of

students' choice-considerations during their transition to the first year at higher education.

Discourse psychology positions itself in opposition to developmental psychology and the idea of identities following certain phases. Instead it highlights how identities are fluently, constantly negotiated and produced in a particular cultural context (Benwell & Stokoe, 2006). Rather than being interested in development, the interest is on discontinuities over time. To follow my research interest I would have needed to combine discourse psychology with other theories to understand my research aim, and that is how I came across narrative psychology.

Narrative psychology: Identity, meaning and choice

Narrative psychology is, like discourse psychology, an outcome of what is known as the crisis in social psychology in the 1970s, breaking with the widespread experimental tradition, towards new criteria for making science (Sarbin, 1986). From examining and measuring the self as traits, abilities and personality, other theoretical positions arose that subscribed to identity as something being multifaceted and complex and produced in social and cultural contexts. Identity as a research object moved from the lab into real life social situations now requiring qualitative research methods (Potter & Wetherell, 1987). But narrative psychology is also inspired by philosophy – in particular Paul Ricoeur (1990) and his ideas on understanding narratives and experiences as storied structures.

Narrative psychology assumes that we – in our everyday life – perceive our lives as a single progressive story and each other and ourselves as possessing a coherent self (Polkinghorne, 1988). Therefore we position ourselves according to a reliable and valid appearance in which a coherent self is expected. This sets the scene as to how flexible and fluently our narratives can appear and for the individual's possibilities for negotiation (Bruner, 1990). Identities are then, on the one hand, embedded in the cultural context setting the scene for the narratives, but on the other hand, they are constructed in relation to the individuals' and their surroundings' sense of a self. Individuals cannot freely invent their narratives without being recognisable in terms of these two central aspects.

The concept of *meaning making* is a central to narrative psychology. Meaning making is to be understood as a way of structuring the world; the complexity in our experiences of the world is through narratives fixed into a sense of coherence and causality we can relate ourselves to.

> Narrative is a meaning structure that organises events and human actions into a whole, thereby attributing significance to individual actions and events according to their effect on the whole. Thus narratives are to be differentiated from chronicles, which simply lists events according to their place on a time line. Narrative provides a symbolised account of actions that includes a temporal dimension. (Polkinghorne, 1988, p. 18).

Narratives or the ways of structuring meaning are related to identities in the sense that individuals are *made* and at the same time *make* themselves recognisable through the narratives – again this duality of identity as constructed through culture (make   recognisable) and through   self-perceptions (made recognisable) is crucial. It might sound as if narratives are tools individuals can use strategically, but this is not the case. Rather, individuals understand and convince themselves as well as others through narratives: '*The self, then, is a meaning rather than a substance or a thing*' (Polkinghorne, 1988, p. 152). Narratives are, then, both what structures the world and what relates us to it. Narratives are a way of framing events, beliefs and desires into a coherent story. When applying narrative psychology to student's choices we therefore learn both how they ascribe meaning to their choice and also gain access to how they relate themselves to it.

In narrative psychology, narratives are understood as culturally embedded: '*we live publicly by public meanings and by shared procedures of interpretation and negotiation*' (Bruner, 1990, p. 13). If narratives are to be understood as sensible and recognised they need to be embedded in cultural ways of performing. By applying a longitudinal narrative psychological approach to students' upper secondary choices we get access to understanding student choice of study after upper secondary school as a process which takes place over time, and in which individuals work on their identities in terms on constructing a coherent choice narrative. This process involves an

ongoing negotiation of who you are (present), who you wish to become (prospect) and how it suits your notion of a self (retrospect) (Bruner, 2004).

Narrative psychology covers a range of different theoretical positions (B. Smith & Sparkes, 2008). In this dissertation I choose a position in which I take both the cultural and individual aspects into account. Rather than considering narratives as an expression of an inner self or cognitive structure, I perceive them as cultural actions. And rather than reducing narratives to being solely cultural products, I perceive them as also being related to the individuals' resources in terms of the individuals' personal history, as the narratives are situated in the individual's own and her social relations perceptions of who she is. Hence the analytic interest is on the production of selves, the complex ways narratives are used, the interplay of narrative resources, the continuities and discontinuities in identities, and self-coherence which is explored as something people actively do (B. Smith & Sparkes, 2008). My interpretation of the narrative psychological theories used in this dissertation is to be understood from this position.

In this dissertation narrative psychology is my methodology in the sense that it is both the underlying conceptual framework of understanding the notion of identity, but it also guides the way I conducted the interviews and the tools for analysing them. I will return to this methodological construct below.

Theoretical considerations

In each of the three empirical papers (Paper I, II and IV) narrative psychology was used together with other theories. In mathematics education research it is argued that using various theories is '*a resource of richness that is necessary to grasp complexity*' (Prediger, Bikner-Ahsbahs, & Arzarello, 2008, p. 166). But combining several theories can be done in many ways at various levels, and Prediger, Bikner-Ahsbahs and Arzarello develop '*a landscape of strategies for connecting theoretical approaches*' when dealing with qualitative data. This landscape covers a spectrum from, in one end, theories ignoring other theories from the perspective of theories as arbitrary and isolated. To, the other end, 'unifying globally' covering positions constructing a new theory by combining others to an new coherence in the sense that diversity is an obstacle and problematic.
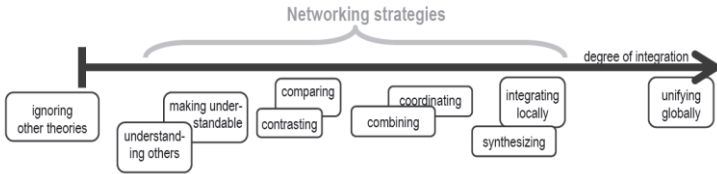
Fig. 1. A landscape of strategies for connecting theoretical approaches from Prediger, Bikner-Ahsbahs and Arzarello 2008.

In this dissertation I use narrative psychology as the underlying theory but I *combine* it with various theories in each paper to approach identities in relation to a cultural level: *The networking strategies of combining and coordinating are typical for conceptual frameworks, which do not necessarily aim at a coherent complete theory but at the use of different analytical tools for the sake of a practical problem or the analysis of a concrete empirical phenomenon* (Prediger, et al., 2008, p. 172). Networking strategies (see figure 1) provide diverse insights for a phenomenon in using various theoretical approaches with different prospects. Approaches if used isolated, only will allow a limited view. But caution must be taken when combining theories. It has to be clear how they are combined; how they feed into the research aim, and it can only be done with theories of compatible cores (Prediger, et al., 2008).

In a large review of studies in science education carried out with an identity focus there is a call for researchers to consider a broader theoretical framework and in particular to include a macro level, and approach identities as embedded in social structures i.e. to pay attention to: *(...) the framework of groups and societies, including social norms, social roles and the pressures that these structures create* (Shanahan, 2009, p. 46). In relation to my theoretical vantage point in narrative psychology it seems highly relevant to meet the call for acknowledging a macro level that sets the scene for the construction of narratives, but in this theoretical framework the knowledge interest is not that of social structures since my research objective is not a particular social group, for example in a classroom. Rather, I follow various students' transition process into various higher education STEM study programmes and the participants can be a part of several social groups at their study programme at the same time. However, I acknowledge a call for combining identity theories with theories providing tools for perceiving identities as

more than a practice taken by the individual. Therefore, in each paper, I strive to combine narrative psychology with a theoretical approach that in different ways embraces and defines a macro level that sets the scene for the students' identities. These theories are not combined across the papers, but locally applied within each paper. The diversity of the theories makes it difficult to gather them under the same label (i.e. culture, structure, discourses), why I use the notion of 'macro level' to describe them. As shown in Figure 2, narrative psychology was combined more and more with other theories across the papers.
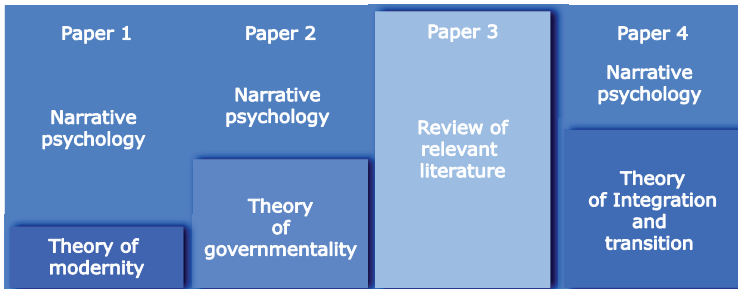
Fig. 2. Overview of the theoretical framework across the Papers.

In the first paper the aim is to explore – through narratives – how students perceive and ascribe meaning to their choice of higher education; what they point to as being crucial when choosing their future study and how their narratives interact with their choice-strategies and identity-work when they are about to choose higher education. Narrative psychology is the primary methodological approach, but it is combined with aspects of the theory of late modernity. Theory of late modernity is used to understand the setting in which the choices are situated and the implications for the student's way of choosing what to continue studying.

In the second paper the primary aim is to understand students' perceptions of STEM and the relation to whether or not they decide to choose to continue studying it. Here, narrative psychology is combined with the thoughts of Michel Foucault and Nikolas Rose. Narrative psychology is used as a methodology to approach the data, and Michel Foucault and Nikolas Rose as the theoretical framework to provide interpretations feeding into the analysis.

Finally paper four aims to understand transition into higher education by combining narrative psychology with poststructuralist transition theory and the concepts of academic and social integration developed by Vincent Tinto. The poststructuralist theory of transition is used to understand the setting in which the students' identities are situated. In this paper an analytic framework is developed by using narrative psychology as the underlying methodology to approach students' negotiations of their identities in the transition process.

In each of the papers, narrative psychology is the underlying methodology used to conduct and approach the data, but each paper locally combines other theoretical aspects to reach the aim. In this respect the combination of theories in this dissertation is *aim-driven* and *empirically oriented* rather than theoretical. Or to put it another way, theories were picked out locally within each paper to approach aims related to understanding the empirical data-material rather than for the sake of producing and developing theory. Therefore I do not attempt to network the theories across the papers (figure 1) to synthesise discrepancies. For instance, using Michel Foucault for the epistemological point of departure is different from using theories of late modern society. I argue that both theories are locally consistent with my narrative psychological framework, since my theoretical position in between realism (the history of the self) and anti-realism (identities are cultural products) make these combinations possible.

2.2 Collection of data and selection of participants

The relation between the three empirical papers in this dissertation is that they are based on the same students but at different points in time. I will here present the design of the longitudinal study that underlies this dissertation. The study consists of a group of upper secondary school students whom I followed for almost three years throughout their transition into higher education STEM study programmes. To follow their identity process the primary data was qualitative narrative interviews. In total I have conducted 86 interviews. The number of students interviewed is illustrated in figure 3.
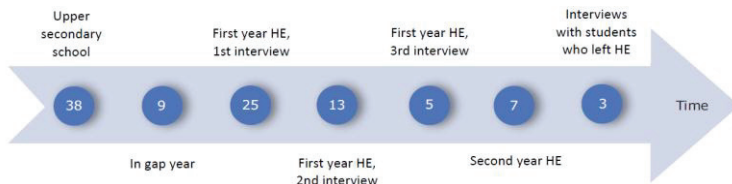
Fig. 3. The longitudinal data in this dissertation. Illustration of the number of interviewed students.

In the following section I wish to present the design of study carried out in this dissertation and the methodological framework with which the data was collected and analysed.

Selection of schools, classes and students

In total six upper secondary schools were picked out; four STX[3] and two HTX upper secondary school classes, all located in the eastern part of Denmark (Zealand) making it easier to access the students, who primarily applied for higher education study programmes in this part of Denmark too. Two schools are located in the urban Copenhagen area, two in suburban Copenhagen, and two in provincial towns. The schools were chosen to resemble variations in the student population: 1. One STX-school had a particular large number of students with another ethnic background than Danish. 2. One STX-school recruited students from socially privileged families. 3. One STX school recruited students from both socially privileged areas and areas of social housing. 4. One STX-school recruited students from both town and rural areas. 5. The one HTX-school recruited students from a large city area. 6. The other HTX-school recruited students from a rural area and some students travelled up to one hour to get to the school. All schools were selected based on information from the Science Faculty at the University of Copenhagen because the students from their science and technology

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[3] In Denmark there are four types of upper secondary schools, all giving equal access to the higher education system (HTX, HHX, HF and STX). STX is a non-vocational general type of upper secondary school with science classes as one of several tracks, whereas HTX consists of various tracks all specialised in science and technology.

classes frequently choose to study STEM higher education study programmes, and I wanted to be sure some of the students in my population actually continued into STEM. The classes were picked to embrace students on various tracks; one specialised in science, mathematics and technology, one in chemistry, biology and technology and four in science and mathematics. For each school I contacted the headmaster, who arranged an appointment for each class during school hours. Also the interviews conducted in upper secondary school took place during school hours.

In a Scandinavian context gatekeepers are often used to access the interviewees, and it conforms with ethical guidelines for qualitative research if the participants themselves approve participating (see for instance Kvale, 1996). This is to some extent contrary to the UK, for example, where the ethical codex is controlled by a national and institutional review board that approve plans for accessing and carrying out data (Creswell, 2009). I did have my empirical setup approved by the Danish Data Protection Agency, a requirement needed when asking for the students' ethnic background, which is a part of the data protection legislation. But during the design of the study and the data-collection I went through various other ethical considerations to ensure that my study complied with ethical guidelines for qualitative research, some of which I will return to below.

The questionnaire and selection of participants to interviews

In each class I handed out a questionnaire (appendix I). The questionnaire consisted of 31 questions spread over five themes and a final question:

- Background (gender, social, ethnic origin etc.)
- Interests and courses in upper secondary school
- Upper secondary school experiences and grades
- Relation to and interest in STEM
- Plans and thoughts about the future
- Acceptance or not of participation in interviews

I began my PhD-project in March 2009 and decided, due to the longitudinal character of the study, to collect the data in upper secondary school before the exams in May 2009. The questionnaire was therefore hastily constructed and distributed by visiting the classes. In two of the classes some of the questions had fallen out by a mistake, and were answered by the students via e-mail afterwards. At first I typed the data into the software programme SPSS, and planned on using the outcomes. Finally I considered the methodology to be problematic, since the order of questions have an influence on the way respondents reply, and so does the context in which the questionnaire is answered (Hansen & Andersen, 2000). I therefore decided only to use the questionnaire to a limited extent; as point of departure for selecting students for the qualitative part of the data and, in paper II, to illustrate the upper secondary school students' favourite subject. The character of this study is therefore qualitative. In order to select the students to participate in the longitudinal qualitative study, I considered following variables:

- Background (social, ethnic origin and gender)
- Relation to STEM in upper secondary school
- Plans for the future (whether or not they considered higher education and STEM, and plans of taking one or more gap years before attending higher education)
- To some extent their marks in STEM

I selected the participants to get various students so to get as diverse data-material as possible, in terms of the above criteria for selection. In total 38 students were interviewed. First of all I wanted students with different social backgrounds, ethnic backgrounds and gender. Seven of the students who were interviewed came from homes where another language than Danish was spoken, 18 of the students came from families with non-academic backgrounds, and 19 of the students were male and 19 female. I did not select the students to match the total population of students in upper secondary school in general. Statistics from 2009, for example, show 61% of STX students to be female and 19% for HTX students, and where 55% of the STX students' parents had a higher education background, the same was true for 38% of the HTX students (Ulriksen, Murning, & Ebbensgaard, 2009). Rather, the criteria in this dissertation was to reflect upper secondary school STEM students' *various* ways of choosing and *various* transition pathways into their higher education STEM study programme. By selecting various students I aim at representing a maximum variation case, as described by Flyvbjerg

(2011), with the purpose of capturing the range of the ways in which a diverse group of students approach their educational choice. In that respect I strive at some kind of generalisation in terms of identifying an array of possible strategies. I do not claim that the results in this dissertation are generalisable to all students in Denmark or that I map *all* possible outcomes. I picked the sample as follows:

- The majority of the selected students considered continuing into higher education; some did not consider the educational level, but they expressed an interest in continuing to study STEM.
- The majority of the selected students had an interest in STEM at the end of upper secondary school; some were not sure whether to continue studying STEM or something else; some did not want to study it, and few considered to continue studying it without expressing a particular interest in upper secondary school.
- Finally I looked through the students' grades in STEM to ensure a variety in the population.

Only three of the students did not indicate that they wanted to participate in the interviews in upper secondary school, the rest of the students wrote either their mobile number or e-mail address on the questionnaire. Out of the 38 students interviewed in upper secondary school, 22 were interviewed between one and five times in their transition process into higher education, and 20[4] were interviewed into their STEM higher education study programme. Five of the 38 students entering STEM were of varied reasons not followed. One did not reply when being invited to participate in the interview (Daniel), three responded too late that they had entered a STEM study programme (Aksel, Dan Frederik), and Fie was left out since I already had two female chemical engineering students. Four non-STEM students were interviewed because they, in upper secondary

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[4] In the four papers the number of students reported to continue into a higher education STEM study programmes differs due to two reasons. First, due to the point in time the students were registered and second, due to which programmes were defined as STEM programmes. Therefore, 18 students are included as STEM students in paper II and 20 in paper IV. This reflects that during the work with the empirical data I decided the selection of students used in paper IV to be the fairest delineation as it includes two programmes within applied sciences at the Faculty of Life Sciences. In both Paper II and IV tables show the selected group of students.

school, expressed a huge interest for STEM. Two of them ended up leaving their study programmes opting for a STEM study programme instead.

Overview of data

On the following page table 1 gives an overview of the students who were followed for this dissertation.

Table 1: The first letter in each student's name indicates they have been attending the same upper secondary school. The category 'no show' is used to illustrate students who did not reply when inviting them to participate in an interview or did not turn up when having an appointment.

Pseudonym Female/male	Upper secondary school STEM-study programme Math & science = M&S Math, science & technology=MST	Number of gap year(s) X= Interview	First enrollment in Higher Education (X)	Second enrollment in Higher Education (Y)	Interview Upper secondary school 2009 I=Individual G=Group	Interview first year HE First quarter 2009/2010 X: First Y: Second Enrollment	Interview first year HE Second quarter 2009/2010	Interview first year HE Third quarter 2010/2011	Interview second year First quarter 2010	Interview after leaving, without being enrolled at HE L
Allan (m)	M&S (Physics)	¾ a year	Medicine		I	X	X	X		
Amalie (f)	M&S (Chemistry)	1 year: X	Molecular bio medicine		I	X				
Asker (m)	M&S (Chemistry)	1 year	Medicine		G					
Alberte (f)	M&S (Chemistry)	1½ year	Medicine		G					
Adrian (m)	M&S (Physics)	1 year	Business and communication		G					
Aksel (m)	M&S (Physics)	None	Geography		G					
Louise (f)	M&S (Physics)	1 year: X	Danish		I	X	X			
Barbara (f)	M&S (Physics)	None	Literature	Design & engineering	I	XY	Y	Y		
Bastian (m)	M&S (Physics)	1 year: X	Mathematics		I	X	No show			
Beki (m)	M&S (Physics)	None	Computer Science		I	X	X		X	
Benjamin (m)	M&S (Physics)	None	History	Computer Science	G	XY	Y	No show		L
Birgitte (f)	M&S (Physics)	1 year	Bio technology		G	X				
Besmin (m)	M&S (Physics)	1 year	Architecture		G					
Basma (f)	M&S (Physics)	None	Medialogy		G					
Coya (f)	M&S (Chemistry)	None	BA in Engineering & construction	Architectural engineering	I	XY				
Christine (f)	M&S (Design)	None	Primary school teacher education		I	X				
Cecilie (f)	Math	None	Sports Science		I	X	No show			
Cathrine (f)	Math	1 year	Business	BA in social work	I	X				
Christian (m)	M&S (Chemistry)	1 year: X	Software engineering		G	X	X	X		
Casper (m)	MST (Physics)	1 year	Medialogy		G					
Djemal (m)	MST (Physics)	None	Design & engineering		G	X	X		X	
Dorte (f)	MST (Physics)	3 years			I					
Daniel (m)	MST (Physics)	2 years	Computer Science	BA in engineering	I	No show				
Deniz (m)	MST (Physics)	1 year: X	Biotech engineering		I	X	No show			
David (m)	MST (Physics)	None	Nature management	Medias & design	G	X				
Dan (m)	MST (Physics)	1 year	Sports Science		G	X				
Ebbe (m)	MST (Biology, Chemistry)	1 year: X	Bio technology		G	X	No show		X	
Emil (m)	MST (Biology, Chemistry)	None	Bio Chemistry		I	X	No show			
Emma (f)	MST (Biology, Chemistry)	None	Veterinary Medicine		I	X	No show			
Elisabeth (f)	MST (Biology, Chemistry)	None	Environmental management		I	X		X	X	
Erika (f)	MST (Biology, Chemistry)	None	Chemical engineering		G	X	X		X	
Emily (f)	MST (Biology, Chemistry)	None	Chemical & biotech engineering	Opt out to gap year	G	X	X		X	
Fie (f)	M&S (Chemistry)	2 years: X	Chemical & biotech engineering		I				LL	
Frederikke (f)	M&S (Chemistry)	1 year: X	Medicine		I					
Frida (f)	M&S (Chemistry)	1 year	Bio chemistry		G	X	X			
Freja (f)	Math	1 year	Social Science		G					
Filip (m)	Math	None	Engineering, design & applied Mechanics		G	X		X		
Frederik (m)	M&S (Physics)	1 year	Architectural engineering		G					

2.3 Conducting narrative interviews

In upper secondary school 19 students were selected for individual interviews and 19 for group interviews. Each of the students invited to participate in the group interview were encouraged to bring a classmate with them, to ensure a safe setting in company of at least one friend. Most of the students had in the questionnaire written their mobile numbers and I arranged a meeting communicating with the students by text messages. The purpose of conducting individual interviews was to provide a room for the students to unfold their narratives about their experiences; allowing the students to articulate themselves without interruptions; allowing for unfinished narratives, unsettled reflections and not yet decided choice considerations. The purpose of conduction interviews in groups was to gain access to the students' ways of making meaning together with peers, and to understand how this interaction of meeting, negotiating and recognising narratives took place in the cultural setting of upper secondary school (described in paper I and II). Each interview took between one hour and an hour and a half. All were transcribed verbatim.

The students who participated in the group interviews in upper secondary school were later interviewed individually, since they entered various higher education study programmes. That is except from a single group interview in which only two students participated. As they went to the same university and chose similar study programmes, I interviewed them together again. But since the students had very different experiences with their engineering programme, I decided to continue with individual interviews only.

The interviews in upper secondary school were conducted from a semi-structured interview-guide (appendix II), and the interviews carried out from a narrative interview approach. After upper secondary school all interviews were conducted from a narrative interview approach beginning with the question: Please tell me what happened since we met last time' (described in paper II). In the narrative interview the focus is on getting the students to elaborate and share their narratives, and the interviewer's interest is in investigating the students meaning-making with follow-up questions in relation to the students' narrative (Andrews, Squire, & Tamboukou, 2008). I did not use an interview guide, but I did guide

the interviews by prompting the students in the interview to talk about their academic and social integration. I tried to encourage the students to share their descriptions, whilst paying attention to the way I prompted the students and how I took part in constructing the interview. As such I recognising myself as a co-constructer of the narrative (see paper I), since I unavoidably recognised certain aspects of the narrative, whilst I questioned others. Interviewing with a narrative interview technique is an outcome of the ideas in narrative psychology, why I consider the overall approach to be a methodology; a theoretical frame to understand students' narratives, meaning-making and identities, but also an approach to carry out my interviews so the research objective, i.e. 'students' meaning-making,' is produced. This requires the interviewer to be more in the background in opposition to more structured interview approaches. By taking this position I do not strive at *avoiding* asymmetric power relations between me as an interviewer and the participant (Kvale, 2006), but I aim at *downplaying* it by paying attention to it before-under-after the interview.

This kind of interview technique, in which the interviewer keeps a distance so as to not involve herself too much in the interview, was hard to practice. Particularly so when after several interviews having formed a relation to the students as a result of spending hours with them where they shared their experiences, worries and sometimes problems in life in general. I felt a pressure on the method in relation to give a piece of myself, and I do understand the benefit of more action-based research methods in which the power relation between the interviewer and interviewee is less obvious (Kvale, 2006). Sometimes the participants required my presence in a way which made it necessary for me to negotiate my method.

One example is one of my interviews in upper secondary school with Daniel at HTX. I recall walking into the classroom where the interview took place noticing the sunshine from the windows but walking out again with sweaty hands. Daniel liked technique and computers and considered continuing studying computer science. Daniel did indeed challenge the interview setting, not because he did not reply to my questions – but because he did it in a superficial way. He replied in few words and asking him to explain further he did not have anything more to say. It forced me to prompt him much more than I wanted to and to frame fewer open questions than planned, and I doubt whether this interview was much narrative in its structure at

all. Perhaps this is also the explanation for why Daniel does not show up at the next interview after he had entered computer science. Daniel belongs to a group of students who do not easily fit into the narrative requirement of articulating oneself, reflecting in a semi-public sphere in front of a stranger. I discovered how some students found it easier than others, and some (perhaps in particular some science students) did not recognise the genre as comfortable. Luckily most of the students did find the interview setting safe, and some actually enjoyed having been provided a room for reflection. The experience with Daniel made me prepare some tricks to support the narrative. When hesitation appeared during the interview, I asked the students to use some minutes to consider something related to what we talked about. In the interviews conducted at higher education I asked the students to draw a coordinate system with the x-axis as the time they had spent at their study programme and the y-axis ranged from no interest to most interested – and I asked them to use a few minutes to draw their interest over time and hereafter explain the ups and downs to me. The drawings are not used directly in my dissertation, but they were used as support narratives during the interview.

Another example of negotiating the interview strategy is how the students sometimes used the setting as a room for counselling. For instance Frida, who had a depression in upper secondary school, and still at bio chemistry, struggled with taking the right amount of medicine and keeping up studying – whilst at the same time having a father seriously suffering with cancer. I struggled with not taking the counsellor position, but ensured that she did have professional support to turn to. And Louise, who dreamt about studying journalism but planned at opting for Danish because she could not be sure to enter journalism even if taking two years of required courses. I knew she was mistaken and struggled with suppressing my past as a counsellor. In the interview I asked to her choice of study, but changing position from the interviewer to the counsellor would negotiate the setting of the Interview and my position in particular. Afterward I felt bad and cynical for holding my own research interest higher than Louise's choice of study. I ended up texting Louise a few days later thanking her for the interview, writing that I had heard something different from her explanation of attrition to journalism and that I just wanted to share that with her. Louise ended up choosing Danish and I ended up feeling less cynical.

When interviewing in upper secondary school I made a logbook in which I wrote down thoughts and impressions I had after interviewing, and it revealed to me how I found it easier to interview working class students like myself, perhaps because I better understood their narratives. On the other hand I discovered how I could use the situations of me being an alien as an advantage, in particular me being an alien in STEM; for instance I could ask, 'What do you mean by saying that mathematics is important,' without feeling that the students did not take my question seriously, and I could use my position from the outside as an interview strategy.

Spending hours with the same persons, I did feel a relation to these young people sharing their lives with me. Sometimes they texted or e-mailed me to tell me about their lives as students. I do not have an account of the numbers of e-mails and text messages, but it was definitely an important channel to keep in touch with the participants. A dilemma related to a close relation to the participants was how they wanted me to share results. I felt a dilemma of; on the one hand, wanting to give them something back for all the hours they have given me. On the other hand, it would indeed set the scene for the interview giving them a piece of my results. In one interview I, in broad terms, told a participant about the research (interview at second year), and in some cases I (honestly) told them how I was in the middle of analysing. I plan on sharing results with the participants after finishing this dissertation, but I still have not settled on how.

2.4 Analytic strategies

I have now outlined the aim, how previous literature has informed my study, I have constructed my methodology, and I am almost ready to approach the empirical data. In each paper local research aims, all feeding into the general aim of the dissertation, guided my combination of theories and construction of analytical strategies. In paper I and II, I used thematic analysis (Braun & Clarke, 2006) to approach the data. Thematic analysis is explained in the papers (Paper I and II), but I would like to make a comment on how using the analytical strategies also affected producing the final text.

The prescriptions of validation, guiding previous quantitative scientific studies, are transferred into qualitative research by a call for

transparency so as the community of co-researchers instead are empowered to validate the research (Kvale, 1996). When conducting the thematic analysis I struggled with how to make my analytic strategy transparent.

I attempted to present the themes, the different positions within them and the patterns within each theme, but in particular in paper II the reviewers called for more transparency in terms of making visible *the numbers of students whose perspectives fell into these categories*. This is an example of how a quantitative tradition and my own qualitative research position needed to be negotiated. Even though I recognised the reviewers' call for numbers of students as a need for transparency, I found that listing the exact numbers of students under each theme would blur the focus of the paper, namely to show the diversity in students' identity work in relation to their perceptions of STEM. To meet the reviewers' call I felt obliged to semi-quantify the themes: *Most of the students in this theme are…* to give some kind of an indication of the numbers of students even though this is somehow contradictory with my research position. Furthermore I provided a table with an overview of the students whose narratives I analysed in the paper. On the one hand, quantifying the results could disturb the point of not aiming at representative data as quantitative research strive for, but rather to present the variation in the data. On the other hand, I will argue that systematising data and providing an overview is also a matter of transparency. Therefore I also made a table to provide an overview of the students whose narratives I used in the analysis.

Throughout the dissertation I developed the analysis; I made it more transparent throughout the papers towards Paper IV. In Paper IV I provided a table with an overview of the students in the study together with the analytic categories, making the analytic categorising visible to the reader. I find this way of presenting the analysis more suitable in providing transparency and a closer relation to the analysis than providing a semi-quantitative label. In paper IV I develop my own analytic approach to understand students' negotiation strategies, and here the thematic analysis approach is not the point of departure.

3. OVERVIEW OF THE CONTRIBUTING PAPERS

Paper I. The process of choosing what to study

Full title:	The process of choosing what to study. A longitudinal study of upper secondary school students' identity work when choosing higher education.
Journal:	Scandinavian Journal of Educational Research.
Status:	Accepted at the time of the defence. Online version, June 2012.
Aim:	How are young people's choices of higher education negotiated and ascribed meaning in their narratives of identity?

The paper is based on 38 upper secondary students' narratives about what to choose studying when finishing upper secondary school and interviews with some of the same students again after they have entered higher education. Through the use of narrative psychology, the paper shows how choosing what to study is strongly related to the students' work on their identities. When choosing what to study, young people face an important turning point with the need to reformulate narratives about themselves. The paper offers three main contributions to the research field of students' higher education choices. First of all the study shows how choice of study is not a delineate decision, but a process of identity work continuing when the application form has been sent. In this process the students not only change their perspectives of the future but also of their past. Secondly, the students internalise their choice of study, considering it to be their own personal task, and as a consequence they feel that they are managing a complex process in solitude. The students' social network is used as tacit knowledge; here the choice narratives are being tried out, informed, and adjusted in accordance to whether it is recognised as a legitimate identity match. Thirdly, the choice of study

is a process of finding a study programme that embeds present interests whilst at the same time finding a proper match with ideas of an attractive life in general and working life in particular. This match of interests needs to be incorporated in the students' narratives and appear as a unique and authentic choice.

Paper II. To choose or not to Choose Science

Full title: To choose or not to choose Science: Construction of desirable identities among young people considering a STEM higher education programme.

Journal: International Journal of Science Education.

Status: Under review at the time of the defence. Online version, December 2012.

Aim: The primary aim is to understand how students' work on constructing their identities and how their perceptions of STEM affect their choice of higher education study programmes, particularly their inclination to enter a STEM study programme. A secondary aim is to explore whether the students' choices are rooted in misconceptions about higher education STEM study programmes, by contrasting the reasons students give for not choosing STEM with the reasons and experiences expressed by students who have actually chosen to study STEM.

This paper investigates how upper secondary school students' perceptions of STEM interact with their choice of a higher education study programme. By using Foucault's notion of governmentality, the study shows how students not considering STEM higher education study programmes, despite of pointing to a STEM subject as one of their favourites in upper secondary school, expect higher education STEM to leave little room for self-government. They do not perceive STEM as a platform for constructing an attractive identity, and in particular they expect that choosing STEM demands them to submit themselves to rigorous methods and strict rules and procedures. The students that do consider choosing a STEM higher education study programme can be divided into two groups; a group of students who

expect STEM to be a point of departure for developing themselves; and a group of students who expect the same of STEM as the non-choosers, but who perceive it as a safe and secure point of departure with limited interpretations and requirements to their identity-work. Comparing the non-choosers' upper secondary schools expectations to first year students' actual higher education STEM experiences, they are to a large extent quite similar. Their notions of STEM as a fairly rigid study with little room for self-development are apparently quite accurate. To get the non-choosing students to opt for STEM, higher education STEM to a larger extent need to support students in managing themselves and to take a greater role in crafting their own study.

Paper III. What do we know about explanations for opt out?

Full title:	What do we know about explanations for drop out/opt out among young people from STM higher education programmes?
Journal:	Studies in Science Education
Status:	Published, Vol. 46, No. 2, September 2010, 209–244
Aim:	To explore whether research on retention and non-completion in higher education, and in STM programmes in particular, has produced findings that can identify a direction forward for HE institutions and programmes to take measures to reduce the number of students leaving their chosen HE programme

This paper provides a review of the literature on students' drop out/opt out from science, technology and mathematics higher education programmes from 2000 to 2010. In a substantial part of the previous research carried out, the problem of retention has been framed as located in either *the student* or *the institution*. Suggestions of how to increase retention within the field of science education particularly tend to focus on adjusting the *students* and leaving the institutional or disciplinary side untouched. This is related to a tradition of perceiving the disciplines as stable and also objective entities which leads any suggestions of changing the curriculum to be

regarded as a setback for the science discipline and student achievement. The review identifies a call for future research to approach retention as a relation between the student and the institution, and points to research that addresses identities as culturally embedded as having promising perspectives as a way for the research to move forward. The review shows how applying identity as a theoretical perspective in understanding students' experiences and student persistence is primarily found in studies focusing on minority students. Future studies are encouraged to approach the majority of students' retention and drop out/ opt out through the lenses of identity, by relating identity to cultural settings and the student's strategies for being recognised as a legitimate member of the group of 'science people.'

Paper IV. A journey of negotiation and belonging

Full title:	A journey of negotiation and belonging: A longitudinal study of students' transitions into higher science and engineering education.
Journal:	Cultural Studies of Science Education.
Status:	Under review
Aim:	To investigate students' transition into higher education both as a process of transition *from* one educational level and *into* another educational level, but also as a transition of the students' expectations and identities.

This study investigates 20 students in their transition from upper secondary school to higher education science, mathematics and engineering study programmes. Through a narrative psychological framework combined with transition theory and Vincent Tinto's model of student departure, the study develops an analytic approach of students' negotiation strategies in their transition process into their higher education programmes. The paper offers three main contributions by applying this approach. First, all students encounter a gap in between what they expected their higher education STEM study programme to be like and their actual experiences when

meeting it. Therefore, it is the rule rather than the exception that students need to adopt negotiation strategies to cope with the gap. Secondly, five negotiation strategies were identified. These differed in terms of the gap, the strategy used to bridge it and in terms of whether the students managed to renegotiate the narrative in few steps or whether the renegotiation occurred continuously through the first and even the second year. Thirdly, the analytic approach to students' negotiation strategies can be used as an extension to Tinto's model of student departure; to embrace different ways students handle the integration process by highlighting the presence of more than one academic system, the question of identity, and the dynamic nature of the renegotiations, which do not just occur through a number of stages, but going back and forth.

How the papers address the overarching research aim

Separately, the papers answer distinct research questions. As a whole, their contributions respond to the overarching aim (p. 4). The longitudinal aspect of the papers makes it hard to make a clear division between the aspects studied in each paper, since some of the papers both concern students' choices as well as their transition.

Paper I addresses the first part of the research aim which concerns students' choices of what to continue studying after upper secondary school. Paper II aims at the second part of the first research aim, namely how students' perception of and expectations to STEM higher education relates to their higher education choices. Both paper II and IV contribute to the understanding of the second part of the research aim which concerns students STEM choices and their transition into higher education. Paper III and IV address the second part of the research question in general.

3.1 Other contributions and publications

Contributions at International Conferences in the period 2009 to 2012

Ulriksen, L. & Holmegaard, H.T.: *Danish Secondary School Students' Interests in Science and Technology*. Paper presented at the 8th meeting of the European Science Education Research Association (ESERA), Istanbul, Turkey, August 2009.

Ulriksen, L., Madsen, L.M. & Holmegaard, H.T. *Choosing what to study within Higher Education*. Paper presented at SRHE Yearly Conference, Newport, Wales December 2009.

Holmegaard, H.T, Ulriksen, L. & Madsen, L.M.: *Why students choose (not) to study engineering.* Paper presented IGIP-SEFI Annual conference, Trnava, Slovakia, November 2010

Holmegaard, H.T, Ulriksen, L. & Madsen, L.M.: *Newcomers' transition to Higher Education and identity work in becoming students.* Paper presented at SRHE Yearly Conference, Newport, Wales, December 2010

Holmegaard, H.T, Ulriksen, L. & Madsen, L.M.: *There is no chance for personal development in it. Why students choose not to study science at universities.* Paper presented at the Annual meeting of the National Association for Research in Science Teaching (NARST), Orlando, Florida, April 2010

Ulriksen, L, Holmegaard, H. T. & Madsen, L.M:*Should I stay or should I go?* Symposium: Improving recruitment, retention and gender equity in STEM higher education. Paper presented at The 9th meeting of the European ScienceEducation Research Association (ESERA), Lyon, France, September 2010.

National publications in the period 2009 to 2012

Holmegaard, H. T. *Hvor er studievejlederen? Unges valg af naturvidenskabelige, tekniske og matematiske uddannelser.* Ungdomsforskning, nr. 3 & 4 2009, Årgang 8. (Not peer reviewed)

Ulriksen, L., Madsen, L.M. & Holmegaard, H.T.: *Hvorfor bliver de ikke? Hvad fortæller forskningen om frafald på videregående STEM-uddannelser?* MONA, vol. 4, 2011. (Peer reviewed)

4. PAPER I: THE PROCESS OF CHOOSING WHAT TO STUDY

The process of choosing what to study

A longitudinal study of upper secondary students' identity work when choosing higher education

This paper[5] presents the first results from a longitudinal qualitative study following 38 Danish students' choice of higher education. By using a narrative psychological framework it is shown how the choice of higher education is embedded in various dilemmas, making it difficult for the students to make meaningful choices. They believe the choice should be unique and individual and that it should correspond with who they are and wish to become. However, the analysis shows that choosing what to study after upper-secondary school is a complex ongoing and social process rather than an isolated individual event. Implications of these results are discussed and the educational system is urged to provide room for and facilitate students' production of choice narratives.

Student choice of higher education has long been an object to international research. In particular an extensive body of American literature on student choice of higher educational choice has been

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carried out, primarily dominated by large scale quantitative studies, aiming at mapping the factors affecting student choices. The American tradition tends to emphasise on the one side how student background affect the choice of study i.e. ethnic, social and gender but also how students prior high school trajectories in different ways seem to prepare them to higher education (Bergerson, 2010). Also a vast number of British studies have been carried out on the topic. Like the American studies, the British focus on understanding how various student backgrounds in general and social class in particular affect their choices and access to higher education (Gewirtz, Ball, & Bowe, 1995; Reay, David, & Ball, 2005). The British tradition is characterized by a range of quantitative and qualitative methods, including longitudinal studies to access how students' choices are formed across time (Brooks, 2003; Read, Archer, & Leathwood, 2003).

A substantial part of the Scandinavian research has been devoted to examining how student choices relates to the construction of an attractive identity (Boe, Henriksen, Lyons, & Schreiner, 2011; Hutters, 2004; Illeris, Katznelson, Simonsen, & Ulriksen, 2002; Schreiner, 2006). The Scandinavian literature has thus contributed to the existing literature by attempting to understand young peoples' choice of study as more than a question of what to study (Illeris, et al., 2002). This study follows the Scandinavian point of departure of perceiving student choice as being closely related to identity.

As the American and British research also the Scandinavian has been devoted to understand the growing diversity of students entering secondary and higher education (Brunilaa, Kurkia, Lahelmaa, Lehtonena, Mietolaa, & Palmua, 2011; Thomsen, 2008). As the higher educational system has become increasingly influenced by market orientation and economic rationales and students are being associated with increased economic value, research in recruiting and retaining students has increased (Jacobs, Lundqvist, & Hellsmark, 2003; Scott, 1995).

Due to lack of young people applying for and completing a career in science, technology, engineering or mathematics (STEM) (European-Commission, 2004; OECD, 2008), this economic rationale has contributed to an attention within the literature of choice towards young people who are about to choose a STEM-career (Boe, et al., 2011). However, there are other rationales than economic for carrying out research concerning student choices. A social rationale is

approaching student choices through the eyes of the students themselves. Jenkins & Nelson (2005) state in a UK context that it is not until recently that research in student-perspectives has been recognized as an object of research; earlier, their voice was marginalized within educational research. A social rationale tends to understand how the choice is ascribed meaning by students in the process of choosing, and how it interacts with the way the choice is socially structured in society in general. In a Danish context, Hutters (2004) presents one example of a qualitative longitudinal study with a point of departure in student choice-narratives. She shows how the students work on their interests to make what they perceive as a sensible choice, and she identifies a social reproduction in the choice in the sense that what the students perceive as being suitable and realistic to them relates to their social background (Hutters, 2004). Our aim is similar to that of Hutters, but where Hutters' point of view is sociological, ours is situated within social psychology. Building upon the Scandinavian research tradition and through a narrative psychological approach, we wish to look through the eyes of the students to explore how they make meaning of their educational choice, and how these perceptions interact with their narratives and self-work.

Aim

The above perspectives have led to the following research question: How are young people's choices of higher education negotiated and ascribed meaning in their narratives of identity?

By applying a longitudinal approach to young people's choices, our aim is through the students' narratives to explore how they perceive and ascribe meaning to their choice of higher education; what do they point to as being crucial when choosing their future study, how do their narratives interact with their choice-strategies and identity-work when they are about to choose higher education. This article presents results from qualitative interviews, text messages and e-mail correspondences with 38 Danish students in non-vocational upper-secondary schools. Despite the fact that the students are selected within science specialized classes, statistics show that they pursue a wide range of educational programmes which are both science and non-science oriented (Nielsen, 2008). To understand their choices we

therefore not only draw on the literature in science education but also on the literature on choice in general.

Theoretical framework

Outlining different approaches to student educational choices

When looking into the research field of student choices of higher education, studies have been conducted with as diverse perspectives as sociology, psychology and economics, constituting a research field with potential implications for practice, policy, and research (Paulsen, 1990).

Historically, an aim that permeates the research has been to research student choices of education by capturing the composition of the educational choice. A study conducted in the UK aimed at finding out why young people chose to pursue a career in science and engineering. In the conclusion, student choices were divided into three interrelated factors: *out-of-school factors*, *in-school factors,* and *personality types* (Woolnough, 1994). An example is the expectancy-value model developed within psychology by Eccles and Wigfield (2002), a complex model aiming at identifying the many significant components important for student choice. The model is constructed with the intention of capturing students' expectancies of success, their ability beliefs and values, and how those factors influence their choice. There is an inherent risk of applying the model by reducing the complexity in a way that presupposes a rational subject who is oriented towards success and goals, with a prominent focus on cognitive processes and motivation and little attention paid to the cultural settings. A similarly rational and calculating subject is presupposed by the sociological theory of rational choice which combines sociology with economic theory. Rational choice assumes that students are capable of making informed choices based on expected returns of these choices, and that the student chooses education to maximize expected utility (Breen & Goldthorpe, 1997; Jæger, 2007).

Instead of focusing on the choice itself, other studies combine the choice with psychology, as exemplified by the classical study conducted by Holland (1973). Holland argues how young people's choice of education is closely connected to their personality type and

develops a theory of vocational choices by dividing a person's competencies, activities, self-estimates, interests, and choices into a six-category typology. He concludes that success is produced in the correct alignment between personality type and type of work environment (J. Holland, 1973).

A recent literature review shows how there is a general movement away from comprehensive choice models like those described above, due to the fact that the population of students is growing increasingly diverse, making modelling difficult. What is important for future research is therefore not to identify the components which affect students' choices, but rather to qualitatively explore how they interact and ´create a sense of fit for individual students' (Bergerson, 2010; Pike & Dunne, 2011).

As an increased attention has been paid to students' STEM-choices due to a lack of young people choosing a science carrier, some of recent literature addressing the above call for research can be found within the field of science education (Boe, et al., 2011).. With a STEM focus, a qualitative longitudinal study has been carried out in England on 16-year old high-achieving student choices of post-compulsory science courses. The conclusion is that students shape their choices in multiple ways, and five different choice-trajectories are constructed ranging from 'the 'directed' trajectory' with early and specific career commitment to 'the 'multiple projection' trajectory' with constantly changing ideas. Background and childhood interests seem to be influential for some students, whereas to others it has less or no influence. Here, students' science choices are interplay of self-perception, occupational images of working scientists, relationship with significant adults and perceptions of school science. It is concluded that there is no model for how this interplay turns out, because it turns out differently depending on the students' trajectories (Cleaves, 2005). Still within a science education context it is argued elsewhere that if we wish to understand young people's aspirations, an identity perspective in addition to an understanding of the cultural processes at work when young people choose, is specifically needed (Osborne, 2007). This query is taken up in a Canadian study, with the aim to find of understanding the discourses available to students when articulating their attitudes towards a science career (Hsu, Roth, Marshall, & Guenette, 2009). This study has a social-psychological position using discourse psychology to identify ways in which students talk about their careers. This is a way to approach the call of

studying the complexity in student choices rather than aiming at mapping it.

Also the Scandinavian research tradition positions itself in this research-area where qualitative and explorative studies are widely used and comprehensive choice-models less widespread. Here, attention is paid to the complexity, the identity-aspects, and the cultural aspects of the choice. Ideas about late-modernity and how it influences how young people conceive of their educational choices are also important in this tradition (Boe, et al., 2011). A fundamental condition in Western late-modern societies is the larger extent to which young people are expected to construct their own biographies in an individualised and de-traditionalised context, where less seems to be given beforehand (Beck & Beck-Gernsheim, 2002). Hence, the decision about what course of study to choose after finishing upper-secondary school is not limited to figuring out what could be interesting or promising, it is also about *defining* oneself, and making a decision about whom one wishes to become (Illeris, et al., 2002; Schreiner, 2006).

This is, however, a highly ambiguous task that young people experience while surrounded by uncertainty and with some ambivalence (Ziehe, 1991). The ambiguity derives not least from the contradiction that on the one hand, it appears as if young people are free to choose anything, whereas, on the other, the choice is made in a highly standardised and institutionalised context (Beck & Beck-Gernsheim, 2002) where socio-economic background, gender and ethnicity has a strong impact (Brunilaa, et al., 2011). Students therefore need to handle the restraints and obstacles in the cultural and social context in a way that does not impede their sense of making their own choice about who they wish to become.

In this paper we address the issue of choice drawing on a narrative psychological approach. We wish to contribute to the existing literature of student educational choices by bringing together issues of identity, culture, and young people's choices of higher education as called for in the existing literature.

Choice from a narrative psychological perspective

To approach an investigation of how student choices interact with their identity construction, we use the framework provided by narrative psychology. Narrative psychology is an outcome of what is known as 'the crisis in social psychology' in the 70'ies (Potter & Wetherell, 1987). Social psychology had until then been dominated by an experimental tradition, and the shift lead to new ways of doing science, including social constructionism and narrative psychology (Sarbin, 1986). Narrative psychology is far from a field characterized by consensus; the notion covers various ideas of what narratives are and how they should be studied (Polkinghorne, 1988; Riessman, 1993; Smith & Sparkes, 2008; S. Taylor, 2009). The common point of departure across the various theoretical positions is that life as it is lived is not the same as what is told, and that narratives work as an organizing principle: a means for humans to make sense and structure the complexity in the world into coherence (Sarbin, 1986). Disruptive elements are removed from the story by the narrator to maintain a degree of meaning. In contrast life as it is actually lived, does not have a similar order and is not necessarily meaningful (Crossley, 2000). Constructing narratives is an ongoing process: as subjects move in time, narratives are retold depending on the subject's immediate considerations of the past and expectations for the future (Bruner, 2004).

To construct one's personal, unique identity is not a requirement which characterises only young people, but a powerful necessity that seems to be a condition that all individuals need to meet and negotiate throughout life. Rose states that '*The self is to style its life through acts of choice'* (1998, p. 21). This emphasises the choice of higher education programme as a turning point in where new narratives can begin and are made possible by the breach of context and the individuals' new horizon, since, the expectation of the future are crucial for the identity-work of individuals.

Throughout the narrative psychological positions, identity is considered to be shaped *by a larger socio-cultural matrix of our being-in-the-world* (Smith & Sparkes, 2008, p. 6), which means that narratives are embedded in a relational world, and meaning is constructed in a complex relation between the person and the surrounding culture. It is not possible to gain access to 'a real self' by going behind this cultural meaning-making process (D. Holland,

Lachicotte, Skinner, & Cain, 1998; C. Taylor, 1989; S. Taylor, 2009), but theories differ as to the extent to which they account for this socio-cultural matrix and how they situate the narratives in social, historical, political and cultural contexts. The narrative psychological theories can be positioned on a spectrum ranging from a 'thick individual' and 'thin social relational' view to 'thin individual' and 'thick social relational' (Smith & Sparkes, 2008). We position ourselves in the middle of the spectrum, 'the inter-subjective position', where both the social and the individual perspectives are taken into account. On the one hand, narrative identities are constructed inter-subjectively in interaction with others, constituted by political power-laden processes and social relationships, and mediated through institutional structures (Ezzy, 1998). On the other hand, we find that each individual has different resources and possibilities available; each subject is involved with specific characters, capacities, and circumstances (Crossley, 2000) and carries with them a history. Therefore, our analysis of young people's choice of study and the involved identity-work looks into both the structures and cultures in the students' environment, and how the students' past experiences influence their actions and ways of positioning themselves.

Since our research object is student narratives, an interesting question is how these narratives are related to student choices in real life. Like most other qualitative research methods, we do not claim that narratives give access to truth (Hollway & Jefferson, 2000). But through students' narratives, we gain access to how the interviewee makes meaning at a certain period of time, and by applying a longitudinal method, we wish to explore how students make meaning of their choices over time. Our research objective is therefore to explore and describe the structures and forms of meaning-systems young people use in their narratives when they are about to choose higher education.

Methods

The results presented in this article are part of a larger longitudinal study where a cohort of 134 students are followed from the end of

their last year in Danish upper secondary school (STX and HTX)[6] and three years on, as they move on to higher education. In the larger study, the research focus is on students' STEM-choices and their experiences when meeting first year STEM higher education study programmes, and therefore data was collected in six Danish upper secondary school STEM-classes.

The first part of the analysis draws on interviews with 38 students just before finishing upper-secondary school, i.e. before they had formally made their choice. Data from later interviews, text messages, and e-mail correspondences with the 38 students after completing their upper secondary exam are included in the second part of the analysis.

Context of Danish student choices

STEM is the second most popular study programme in upper secondary school. 25 % of the students in STX and 34 % from HTX are enrolled in STEM-classes with high level of mathematics and either high level chemistry or physics. The number is even higher if high level biology is added (Bech & Behrens, 2010). However far from all of the students, female students in particular, continue a higher education STEM-programme, which in Science Education is treated as the phenomena of 'the leaking pipeline' (Alper, 1993). In a Danish context it is also more likely for boys (74 %) enrolled in STEM-classes to continue on to a STEM related programme at higher education than for girls (43 %) (Jensen, 2006). These numbers show

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[6] In Denmark we have four types of non-vocational upper-secondary schools, which give equal possibilities for entering the higher education system (HTX, HHX, HF and STX). STX is a general upper secondary school with a variety of study programmes both STEM and non-STEM related. HTX is an upper secondary school with study programmes specialized in science, mathematics and technology. The higher education system in Denmark is free of any fees, and students receive government financial assistance every month to cover their most basic living expenses. Students are therefore in principle free of any economic obstacles, however access to certain higher education courses is limited to students who complete certain subjects at specific levels at upper-secondary school and obtain specific marks. When choosing higher education students must choose a specific course of study, for instance Biology. Once a course is chosen it is rather difficult to change to other courses and there is only a narrow possibility to combine different courses of study. Changes in the students' study-track are considered as a drop out both by the institution and the student.

how far from all the students' consider continuing studying STEM at higher education, why our focus in this article is not on whether the students' choose to continue studying STEM or not, but on their choices of higher education in general.

Selection of students and collection of data in upper secondary school

In the spring of 2009 we chose four STX and two HTX upper secondary school classes, all located in the eastern part of Denmark (Zealand). Two schools were situated in the urban Copenhagen area, two in suburban Copenhagen and two in other parts of Zealand. The schools were picked from reasons in the overall research project. The schools were selected because students from their science classes, frequently continues to study STEM at higher education study programmes. Schools with the following variations in the student-population were chosen: 1. One STX school had a particular large number of students with another ethnic background than Danish. 2. One STX school recruited students from socially privileged families. 3. One STX school recruited students from both socially privileged areas and areas of social housing. 4. One STX school recruited students from both town and rural areas. 5. The one HTX recruited students from a large city-area 6. The other HTX school recruited students from a rural area, and some students travelled up to one hour to get to the school. The classes were selected to represent different science- study programmes.

In total, 134 students completed a questionnaire concerning their socio-economic background, their interests in and experiences at upper-secondary school (in particular with science, mathematics and technology (STEM)), and their plans for the future. Based on these data students were selected to resemble the diversity in the group of students concerning gender, socio-economic background, ethnicity (Søndergaard, 1996), but also in terms of the student's interests in STEM and plans for the future. We invited two students from each class to join a focus group interview. Each of these students was encouraged to bring a friend from their class to participate in the interview to make the setting as safe as possible, and for the students to feel comfortable in sharing their views in a group. Not all students brought a friend, but in total nineteen students were interviewed in groups. In addition, three students from each class were selected for

in-depth interviews. In one class, an extra student was interviewed because only two students showed up for the focus group interview. Nineteen students were interviewed individually, which in total makes 38 students. Of the 38 students, half of the students were girls and 18 came from non-academic backgrounds. Our selection of students presents a maximum variation case as described by Flyvbjerg (2011) in order to obtain as much variation in our population as possible, with the purpose of capturing the range of the ways in which different students approach their educational choice. In that respect, the goal was not to generate representative students but to explore the variation within the student population that could provide insights into the research question.

The purpose with focus group interviews was to gain access to the narratives in the cultural setting in which the choice takes place, namely in a group of peers. In this setting the individual narrative is met by a larger group of students and this interaction of meeting, negotiating and recognizing the narratives provides an insight into how the individual student constructs her narrative in the cultural setting of upper secondary school (Søndergaard, 1996). A limitation of carrying out focus group interviews is the possibility that the group is not a safe place to share one's narrative. However, it does give an understanding of what can be expressed in a peer-group and what cannot, what is questioned and what is culturally acceptable. On the contrary, the purpose of individual interviews was to gain access to the individual narratives in a safe environment in which unfinished narratives, unsettled reflections and unconstructed choices could be presented. This could have been difficult in a focus group where the participants position themselves in relation to one other (Søndergaard, 1996).

All interviews took place at schools during school hours in agreement with the headmasters who supported the purpose of the research project. The students volunteered individually for participating in the interviews. The duration of the interviews varied from 45 minutes to 2 hours. All interviews were recorded and transcribed verbatim. To conceal the identities of the students we have used pseudonyms and the actual names of their schools and later their universities are not used. Further, we have left out information about participants' narratives which would possibly identity them.

Collecting data during 'gap-years' or while in higher education

The students who participated in this study in upper secondary school are part of a longitudinal study where they are followed throughout a three year period. Once a year when the semester began all of the 134 students were contacted by text massages to ask if they had entered a study programme, and if so which one, if it was their first choice of study and how they felt about it.

The 38 students who were interviewed in upper secondary were followed more intensively. Ten of the 38 students were interviewed in the autumn/winter 2009 as they decided to take one or two 'gap-years' before applying for higher education. The focus in these interviews was whether their 'gap-years' influenced their future plans and in what way. Of the 38 students 22 were followed into their first year of higher education and interviewed 1-5 times during their first years of study. The focus in these interviews was on the student experiences with first year higher education. Sixteen of the interviewed students attended a STEM study programme, and eight students entered another study programme (two students' changed from a STEM to a non-STEM study programme and are counted both places). In addition they were contacted by e-mail messages asking for their experiences with studying in between the interviews. Some of the students contacted us by themselves by writing text-messages and e-mails to inform us of something extraordinary or just to share their experiences. All of these interviews were conducted from a narrative approach.

Narrative interviews

Experience-centred narrative research consider narratives to be the means of human sense-making and thus aims at understanding human experience by using a narrative approach. When doing narrative interviews, the purpose is to encourage stories and descriptions rather than de-contextualised explanations (Andrews, Squire, & Tamboukou, 2008; Hollway & Jefferson, 2000). The interviewer positions the student as the expert of her life, and inquires into the narrative the interviewee presents. In this way, emphasis is put on the narrative rather than on responding to the researchers' questions. The focus is on how the students make and ascribe meaning and the researcher pays attention to how she positions and recognises the

student during the interview as a co-constructer of the narrative. Therefore, the researcher asks 'how' and 'what do you mean when you say...', emphasizing descriptions rather than engaging in a dialogue (Søndergaard, 1996). Naturally, this does not mean that the researcher can avoid being a co-constructer of the narrative, since her presence and the entire setup is an unusual setting with asymmetric power relations (Kvale, 2006). However, by reflecting upon these issues, the researcher can be aware of her own position, and by recognizing and encouraging the narrative she may reduce the extent to which she causes the interviewee to give narrow responses.

Analysing the data

A theoretical thematic approach was used to analyse and structure the data (Braun & Clarke, 2006). Taking as point of departure in the research question, and reading through the transcripts, three themes were created: 1. the right choice, 2. the individual choice, and 3. the horizon of choosing. These themes structured the second reading of the data. Concrete quotes from students relating to the theme were gathered into one document. From working through this data-material, the themes were reformulated into two central dilemmas which turned out to be pivotal to many of the students' narratives; 1. Right and free choice/ limitation in choosing. 2. Choice being understood individually/ also socially embedded. Not all of the students related to these dilemmas in the same way, and as we worked through the data, sub-categories emerged under each theme showing patterns in the data in terms of different student-narratives. The steps can be understood dynamically in the sense that the researcher moves back and forward between them. Writing the analysis is not the end product, but a continuous process (Braun & Clarke, 2006). The narrative psychological framework is the overall frame, feeding into the analyses with questions, and used as a tool when understanding the data. Both the narrative of the individual student and the patterns across the 38 interviews were analysed. In this way, the analysis moves between the concrete narratives, understanding the narratives in a more comprehensive context of meaning, and finally recontextualizing the narratives into general codes across the material, i.e. a more general theorization (Søndergaard, 1996). In this way the results show some tendencies across the students' narratives, exemplified by a quote from a single

student but also being present in other students' narratives. We aim to show different strategies in how students perceive and ascribe meaning to their educational choices. Sometimes this is best shown by looking across the narratives in general, and sometimes by looking through the eyes of an individual student. When presenting the results, we point at whether the analysis covers the students in general or is one of several examples.

Results: The process of choosing higher education

In this section we present the results regarding how students construct, negotiate, and ascribe meaning to their narratives about what to do after finishing upper-secondary school, and not least, what study to pursue. The results are organized in two subsections structured around dilemmas most of the students struggle with when choosing what to study: 'A free choice with limitations' and 'An individual responsibility being socially embedded'.

A free choice with limitations

Struggling to make the right choice of study

A substantial number of the students interviewed in upper-secondary school are ambiguous about the choice they are about to make. Several of them explain how they find the choice exciting, being able to choose whatever they want to do and the possibility of entering new territory, but at the same time they express a sense of uncertainty about choosing what to study after upper secondary school. This anxiety is not only about which study to choose, but also about the act of choosing itself. One boy puts it like this:

> 'Previously it had been quite clear what I should do. I should go to primary school[7] and then I should go to

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[7] The Danish educational system has ten years of compulsory schooling in 'folkeskolen' which includes primary and lower secondary school. Upper-secondary school can either be vocational or academic, the latter giving access to higher education. See note 6.

upper-secondary school. And now all of a sudden, it is not clear any longer. It is a kind of a process that has been quite fixed and that suddenly stops. Suddenly, it's much more open, and there are many opportunities which in a way could be considered as freedom. But I haven't minded being tied up like that. So I consider it more as an uncertainty, and it's a bit as if you once again have to find out who you really are. You have to define yourself in relation to something different from what you have done up to now'

(Allan in upper secondary school)

The sense of having to define oneself puts a significant pressure on students which manifests itself as a fear of making the wrong choice, that is, a choice that does not match their idea of who they are and who they wish to become. The 'wrong choice' therefore is related to selecting a study programme that may not meet their expectations, but also it means wasting ones time[8] because they would have to subsequently leave the study programme to find 'the right one'. This is one of the reasons that some students decide to take one or two 'gap-years' away from studying, a *sabbatical* as the students call it. It appears more meaningful for some students to take a 'gap-year' in order to find out what they really wish to study, than to enter a study right away that eventually may turn out to be the wrong choice. When asked about how they are to find out what to choose, some of the students reply that they hope the 'right choice' will present itself to them as a kind of revelation.

The students' narratives reflect the late-modern condition for choosing that we mentioned earlier. Therefore, self-realization is a prominent component in their accounts and reflections. Likewise, the ambiguity we mentioned in relation to youth in late-modernity is also present in terms of the students need to balance their personal

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[8] Wasting time is not only related to adding one more year to your age, but it is also about using the Danish government financial assistance, because there are a fixed number of months you can receive that financial assistance, no matter how many studies you begin.

interests with a range of other factors, such as the academic requirements of the courses compared to their expectations of their own academic abilities, how the culture at the study programme suits the kind of person they are, the geographical location of the institution compared to where their friends or family live, the reputation of the university, etc. Most of the students struggle to combine these various elements into a sensible narrative of choice that can comply with the norm of choosing from interest, while integrating the other elements as well.

A match of interests and an attractive horizon

In reflecting on the elements that influence their choice of study, career possibilities are present in almost all of the student narratives. A student commented as follows:

> Martin: I think I will choose my future study based on what interests me right now. And what I could imagine myself working with – therefore also applicability. I need to see that what I study eventually leads to a job that I would like to have. It's not enough that what I study is totally exciting, if I end up becoming something that I cannot imagine doing for the rest of my life. But I haven't found out yet. Something where I can see there's a sense in what I'm doing, but where I can challenge myself with some problems, too.

> (Martin in upper secondary school)

This quote contains several elements that permeate the bulk of the interviews. First, the choice based on interest is balanced by other factors, and among these, career possibilities are particularly important. Even if students emphasise that the study programme should be about something in which they have a genuine interest (and hence fits with who they 'authentically' are), they should also have a clear idea about the career perspective the study programme opens up for them. Secondly, the students do not only want job opportunities, they also require the jobs to have certain qualities. Many of the interviewed students agree with Martin in the features of a future job: it should be meaningful to them in what they will be doing; it should be challenging and provide opportunities for learning or self-

development; it should be varied. Other students mention other features, e.g. that they wish to get a job where they relate to other people or get paid well, but to many of the students salient characteristics of a future job are a sense of meaningfulness, variety, and development. For some of the students, these two elements – that both the study programme and the future career should be interesting – present a dilemma. In a group interview, one student says:

> 'I am crazy about medicine– but most of all because I want to be a doctor, I don't want to study medicine. I would love to study literature, but I don't really want to be a teacher. It's a tough dilemma. What do I do?' (Louise in upper secondary school)

Louise describes how choosing a study programme and choosing a job does not necessarily fulfil the same criteria. For her, the two horizons – that of the study and that of the life after graduation – do not merge seamlessly, but accepting that one of them may not meet the criteria of matching her interests with who she wishes to become is difficult.

An additional challenge for the students is to acquire some idea about what kind of jobs different study programmes give access to. Some of the students search the Internet for information, and form ideas about what working life will be like from the sometimes fragmented information available. This is the case, for instance, for Allan who has been looking at the engineering union's homepage:

> 'If I was supposed to choose a university study programme from what interests me the most it would be something technical or engineering, to get deeper into how things work. But I cannot picture myself working as an engineer. It would be hopelessly boring to be in your office by yourself with your calculator' (Allan in upper secondary school)

Instead, Allan emphasizes that his work should 'mean something for somebody', should make a difference and this is not what he has taken away from information on the Internet. Many engineers would probably object to Allan's image of the engineering profession. The point in this context is not whether or not the information is correct, rather it is that the students construct their own images and ideas

based on the information they meet or look up, and these images – accurate or not – inform their choices.

Some of the students face a challenge related to what we will call the horizon of the choice, namely that the choice of study programme can hold various perspectives which sometimes collide. One is an immediate interest in the content another is the horizon of being a student at a certain study programme and finally the horizon of what will follow after graduation. These three horizons need to be balanced against each other in the choice narrative. Consequently, the information the students have access to has an impact, and for many of the interviewed students their personal network is an important source of information about what kind of study programmes exist, what it is like to be a student in that programme, and what kind of jobs the programme leads to. Hence, the choice becomes embedded in social relations. This, however, leaves the students with another dilemma, which is the second theme we wish to present.

An individual responsibility being socially embedded

An individual choice

A consequence of the choice being considered as something you have to search for yourself ('a gut feeling') is that the students consider this enterprise to be their own responsibility.

> 'Personally, I'm sort of nervous about being influenced by a career counsellor. That kind is not neutral. It would be nice if he was, but nobody is neutral. A counsellor also has an idea about what would be good to study. I would be nervous, then, to be influenced by it. I would like to make my own choices' (Filip in upper secondary school).

Because the choice is experienced as an individual task, some of the students refrain from seeking advice from the career counselling available at each school, a pattern we found throughout the empirical material. Some students explain how they use the counsellor for practical issues such as finding the right forms and the deadlines for applications, and a few students underline how the counsellor has been helpful in making the choice. In most of the students' narratives the part of the choice that is related to their identity work is put

forward as something that can only be made by themselves on their own. Not only does this mean that the students are committed to find a study programme that corresponds to their interests and to whatever they wish to become, but also that it must represent an individual, if not unique, choice. In the narrative of Monica, the difficulties in juggling these different expectations and requirements clearly appear. She tells the interviewer that when she started at upper-secondary school she wanted to become a medical doctor. During lower-secondary school she visited a hospital for a week and became fascinated by the culture and the work environment there. However, her thoughts about going to medical school are disturbed by other considerations. She says:

> 'I'm just having more and more doubts. It just seems so cliché to opt for Medicine. It's just because it's more special to study something a bit different. It is a bit stupid, but I'm feeling a bit… I think it's because my Dad's a doctor. But it's because, I think, it has always been like ... I just think it's really fascinating. And my older sister has started going to medical school…then it just seems so much by the book, that I'll be doing that too. It just seems so stupid. But it's really me, that I think it could be interesting, myself. But it would be nicer if my family wasn't into it too'. (Monica in upper secondary school)

This passage from Monica's narrative illustrates the dilemma that some of the young people face and have to handle. On one side, she has found a field of study in which she is genuinely interested in, partly based on concrete, personal experiences. This part conforms to the ideas about how one should choose one's future study. On the other side, she faces the risk of being considered 'cliché', of doing what everybody else does (medicine is a study with many applicants every year) and especially to 'go by the book' and follow in the footsteps of her father and sister. This other side collides with the idea of how educational choices should be made: they should be individual, personal and special. The dilemma expressed by Monica requires her to construct a narrative of medicine as her own unique choice of an individual career. The interruptions and hesitations in her way of talking suggest that this is not an easy task. Another student,

Amalie, also tries to deal with the fact that her interests run in her family:

> 'But I'm sort of into that environment from the beginning, and I definitely think that it has influenced my choice. Both my granddads are engineers, and my grandmother is a biochemist. So it kind of runs in the family [laughs]. I think that's why I would like to study abroad, to feel it's a bit different' (Amalie in upper secondary school).

Amalie has accepted following in the footsteps of her family, but at the same time she struggles to construct an individual and unique choice by wanting to study abroad. Students' choice of higher education is not only a task of finding the right match between their interests and study programmes, they further have to construct a narrative where the choice is being adjusted to the student's own personal, unique identity project.

The choice is informed and adjusted in social practices

Even though the choice is understood as an individual task, the identity work does not take place in a vacuum. The student has to make it appear plausible to their families and friends that the choice matches their interests and the person they are. If the choice narrative is not recognised as convincing by the students' family and friends, it can be difficult to maintain it. This is what happened to Ian:

> Ian: People said I just had to choose what I found interesting (…) and no matter who you ask they said that you must take what you think is interesting. Otherwise you just get tired of it and will not want to do it later (...) I also considered going to law school, but that was not popular
>
> Researcher: Where? At home, or?
>
> Ian: Yes, because... I don't know. I don't know why. But I could sense, that it was not something one should do
>
> Researcher: What did they say?

> Ian: 'Lawyers are just swindlers. They are the kind of people who cheat. This study programme, you wouldn't like to choose. Why I at all found it interesting? The study was so boring' and things like that. I should definitely not choose this...
>
> (Ian, First year at biochemistry)

Ian's narrative about his choice is interesting because he describes a dilemma. On the one hand he was told to choose something he found interesting. On the other hand, not all his interests were recognised by his family. The narrative must not only make sense to the students themselves, but also to their social relations – it must be recognised as a reasonable choice, suitable to the student. This was not the case when Ian presented his thoughts to his parents. Eventually, he chose to study bio-chemistry, a choice which particularly his mother, who holds a bachelor of Biomedical Laboratory Science, finds sensible. The example illustrates how the student's social backgrounds affect their educational choices. This not only is the case when the family (particularly the parents) explicitly encourage or discourage young people's choices, but also when the parents provide access to particular fields of knowledge and experiences that can serve as material for the student narratives about their future study programme. The family members' educational and occupational backgrounds present young people with knowledge about the educational system and professional opportunities. Knowledge they can relate themselves to through concrete information and experiences that can serve as resources in the construction of their narrative. Hence, it is not surprising that children tend to have inclinations similar to those of their parents simply because they are familiar with it.

The main part of student educational choice is less an isolated event than an ongoing process, moving back and forth between identifying one's own interests, constructing a convincing narrative, and trying it out in social relations. This became evident when some of the students were interviewed again right after having entered higher education. In the interview in upper secondary school, Christine explained that she would like to study something that involved design, and she thought she would apply for an engineering programme that included design. She had considered different study programmes where design was a component, and the engineering

study appeared as the right choice. The interviewer asked her how she decided what to choose, and she replied that she '*has this idea that if I find something that is the right thing, then I'll know. I have that with design and engineering. It seems a bit natural for me in a way to think that I should study engineering'*. Earlier in the interview, she had explained that she had considered studying at the University to become an upper-secondary school teacher, but concludes:

> 'Now that I think about it, I'm convinced that I would kill the children before I got to teach them anything (laughs). I don't think I would fit well as a teacher. […] Now that I think about it, I don't think I could stand becoming a teacher' (Christine in upper secondary school).

In September, five months later, we texted the students to ask if they had entered a study programme, and if so, which one. Christine replied: *'I have started in teacher-education [to become a primary and lower-secondary school teacher]. I have always wanted to become a teacher'.* Christine's narrative has changed from wishing to work with design and engineering to teaching, even naming teaching as what she always wanted.

Following the response, Christine was interviewed again. In the interview, she explains how she since the first interview in spring has settled in a nice apartment with her boyfriend, who is still attending upper-secondary school, and how she really treasures their relationship. If she was to move closer to the engineering institution, which is situated more than an hour away from her home, she would see her boyfriend less often. She had begun to doubt whether engineering was right for her, and she decided she could just as well find something to study close by instead of having to move, eventually deciding on teacher-education. Christine's story shows that the choice of study is much more than finding the right match between interests and study programme; it is also constructed in relation to other elements in life such as a boyfriend and apartment. However, as seen in her text message it is not merely that she constructs a new story about choosing another study. She also reconstructs the story of who she is and what she always wanted to be. Similarly, Christine's narratives in the first interview may have

been a reconstruction of a previous narrative where she considered becoming a teacher.

Across the empirical material we find that the narratives continuously are retold and revised according to the experiences of the students, whether it is because they make a different choice, like Christine, or because the experiences at the study programme question the original ideas and narratives, as is the case for Filip. Both in the interview in upper-secondary school and immediately after beginning to study mechanical engineering, Filip explains that he finds the field between engineering and working with humans very interesting. His plan is, he explains, to combine mechanical engineering with management. But Filip's narrative changes after he has met with his mentor, an experienced professor assigned by the institution. The mentor tells him that he needs clear-cut engineering skills and that it is too arrogant to enter the labour market as a new engineer and say 'I want to be a leader'. In the second interview, during the first half year of study, Filip explains how he wants to study energy, because energy is very important to our future life, and then later combine it with management. When he is interviewed at the beginning of his second year at university, the idea of becoming a manager is no longer a part of Filip's narrative, not even when he explains about why he decided to study engineering. Instead, he explains how he has always been interested in energy.

The point here is not whether the changes are reasonable or well-founded. The point is that the students' narratives about what to study change over time, in interaction with how they construct and re-construct meaning. Through social and cultural discourses, new coherence is made in a way that makes the authentic, autonomous and unique aspects of the choice visible. The change in narrative can also reflect a change in the focus of the choice and the story about the choice. In Filip's case, his narrative changes from his desire to combine management with engineering, to energy being the most important issue in the future world. In that respect, one can say that his change of choice is both a retrospective change, but also a change in his horizon. A similar example is with Marianne who in upper secondary school wants to become a dentist:

> 'And I'm really confident that I will be a dentist. Also because the study programme is appealing to me (...). When you read about the content of the semester, it

> really sounds exciting.' (Marianne, in upper
> secondary school)

But Marianne was not admitted to the Dentist study programme, and instead opted for studying Physical science, which makes her re-construct her narrative of why she in the first place came to apply for the Dentist Study programme:

> 'After not having been accepted to the dentist study
> programme I considered whether this was what I
> really wanted (…). I began doubting whether I
> wanted to become a dentist because of the salary and
> the course-content. I never tried to put my fingers
> into anybody's mouth so how can I really know if
> this is my future? (…)'
>
> (Marianne at her first year study of Sports Science).

In both the case with Filip and Marianne, institutional demands in different ways made them reconstruct their choices, whereas Christine's' choice was revised and adjusted to her life outside school. Other students' struggle to find out what to choose which the case is for Susan, who in upper secondary school considers studying Business:

> 'I really can imagine myself in a business-suit as a
> leader. I am always like a leader in my class when
> working in groups but also in general. I am also the
> one who takes care of coordinating when we meet
> outside class. (...) I think the kind of working culture
> and job will suit me well (…)' (Susan before
> choosing, spring 2009)

In her 'gap-year' Susan was confused about what to study, and she began considering different other options such as Design, Law studies, Medicine and Journalism, and she tells how she finally decided to opt for Danish:

> 'I think Business will be too superficial and fixed to
> me, too superficial to work on people getting more

money. I have been really in doubt of what to choose, and in the end I asked myself what am I best at? Throughout upper secondary I got the highest grades in Danish, and I always loved analyzing Danish texts. I always loved reading and writing, and I always have been good at it. I do not think I will be tired of it, and it leads to a variety of possibilities (…)'

(Susan in her 'gap-year' 2010)

Throughout the data, the students articulate their choice as something they have *always* been interested in. This illustrates how students' choices change in interaction with their identities, and how a new choice-narrative not only produces changes in future perspectives, but also changes the perspectives on the past. In Susan's case she argues how business is something that suits her as a person, and how managing things is something she always does naturally. Changing her mind she tells how Business is too superficial for her, and how Danish is something she has always been interested in and good at.

Discussion and conclusion

In this paper we have shown that choosing what to study after upper-secondary school is a complex, ongoing and social process rather than an isolated individual event. Many of students experience it as an insecure process and fear that they will not be able to make the right choice, because they consider it crucial for their future lives to choose the right path of study. Through the use of narrative psychology we have shown how the process of choosing is strongly connected to identity. When choosing a study programme, young people face an important turning point where new meaning becomes available, and they are faced with the need to reformulate narratives about themselves. To understand why young people's reflections about education and their future revolve around themselves and who they wish to become, Nikolas Rose (1999) by drawing on Foucault suggests that this not is an indication of a spoiled, self-centered generation, but rather students responding to a fundamental condition in time that requires that they develop and produce themselves through working on their identities. As a result, students internalize

the choice of study programme, making it a personal task for them to solve on their own.

The students articulate how they can choose whatever they want to do, but they still struggle to find out what they really want and what would be suitable to them. The students strive to choose a study programme that fits their present interests while at the same time trying to achieve a proper match between a study programme and their ideas about various trajectories of life in general and an attractive study life and working life in particular. This difficult process is repeated until the students feel a proper match has been made. The difficulties stem from students often having more than one interest, but also that they have difficulties learning about the content of the study programmes and what career opportunities various study programmes provide.

Consequently, the process of choosing a study programme is not finished for these students when the application form has been sent and they have entered a higher-education programme. It is a continuous process of identity work and ongoing reflections about whether this was in fact the right choice. We showed how the students articulated the choice as something they had *always* been interested in, even if major changes had occurred and affected their considerations from the first to the second interview. From narrative psychology we know how narratives are retold depending on the subject's considerations of the past and expectations of the future (Bruner, 2004). In this study, this is seen in relation to how the student choices are produced in interaction with their identities, and how a new narrative about what to choose studying not only produces changes in future perspectives but also in general changes student perspectives on the past. These findings can nuance the present discussions within research about the extent to which student choices of study are made as early as primary school (Archer, DeWitt, Osborne, Dillon, Willis, & Wong, 2010).

Across the student narratives in this study, we identify some cardinal points around which the students construct their choices. The choice must appear unique, authentic and individual. At the same time, the narratives the students construct around their choice are being tried out and validated in the students' social network; they are told, revised, and adjusted based on how the social relations meet and inform the student narratives, but also according to whether the narratives are recognised as a legitimate identity match or not. The

negotiation of the narrative happens continuously in order to become convincing both to the students' environment and to the students' own sense of who they are. The students' social background, particularly that of their parents, are gateways to ideas about possible choices to make and paths to follow, and the students' social network provides access to experiences, knowledge and ideas that may inform their choice. The students, however, do not consider this interaction with their social network as a valid part of their choice and they do not intentionally draw on the resources available to them from family, friends, and counsellors. Therefore, in the students' experience, they are managing a rather complex process in solitude. We show how the knowledge provided by the social network act as a gatekeeper in the sense that students with well-educated social network have access to knowledge about the educational system and job market to which less educated social network do not provide access. In accordance with previous research, we find that for the young people, the choice appears as if it is a question of their personal competences and interests only (Brunilaa, et al., 2011); however, we further find that the social network is used as tacit knowledge by the students to interpret and access information of whether a study subject is perceived to be too difficult, boring, useless, etc. This interpretation is validated in the network, but as a hidden mechanism. To reach a deeper understanding of these mechanism than this paper allows, future research could benefit from approaching the phenomena using Bourdieu (1986) to study how cultural capital is distributed and embodied, and maybe can be understood as something natural, as a personal skill or competence which in this case makes student choices appear as an individual task rather than something socially constituted over time.

Implication for practice

Choice being an ongoing process rather than something 'I always wanted', has implications for future methods of approaching students' choices in at least three respects.

First, it raises the question of to what extent the students' own responsibility is to know about the educational system, the labour market, and different job possibilities etc., and whether their personal networks are the optimal resources for gaining knowledge. Attention

must be paid to the student's access to information, and to what kind of information students get from their personal network. More generally, it seems crucial to find a way to balance on the one hand students need to experience choice as individual and unique. And on the other hand, to de-individualize the process of choosing to provide the students with the experience that some of their difficulties are shared by others, and are the results of social and structural components rather than individual traits and inadequacies. Attempts to de-individualize educational choices has only to a limited extend, been tried out (Krøjer & Hutters, 2008).

Second, for university practice, it cannot be assumed that students have completed their choices when entering higher education. Rather, institutions should consider how they may provide room for and facilitate student production of narratives about their choices in relation to the subjects and programmes they meet, since we know that these processes are related to retention (Ulriksen, Madsen, & Holmegaard, 2010).

Third, for research, it emphasises the importance of regarding students' choice of and encounter with study programmes as a process of negotiation between their expectations, interests, and experiences. This calls for a strong emphasis on future research to study these ongoing processes and shifting rationalities and in particular how they appear in different cultural settings.

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5. PAPER II: TO CHOOSE OR NOT TO CHOOSE SCIENCE

To choose or not to choose Science: Constructions of attractive identities among young people considering a STEM higher education programme

In the literature there is a general concern that not enough students choose to study science, technology, engineering or mathematics (STEM). This paper[9] presents results from a Danish longitudinal study which examines students' choice of whether or not to continue studying STEM after upper secondary school. In particular this study focuses on students who held a STEM-subject as one of their favourite subjects at secondary educational level, but who choose to not study STEM at tertiary level. This paper explores how students' perceptions of STEM relate to their identity work. The data used, primarily consist of interviews with 38 students at the end of upper secondary school. Mainly their perceptions of what higher education STEM might be like is explored, but also, these perceptions are contrasted with first year interviews with 18 out of the 38 who later chose to study STEM. The results show how the students who did not choose STEM, perceive STEM to be stable, rigid and fixed; too narrow a platform for developing and constructing attractive identities from. This way of perceiving STEM, turns out to be similar to the experiences described by those students who begin a STEM-programme. If we want to attract and keep more students in STEM, institutions could benefit from considering educational strategies that match the expectations of students who <u>do</u> choose STEM. If this could be implemented, this study indicates that also the

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group of students that does not choose STEM might become interested in pursuing a science career.

In recent years there has been a general concern that Europe is facing a shortage of engineers and scientists (European-Commission, 2004; OECD, 2008; Osborne & Dillon, 2008). This has sparked extensive research into students' choice of science studies (cf. Boe, Henriksen, Lyons, & Schreiner, 2011).

Since the 70´ies general research into students' choices of higher education has been carried out to help policy makers predict and influence student enrolment planning as well as to inform and plan recruitment activities and marketing aimed at prospective students (Paulsen, 1990).

Throughout such literature, an effort is made to construct comprehensive models of student choice (Eccles & Wigfield, 2002; Holland, 1973; Hossler & Gallagher, 1987; Woolnough, 1994) and large-scale quantitative studies have been carried out to map young people's educational choices. The result is a reasonably clear picture of the kinds of variables that affect students' educational choices (Bergerson, 2010). To gain knowledge of how these variables affect an increasingly diverse student body however (Reay, David, & Ball, 2005), there is a need to not only identify the variables that affect student's' choices, but to explore how the students themselves handle and make their choice meaningful (Archer et al., 2010). During the first decade of the 2000s, research that addresses this specific purpose has been carried out, by combining a focus on students' identities with the way they make sense of their choice of education. Illeris et al. (2002) claim that changes related to the late-modern society loosen the established norms and social patterns, and hence choice of education is considered more free than previously. Consequently, choosing what to study is no longer merely a question of what you want to be, but also of who you want to become. Choice, thus has become an issue of constructing an attractive identity (Illeris, et al., 2002). Applying this framework to choice in science education, research show how some students, and especially girls, find STEM to be unattractive because these students do not see their interests reflected in the curriculum (Schreiner, 2006; Schreiner & Sjøberg, 2004). Other studies show that a border exists between the cultural world of young students in general and the cultural world of science

(Krogh, B., & Thomsen, 2005). Taconis and Kessels (2009) have constructed a quantitative approach to capture the relation between students' notions of science stereotypes and their self-image. In fact, some studies show how some students in particular ethnic minority students, and students from low-income families, are less likely to find STEM to be a legitimate choice because they do not recognise a science identity to be desirable or even possible (Archer, et al., 2010; Brunilaa et al., 2011; Wong, 2011).

Recent research suggests that the choice about whether or not to study science at higher education is primarily made before the age of 14, and therefore needs to be studied from the students' childhood to fully understand the development of their interests and experiences with science (Archer, et al., 2010). Attempts have been made to identify 'scientists-to-be' at an early age by comparing to characteristics of scientist (Head, 1997). Studying students' science choices in secondary school, it becomes evident that: "The situation regarding science choices hinges on far more dynamic considerations than the stereotypical image of the potential advanced science student, committed to becoming a scientist from an early age" (Cleaves, 2005, p. 471). Instead Cleaves in her longitudinal study categorizes students into five different choice-trajectories that ranges from early and specific career commitment (the directed trajectory) to students with constantly changing ideas (the multiple projection trajectory). According to Cleaves childhood interests and experiences seem to be influential for some students, whereas they have less or no significance to others (2005).

All in all, there seem to be an agreement about the choice of study being related to the students' construction of an identity. As also Bergerson (2010) notes in her review of research on students choices, it remains to be studied how the different factors known to influence students' choice of study create "a sense of fit" for the students when choosing what to study (Bergerson, 2010 p. 114). Further Cleaves work (2005) reminds us that choice of study is shaped different for different students, and therefore cannot be reduced to one simple model.

This calls for detailed explorations of how students, in their construction of an identity, negotiate and balance the options that pursuing a STEM course of study offers to them, and further how these acts of balancing, negotiating and constructing identities

eventually lead students to decide whether or not to enter a STEM study programme. Both the studies by Schreiner & Sjøberg (2004) and by Taconis & Kessels (2009) mentioned previously adopt a quantitative approach that seem to limit the extent to which such interrelated complexity of different factors can be studied.

This paper contributes to research on student choice by analysing choice as a complex process of identity-construction that in part entails balancing different factors regarding individual perceptions of possible study programmes and careers.

Aim

Summing up, there is an emergent agreement that students' choice of higher education is closely interwoven with their identity construction, and that perceiving this as a complex relationship might help inform student recruitment to STEM higher-education programmes. Research in this field has yet to capture and contribute understanding to the multifarious factors concerning students' choices of study – especially with regards to the intricate details of identity formation. This is both due to the fact that most studies are limited to studying the choice of study at one particular moment in the process and that the quantitative approach that is used in several studies is restrained in the kinds of details it can unveil. Primary we thus aim to understand how students' work on constructing their identity (which we will phrase their identity work) together with the students' perceptions of STEM affect their choice of higher education study programmes, particularly their inclination to enter a STEM study programme. A secondary aim is to explore whether the students' choices are rooted in misconceptions about higher education STEM study programmes, by contrasting the reasons students give for not choosing STEM with the reasons and experiences expressed by students who have actually chosen to study STEM. .

Theoretical framework

The studies of both Illeris et al. (2002) and Schreiner & Sjøberg (Schreiner, 2006; Schreiner & Sjøberg, 2004, 2007) rested on a particular understanding of late-modern societies. The central tenet of

this understanding is that because of the dissolution (or at least weakening) of fixed social structures young people need to develop a high level of reflexivity where they continuously observe and reflect on themselves in relation to their surroundings. To the individual this appears to happen in a setting of open opportunities where each has to construct his or her own biography. At the same time, however, there is also an increased institutionalisation that frames this biographical construction (Beck, 1992). This, in turn, makes the situation ambiguous. On the one hand, students' construction of an identity occurs in a context in which they conceive of themselves as free, yet with the obligation to find the right choice for themselves and decide who they wish to become. On the other hand, the students are still situated in contexts, where their choices are limited by institutional constraints and where they have to balance what is possible with what they desire (Authors, In press).

In order to study the complexity of how different factors interrelate with students choices we need a theoretical approach that can provide a framework for capturing the ways the external frames and restraints are adopted and integrated by the young people as decisions of their own in their construction of an identity. In this process of identity work, where students continuously make meaning of the world and relate themselves to it, students continuously struggle to know, maintain and develop themselves in what they recognize as the best possible way. This notion of identity is inspired by the ideas of Michel Foucault according to whom identity is embedded in a range of social practices. The ways students understand and think about themselves and the ways in which they perceive their possibilities and limitations are embedded in the discourses available to them. This does not mean that the students are controlled by discourses, but that the discourses set the scene for the ways students think and act (Foucault, 1997). According to Foucault, the discourses are 'translated' into practices, but this translation can occur in several ways, depending on how students perceive their surroundings and themselves.

To capture the practices in which individuals are dealing with themselves Foucault (1997) uses the concept of governmentality, that describes a historically change in the way power exerted over the individual, from being an open external control and exercise of power to a situation where the individual incorporates the power and exercise it on themselves. Inspired by Foucault, Nicholas Rose states:

> 'The individual is to become, as it were, an entrepreneur of itself, seeking to maximize its own powers, its own happiness, its own quality of life, through enhancing its autonomy and then instrumentalizing its autonomous choices in the service of its life-style' (Rose, 1998, p. 21).

In other words this way of constantly having to entrepreneur, govern, and (re)produce oneself is considered a fundamental condition in our time. The students are imposed to take themselves as the point of departure, they are the ones who need to make meaning of the world and thus govern themselves. Therefore the world has to make sense to them (Raffnsøe, 2010).

We use Foucault's concept of governmentality as a theoretical perspective to understand the conditions of existence in which students construct themselves. Students' choice of study is a pivotal point in this construction, because it is a crossroad where new narratives are made possible. Still, the identity construction occurs in a social world where rationales and what is possible or not, are expressed through discourses. In their identity-work and their construction of a narrative of their choice, students have to use and relate to existing discourses if their choices and reasons are to be recognised as sensible. Hence, discourses provide a framework that the students need to submit themselves to. However, since one of the dominant discourses emphasises that the choices of the young people should be entirely their own to make they need to construct a choice that reflects and integrates these social requirements and make them their own.

Methodology

Following our research aim

We need to combine our theoretical approach which draws on the ideas of Foucault with a narrative psychological methodology to gain access to students meaning making in interviews. In this section we describe how our data were collected and analysed from a narrative psychological point of departure. In the section 'Analysis' we use Foucault's ideas to understand and interpret this data.

Conducting narrative interviews

Narrative psychology focuses on how individuals make meaning in relation to their identities. We all use narratives to make sense in the complexity of our lives by relating to certain circumstances while others fade out into the background (Polkinghorne, 1988; Sarbin, 1986). The way we relate to and ascribe meaning to these circumstances changes across time, and what at one point seems to be central to our narratives might become less important later on. Narratives are meaning making processes in which we continuously work on relating what we experience in our lives to our identity (Bruner, 1990).

When students' narratives are the objects of research, the purpose of doing interviews is to encourage the interviewee to present stories and descriptions (Andrews, Squire, & Tamboukou, 1998; Hollway & Jefferson, 2000). Attention is paid to how the students' ascribe and make meaning of their lives. Therefore, the researcher asks 'how' and 'what do you mean when you say,...', to thus create and

emphasize a situation where the interviewee produces a narrative to the interviewer as a listener that the interviewer listens to, rather than a situation where the interviewee provides answers to questions posed by an interrogating interviewer (Søndergaard, 1996).

Collecting data in upper secondary school

The primary analysis presented in this paper is based on interviews with 38 students that were carried out just before the students finished upper-secondary school (STX and HTX)[10], i.e. before they had

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[10] In Denmark there are four types of upper-secondary schools giving equal possibilities for entering the higher education system (HTX, HHX, HF and STX). STX is a non-vocational general type of upper secondary school with science classes as one of several tracks, whereas HTX consists of various tracks all specialized in science and technology. The higher education system in Denmark is free of any tuition fees, and students receive government financial grants every month to cover their most basic living expenses. Access to certain higher education programmes is limited to students who complete certain subjects at specific levels at upper-secondary school and obtain specific marks.

formally made their choice of their further course of study. Data was collected in six Danish upper secondary school classes, one specialised in science, mathematics and technology, one in chemistry, biology and technology and four in science and mathematics. In the spring of 2009, 134 students in the six classes completed a questionnaire concerning their socio-economic background, their experiences with upper-secondary school in general and STEM in particular, and their plans for the future. Based on the information obtained from the questionnaires two students from each upper secondary school class were selected for focus group interviews. Each student was asked to bring with them a friend from class to make the setting as safe as possible, and to make the students feel comfortable by sharing their views in a group. Not all students succeeded in convincing a friend to spend time participating, and 19 students in total were interviewed in groups. In addition, three students from each class were selected for in-depth interviews. In one class an extra student was interviewed because only two students showed up at the focus group interview. 19 students were interviewed individually, which in total makes 38 students (Table 1).

Half of the 38 students were girls and 18 came from non-academic backgrounds. We selected our students so as to represent a maximum variation case as described by Flyvbjerg (2011). The purpose of this sample strategy was not to generate representative results but to get access to a wide range of ways in which different students make meaning of STEM and of their choice of study. Table 1 presents the students selected for interviews in upper-secondary school, their sex, their favourite subject in upper secondary school and what they plan on studying after upper secondary school. It is also indicated if the students have chosen to study a STEM higher education study programme or not, whether they were interviewed during their first year at higher education and in such case how many times they were interviewed.

| | | Study-plans for the future in upper secondary school | | | | | First year STEM |
Psedonym	Sex	Science and mathematics	Engineering	Other	Favourite subject in upper secondary school	Interview in upper secondary	Choice of higher education STEM study programme, and numbers of interviews during first year
Coya	F		X		Chemistry, Mathematics	Individual	Architectural engineering: 3
Cecilie	F	X			Mathematics	Individual	Opt out of Sport Science to BA in social work: 1
Cathrine	F			X	Chemistry	Group	Non STEM chooser
Christian	M		X		Mathematics	Group	Software engineering: 3
Casper	M			X	Mathematics	Group	Non STEM chooser
Christine	F		X		Design	Individual	Non STEM chooser
Barbara	F			X	Mathematics, Danish	Individual	Opt out of Literature to Design & engineering: 4
Benjamin	M			X	Mathematic, History	Group	Opt out of History to Computer Science: 4
Bastian	M	X			Mathematics	Individual	Mathematics: 1
Belal	M	X			Mathematics	Individual	Computer science: 2
Basma	F			X	Mathematics, Religion	Group	Non STEM chooser
Birgitte	F			X	Mathematics	Group	Bio technology: 1
Erika	F		X		Chemistry	Group	Chemical engineering: 2
Emily	F		X		Chemistry, Mathematics	Group	Opt out of Chemical and biotech engineering: 3
Emma	F			X	Technique, Danish, Psychology	Individual	Non STEM chooser
Ebbe	M			X	Chemistry, Biology, Mathematics	Individual	Bio technology: 1
Emil	M	X			Biology	Individual	Bio chemistry: 2
Elisabeth	F		X		Mathematics	Individual	Environmental management: 1
Daniel	M	X			Physics	Individual	Computer Science: 2
Dorte	F		X		Mathematics	Individual	Gap year
Deniz	M		X		Physics, Chemistry, Mathematics	Group	Biotech engineering: 1
David	M			X	Technique	Group	Opted out of non STEM to Medias and design: 0
Dan	M			X	Philosophy	Group	Non STEM chooser
Djemal	M		X		Physics, Philosophy	Individual	Design and innovative engineering: 2
Frida	F	X			Science in general	Individual	Bio chemistry: 2
Fie	F			X	Sports science	Individual	Chemical engineering: 0
Frederikke	F			X	Chemistry, Danish, Music	Individual	Gap year
Freja	F				Danish	Group	Non STEM chooser
Filip	M		X		Physics, Mathematics, History	Group	Engineering design and applied Mechanics: 2
Frederik	M	X			Physics. Mathematics, Psychology	Individual	Architectural engineering: 0
Amalie	F	X			Chemistry	Individual	Molecular biomedicine: 2
Allan	M			X	Physics	Individual	Non STEM chooser
Alberte	F			X	Many	Group	Non STEM chooser
Asger	M			X	Chemistry	Group	Non STEM chooser
Adrian	M			X	English	Group	Non STEM chooser
Aksel	M		X		Geography	Group	Geography: 0
Louise	F			X	Physics	Individual	Non STEM chooser
Besim	M			X	Many	Group	Non STEM chooser

Table 1: The students interviewed in upper secondary school, and first year STEM higher education study programmes.

The focus group interviews were conducted to gain access to the students' ways of making meaning together with peers, and to understand how this interaction of meeting, negotiating and recognizing each others' narratives took place in the cultural setting of upper secondary school (Søndergaard, 1996). For instance, if one student argued why physics is of no use, would the other students then accept the explanation or negotiate it by arguing something else? A limitation of focus group interviews is that the group may not be perceived by participants as a safe place to share one's own narrative. The focus groups however, does give an understanding of what can be expressed in a peer group and what cannot, of what is questioned and what is culturally acceptable.

The purpose of the individual interviews was to allow the students to unfold their narratives about their experiences with upper-secondary school in general and STEM in particular. The setting allowed the students to articulate themselves without interruptions allowing for unfinished narratives, unsettled reflections and not yet decided choice-considerations.

The narrative psychological approach was combined with a semi-structured interview guide (Kvale, 1996). The interview guides for both the individual and the focus group interviews concentrated on the following two pivotal themes to ensure that these focal points were addressed in the students' narratives:

> Theme 1: Upper secondary school experiences in general and with STEM in particular

- The students' experiences of attending upper-secondary school (in particular related to STEM)
- The students' interests and how they relate to their courses and teaching in upper secondary school (in particular related to STEM)
- Study strategies. How do they engage and interact with their courses.

> Theme 2: The students' considerations about their future.

- Considerations about choosing what to study after upper secondary school
- Expectations of future studies

Some of the themes were introduced during the interviews (e.g. 'please describe your experiences with Science, Technology and Mathematics during upper secondary school' or 'will you please tell about your considerations for the future'). Others were addressed by the students themselves in the interview. By the end of the interview each theme and sub-theme would have been raised, but the extent to which they were addressed varied between different interviews.

All interviews took place at school during school hours and lasted from 45 minutes to 2 hours. All interviews were carried out in Danish and recorded and transcribed verbatim.

Collecting data in STEM higher education

Of the 38 students who were interviewed during upper-secondary school 18 have been interviewed after leaving secondary school, once and up to four times (see Table 1). Like interviews in upper-secondary school, these interviews were conducted using the narrative interview method (Andrews, et al., 1998), to investigate how the students made meaning of their new programme. The first question in the interview was 'please tell me what has happened since we met in upper secondary school' encouraging students to share their narratives. The rest of the interview took its point of departure in the narratives provided by the students, and the interviewer asking follow up questions to encourage the student to elaborate more, e.g. 'could you please say something more about your meeting with the courses'.

The first-year interviews are used to compare the preconceptions of the students who did not choose to study higher education STEM to the experiences of the students who did choose higher education STEM.

Analysing the data

A thematic approach was used to analyse and structure the data (Braun & Clarke, 2006). The process of the thematic analysis is shown in Table 2, beginning at the top going through the six steps leading to the final analysis text at the bottom. Moving through the phases in thematic analysis there is a lot of going back and forth between the phases (Braun & Clarke, 2006; Søndergaard, 1996).

Phase	Description of process
1.Getting familiar with the data	In this phase we first transcribed the data and then reading and re-reading the interviews while noting down ideas bearing the research aim in mind.
2. Generating themes	Constructed several analytic questions (themes) taking a point of departure in the research aim. For instance we asked: How is STEM articulated in the students' narratives, what position does STEM hold in the narratives (when is STEM being articulated as interesting and when is it not)? Which arguments are articulated as rationales for choosing or not choosing STEM? How do students relate themselves to STEM?
3. Searching the data	Systematizing of the data across the entire data set, and relevant quotes from each interview were gathered under each theme
4. Understanding the themes with the theoretical framework	In this phase we tend to understand the patterns within the themes in a more comprehensive context of meaning according to our theoretical framework. This part of the process is about recontextualizing the meaning within the students' narratives by using the lenses of Foucault.
5. Reviewing themes	Reviewing the themes by re-reading the transcripts to check if themes and theoretical interpretations work in relation to the entire data set.
6. Producing the text	Defining the analysis heading towards a thick description of the data, moving across the dataset but also looking deeper into some specific interviews, finding ways the specific student's narrative separated from the tendencies across the material. Picking out quotes illustrating points and patterns in the themes.

Table 2. Based on thematic analysis (Braun & Clarke, 2006; Søndergaard, 1996).

This way of analysing data is not inductive (Braun & Clarke, 2006). On the contrary, the research data were produced using our theoretical framework why the generation of themes is likewise informed by our theoretical approach. Through the lens of Foucault's notion of governmentality we are interested in how students' work on relating their ways of making meaning of STEM to their identities. This means, for instance, that when we pose the analytical question 'which arguments are articulated as rationales for choosing or not choosing STEM?' we presume, informed by Foucault, that by looking into the student's arguments for choosing or not choosing STEM, we not only learn something about STEM or the specific student, but also about the patterns through which students need to make themselves recognisable if they wish to appear to be someone who has made an appropriate choice. Our aim is to show different rationales for choosing or not choosing STEM and how these rationales relate to first year students actual experiences. Sometimes this is best shown by looking across the narratives in general, and sometimes by looking through the eyes of an individual student. We do not mention the exact number of students sharing a certain perspective, since this study does not attempt to be representative. Instead, we may indicate whether the quotes cover a general tendency across the material or an experience held by few students to thus suggest what a shared experience among most of the students in the data-material seems to be and what is negotiated in relation to what in general is being recognized among the students.

first year students actual experiences. Sometimes this is best shown by looking across the narratives in general, and sometimes by looking through the eyes of an individual student. We do not mention the exact number of students sharing a certain perspective, since this study does not attempt to be representative. Instead, we may indicate whether the quotes cover a general tendency across the material or an experience held by few students to thus suggest what a shared experience among most of the students in the data-material seems to be and what is negotiated in relation to what in general is being recognized among the students.

Analysis

The results of the analysis are structured in two parts. The first part, constituting the main part of the analysis, concerns 38 upper secondary schools students' identity-work related to their perceptions of STEM and how this relation interacts with their choice of higher education study programmes. This part of the analysis is structured around three themes which were central to both the group of students considering to choose STEM (choosers') and the students who did not seriously consider to choose STEM although STEM-courses was among their favourite subjects in upper secondary school (non-choosers') and their perceptions of science and considerations of whether or not to choose it at higher education; Science as giving access to understanding the world, the nature of science, and science careers. The second part of the analysis focuses on the 18 students among the 38 students, who all entered a higher education STEM study programme (see Table 1), and their experiences and identity work when meeting first-year STEM. This part is twofold, in that it focuses on engineering and science students' experiences respectively. In the discussion we contrast the two parts of the analysis i.e. first year students' experiences with meeting higher education STEM with the choosers and non-choosers expectation of higher education STEM.

Understanding the world

Almost all of the upper secondary students stated that they had a STEM subject among their favourites because they perceived of

science knowledge as something that gives access to understanding the world that surrounds us. In different ways the students articulated how they found science to be closely related to the surrounding world and this was both motivating and fascinating. This way of favouring science was not different between the choosers and the non-choosers. However, variations were found in what the 38 students conceived of as 'understanding the world'.

To some of the students, relating science to the surrounding world opens the opportunity for seeing the great possibilities in science without necessarily being able to understand every aspect of the scientific processes themselves. To other students this fascination is about getting a glimpse of the applicability of the knowledge being presented to them. Many of the students describe their interest by using the phrase that STEM relate to their *everyday life*, but apparently the students have different ways of interpreting what this means. An example is Bastian who stated that 'it is stuff I can relate to, and stuff that influences my everyday life'. Further he describes how 'science explains about all the things humans can do. It is very present in my life'. For Bastian, science provides knowledge of the world and he relates this knowledge to being more skilled in understanding his own life and the world surrounding him. Science is described as an eye-opener, making him aware of all the science that surrounds. In this sense, science is described as empowering people by making them able to think with science.

Other students ascribe a more practical dimension to 'everyday life'. For these students the fascination of science relates to the fact that science makes them able to do things, even if it explicitly does not need to relate to the students' own personal lives. These students describe the practical dimension as something they can relate to and 'get hooked' by in various ways. For example, Robert referred to his preferred kind of teaching when he described the value of this practical dimension of STEM:

> 'When we were doing vectors in math, we needed a break and our teacher suggested that we went outside and used vectors to calculate the surface of the school' (Robert, in upper secondary school).

To most of the students, this practical dimension is particularly present when doing laboratory-work. Teachers, who give small

practical 'appetizers' during a lesson, however can also function this way, and give the students a sense of how what they learn can be applied in the real world:

> 'It does not necessarily need to be relevant to me. I just need to put it into a bigger perspective instead of thinking: 'this formula, there is no one at all using it, and what I am to use it for? But when my teacher explains, that to find out how much asphalt is used to make a speed bump, you calculate the area, then it's fine' (Dorte, in upper secondary school).

As Dorte explains, when one sees the applicability of the science taught, it can become meaningful to learn the content even if you do not understand it fully. To some students this applicability links science to the world, and it catches their interest. Furthermore perceiving of science as an access to understanding the world also affects these students' considerations about choosing higher education. Amalie for example stated "I want to study something which interests me in my everyday life and biomedicine does that" (Amalie in upper secondary school).

The students articulated in different ways how science provides access to understanding the world. By linking science to the surrounding world the students also link science to themselves, and 'understanding the world through science' becomes a way of making science meaningful to themselves. 'Understanding the world' is a core theme in the data. The students' perception of science as being integrated into their lives reflects what Raffnsøe (2010) describes as individuals being imposed to understand themselves as the point of departure to be able to govern themselves. Science becomes relevant to the student, according to how they interpret the applicability and relate to it. This relational and interpretational aspect of experiencing science thus becomes a point of departure for developing and constructing attractive identities.

The way of thinking within science

For both the choosers and the non-choosers the special way of thinking within science characterised by logical and rigorous methods of approaching a problem were identified as central to school science. This both related to their upper secondary school experiences with

science subjects and their expectations of what STEM higher education is like.

The choosers

A large group of the students, who considered choosing STEM, recognize the way of thinking within science as a premise they easily relate to. One example of this perspective is Amalie:

> 'There are answers to everything. Sometimes when you do an assignment in English or Danish there are interpretations to be made and it's very subjective. [In science] you can always make it right, look it through and correct it. Get the right answer somehow. I think that is rather cool'.

> (Amalie in upper secondary school).

For this group of students, the best part of science is the fact that it is concrete, tangible, logical, and has strict procedures. One student described that he appreciates that there is very strong frames for what is right and what is wrong. These frames made it easier for him to relate to mathematics, because he knew what to do and what was expected of him, which was not always the case in subjects of the humanities. Another student, Frederikke, explained how she likes science because "you just have to understand it (...) there is not that much you have to discuss as in Danish or in Social Science" (Frederikke in upper secondary school). In fact many of the students compare science to the other subjects which they perceive to be diffuse and lacking the rigorous methods and systematic procedures they find attractive about Science.

To others, and fewer, students thinking within science is about the process itself:

> 'Some see the answers right away, while others need to think and analyse quite a lot before reaching the solution (...).To work like that before you reach the solution is what is fascinating and interesting to me (...) Some just know that the result is 273.5, while others need to think about it, try out some different formulas to reach the result'. (Djemal in upper secondary school).

Like Djemal, a few other students emphasised their engagement in the scientific process and in particular, the pleasure in finding a way to solve the problem themselves. To these students it was not finding the correct answer, but trying different solutions out and puzzling their way through the problem, they like the most.

A slightly different understanding appeared in a focus group interview with David, Dan and Deniz, where David explains "it is interesting to work with things where there is no right way of doing it. Where you have to find the conclusion yourself" (Focus group in upper secondary school). They keep on discussing what they like the best in science, and describe how it has to with the process of defining a problem yourself, choosing a method to explore it and concluding the process by having reached new understanding. Similarly, a few students discussed how science can be used to invent something new.

When looking into the narratives of the students who consider choosing higher education STEM, we found two tendencies. One group of students' was attracted to the rigorous methods that made it clear to them what to do. Another group of students either liked that science related to their everyday lives or was attracted by the science process. The first group of students found the way of thinking within science to be meaningful and easy to relate to because it was clear what to do and there was a right way of doing science which did not require them to make individual sense of the content as was the case in the humanities. It seems like these students were fascinated by the clear guidance in their identity-work that may be attractive to students who find it difficult to navigate in the complexity of the modern world (c.f. Boe, et al., 2011; Illeris, et al., 2002; Schreiner, 2006) . To this group of students STEM study programmes are perceived to reduce the complexity and be a narrow and comfortable platform for their identity-work. They expect STEM study programmes to provide clear instructions about what to do and how, and they displace the responsiblility of governing themselves to STEM. Following Foucault, this way of relying on an institutional authority to facilitate one's identity-work is a way avoiding to manage one self. However, another group of STEM choosers opted for STEM either because it provided them access to understanding the world, or because of the process of working with science problems. This group of choosers were more similar to the non-chooseres in the their way of ascribing meaning to science.

The non-choosers

In the non-choosers' narratives we found two main kinds of reasons given for not choosing STEM. One was about the students' perceptions of the nature of science and the other about their teaching and learning experiences. An example of the former kind of reason is found in the interview with Louise while she was in upper-secondary school. During most of the interview she told about her great interest in physics, especially the more abstract parts of physics. At the end of the interview, it was therefore surprising to hear her explain why she considered studying International Business:

> 'I've always thought I was going to study engineering, physics or nanotechnology or something. But I just think it will become too boring for me. I like being around people. But physics is just so very fixed. Unless you are really clever, and get to do research in the things that are not explored yet – it is fixed (…) It is just too superficial, really. There are no perspectives of personal development in it, and I could not see myself not having anything to do with other people at all'. (Louise in upper secondary school)

Louise pointed to the way she imagines that physics in higher education programmes will be: How it will be taught and structured (in a fixed and superficial way), how the content will be like (something different from the research field, where the fun parts of physics take place) and how the social aspects of physics will be (something you do by yourself). Interviewing Louise again nine months after she finished upper secondary school, she had joined the army for four months. She told that she was still "crazy about physics" but she nevertheless found it "too uniform, square and fixed", a perspective she shared with a large group of students in the data. Louise exemplifies how discourses are made meaningful in different ways in different institutional settings. To Louise being in the army was like a game to test herself in a limited period of time. Therefore, the setting with its fixed ways of behaviour, discipline and uniformity suited her fine, for the time being. In contrast, studying physics is much more than a game to Louise: physics is a point of departure for entrepreneuring her identity. She explained that choosing to study physics would prevent her from discussing the physics she found interesting, because her experience from upper secondary school was that when she asked the teachers a question the

reply would be "that's the way it is, because that's the way it is". To develop an attractive identity Louise needed to discuss, explore and be able to relate personally to physics and to be around other people, all elements she did not expect physics at higher education to contain. This is an example of how Louise's require her future study programmes to relate to her and engage her in terms of getting her to develop herself. She did not wish to settle with the superficial physics she expected to meet at first year higher education. This need of developing herself is so important to Louise that she did not choose to study physics but has now opted for studying Danish. Louise´s example shows how the way she make meaning of what higher education STEM programmes is like, is in opposition to her expectations about how a study programme ought to support developing competences and identities. Louise internalized this requirement of developing and governing oneself as a personal need necessary to construct an attractive identity.

Another example of how important the students' experience of the nature of science is, appeared in a group interview where Alberte and Asger discussed how Alberte found upper-secondary school STEM teaching to be distant from her own preferred way of learning.

> Alberte: Sometimes I really need an explanation of how things relate. But I guess that is a problem I have, myself.

> Asger: Alberte finds it difficult to accept that things are as they are.

> Alberte: I do not think that I am very good at learning by heart. I think that it has actually been a pretty big part of science here in upper secondary school: that you should learn some formulas by heart. And I don't really think it makes sense. The only way I can learn it by heart is if I understand it properly. Then it makes sense to me (...).

> Asger: It is also about, and I think I have been good at that – it is about a temporary acceptance of that it is the way it is. You have to learn by heart because there is no logical explanation to why it is like that.

> (Group-interview in upper secondary school)

In this transcript a consensus is negotiated among the students that you sometimes need to learn by heart without understanding all elements. The students also point out a dilemma: on the one hand the nature of science knowledge is described as being built upon logic, but on the other hand having to learn by heart sometimes makes it difficult to make sense and find the logic, why you need to trust that at some later point you will be able to make that sense. This is exactly what some of the students who did not want to study STEM found difficult. They did not accept that to learn STEM subjects you need to postpone your understanding and settle with learning by heart. In this case, Alberte struggles to accept that she is not to able to relate to the knowledge taught. Asger had solved the dilemma by accepting that there is no logical explanation that things are the way they are.

Both Alberte and Louise found very limited ways of relating science to their identities, both because the knowledge taught was fixed and not to be discussed, and because they were expected to accept rather than to understand. In a modern world where truth is negotiated (Illeris, et al., 2002; Schreiner, 2006), such perceptions of STEM has poor fit with the students' understanding of constructing an attractive identity where relating oneself, discussing and questioning the content are crucial. In this case STEM appears to be too narrow a platform for constructing an attractive identity why they cannot rely on science to provide them with the opportunity to develop their competences the best possible way (c.f.Rose, 1998).

Another kind of reason for experiencing STEM as an unattractive choice was shared by fewer students. One was Benjamin, who linked his learning experiences in mathematics with his considerations of what to choose. He told that he had a talent for mathematics, but he just did not feel the motivation to continue studying it:

> 'It is as though I'm not getting any personal benefits out of it. If I write a short story or something, I get something out of it personally, emotionally. If I solve a problem in mathematics, then I will maybe feel 'I did it' but it only lasts a few days or something, it is not permanent in any way, and it is not something I can go back to, and look at the math problem and see something new in it but the right answer (...) I guess it's because I like to interpret things, and I like to develop myself that way (....)' (Benjamin in upper secondary school).

Benjamin faced a dilemma. His grades in mathematics are really good and he likes to solve problems in mathematics, but he does not find that the subject supports him in his identity-work developing himself. Benjamin also likes history and eventually after many considerations this is what he decided to study when he finished upper secondary school. Interviewing him during his first months as a history-student he reflects upon his choice:

> 'I was always torn between history and math (...) I had to find out whether I was like one from the humanities or one from mathematics or science (...) It took a lot to consider it. Finally I chose to study history and listing to my friends studying economics, math and computer science I have no doubt anymore, that I prefer being a humanist. (…) it is more attractive and open, there is no truth and it is about questioning everything.'

> (Benjamin at first year history).

To Benjamin it is important to discuss, question, and engage in the knowledge being presented to him; all aspects of his preferred mode of engagement that he does not believe to find in mathematics. Benjamin perceives the knowledge in mathematics to be accumulative and he does not see how he will gain new perspectives by revisiting old exercises as he would in Danish where he perceives the knowledge to be hermeneutically constituted in the sense that he can gain new insights from old assignments. In fact he points to hermeneutic knowledge which he perceives as more supportive to his process of learning and developing himself.

Other students within this group do not talk about learning-possibilities but point out that the teaching of STEM limits their motivation. One student explains:

> 'I find chemistry, where you do an experiment, and you spend one and a half hour mixing two liquids, heating them and cooling them down and all sorts of things. And then you might get a change in colour. I feel it is waste of time in some kind of way. People know it beforehand. I do see the point in making experiments to discover new medicine or something, but when the answer is in the textbook, then to me there is no point in spending time redoing it.'

> (Cecilia in upper secondary school).

Not being able to see the purpose of the STEM being taught is one of the decisive factors that students consider, when they decide not to choose STEM. In this category, students articulate how they do not see the point in engaging in STEM the way it is presented to them. To some students this is because STEM seems to be about getting a particular answer, and not about exploring the subject which is what these students find interesting. Other students mention a particular teacher as one of the reasons for not feeling engaged in a certain STEM-subjects and for not wanting to continue studying STEM. To the non-choosing students in this category their perceptions that STEM insists in right answers and that one need to learn some elements by heart, does not correspond well with the students understanding of constructing an attractive identity.

Towards an interesting future

A third theme about how students perceive and relate to STEM found across all upper secondary school interviews, had to do with prospects of an interesting future. This concern is often articulated in their descriptions of possible future jobs. Again the non-choosers and the choosers related differently to this issue.

The choosers

To a group of students in this theme, the possibilities of working with a particular content is what keeps them interested in pursuing a STEM career. An example is Filip, who plans to be an engineer and work with management or Belal who wants to study computer science in order to get a job in the computer game industry. For another group of students, their interests are not aimed at the job in itself, but at the possibilities such jobs hold – e.g. frequent travels, high earnings, combining a career with a family life, or helping other people. To most of the students, however, these job-related interests in STEM coexist with other interests found inside STEM:

> 'I need to know what to do when I´m done studying– I am afraid of wasting my time by spending six years of my life on something and then ending up being unemployed. But

> I need to be interested in what I choose to study – I do not just study to get a job and earn a lot of money (...).'

(Amalie in upper secondary school).

Amalie is considering to choose molecular biomedicine, which she finds to be a choice of study that combines her interests for chemistry with a variety of job possibilities. Some of the students need to see very clear carrier-paths with concrete jobs they can relate to, whereas others do not seem to be bothered by unclear future prospects. They merely need to be able to perceive some kind of job-prospect which can act to support their interests when choosing what to study.

Although the non-choosing students talk about STEM carreers though they ascibe different meaning to what a future in STEM may look like, than do choosers.

The non-choosers

In this category three subcategories appeared; STEM-jobs being a lonely career path, STEM-professionals being the worker bees without the power to control their job and finally not being able to see a job-perspective at all.

A perception among the students who did not choose STEM in spite of being interested is that a STEM-career is a lonely career path, where professionals work in isolation without cooperating with other people. One student, Coya, who considered studying biochemistry explains that she cannot picture herself sitting somewhere alone in a lab. To her lab-work is understood as unattractive work, because it takes place in isolation from other people. Another student explains:

> 'If I were to choose from what interests me the most, it would be something like technical engineering … But I cannot see myself working as an engineer. It would be hopelessly boring to sit on your own in an office with your calculator, getting the numbers out.' (Allan in upper secondary school).

To Allan, engineering is about numbers rather than people. Also he finds it hard to see how engineering makes a difference, which is contrary to that which he considers to be an attractive working life.

To find 'an interesting carrier for the next sixty years, five days a week', Allan explains 'it is the everyday satisfaction of having accomplished something that matters', and this is done by doing something that helps other people, Allan argues.

Another example is Jacob who considered studying medical engineering. He expected scanning patients to produce images of their maladies to be interesting, but found it unsatisfactory that the interpretation of the images would be done by medical doctors rather than by the engineers.

Across the data the students' choices are adjusted in relation to what job-perspective they find to be available when considering choosing a specific study programme. Not being able to see an attractive future is being one of the reasons why the students do not opt for a STEM programme. The examples illustrates how some of the non-choosers perceive scientists or engineers as someone who works in isolation to do calculations: the worker bees who have neither insight nor power to manage the process. This partial access to the process is considered unattractive by these students, and they fear ending up doing routine work without any influence on managing the job themselves. The non-choosing students' expectations of STEM careers are not consolable with their constructing of what they consider an attractive identity and with who they want to become as persons. They want a future job to be meaningful to them but also to manage their carriers which to some of the students are incompatible with choosing STEM i.e. what Jacob describes as not having the power to manage the process and by Allan being isolated behind a desk only doing the calculations. It becomes crucial to the students choices that their expectations to STEM implies that they will not gain access to constructing an attractive identity in where to get influence on who to become and how to carry out and manage their future job. That a career in STEM is not perceived to provide room for governing and entrepreneuring oneself (c.f. Foucault, 1997; Rose, 1998) is one of the factors that prevent students from choosing to study higher education STEM although it was among their favourite subjects in upper secondary school.

A minor part of the students the data find it hard to see how their STEM-interest can lead to a job at all, and they find it hard to see the purpose of applying for a STEM higher education-programme;

'If I study astronomy, I can't really use it afterwards. Not astronomy in itself. Except that it's a master-programme. It sounds really interesting, but I can't really use it for anything, and there are not that many jobs to get. That's a problem' (Djemal in upper secondary school).

Djemal finds it problematic to pursue his interest in astronomy by choosing to study physics after upper secondary school, because he is unsure whether it will be a sensible choice when he cannot see a future job perspective. The example shows how some of the students' rationales for not choosing STEM are related to STEM not giving access to an attractive life in general and career path in particular. Having an idea of an attractive job-perspective is one element that is important when young people choose what to study after upper secondary school, and to some students their perception of a science future is in opposition with an attractive future.

Students meeting first year STEM programmes

In the above analysis we saw how students relate their perception of STEM higher education programmes from their upper secondary school STEM-experiences and from what they imagine higher education programmes to be like. To approach the implication for practice, one central question is still to be answered: How are the expectations of upper secondary students not choosing STEM related to how STEM is experienced at higher education programmes? If the upper secondary school students' expectations to higher education STEM study programmes are misunderstood, this might be a question about informing the students about how it really is. And the other way around if their expectations actually are similar to new students' experiences, the problem of attracting the students interested in STEM in upper secondary school, also relates to the higher education programmes themselves. From following the 18 students that in our material opt for a STEM programme (see Table 1) after upper secondary school we outline the students' expectations to engineering, science and mathematics and how those are met when entering first year. The analysis is structured in two sections; engineering students and science students' expectations and experiences when meeting first year higher education STEM study programmes. This insight into first year students meeting with STEM

will be used as point of departure for discussing the implication for practice.

Meeting engineering

While being in upper secondary school the students that end up by choosing engineering at higher education describe their expectations as an alternative to traditional science programmes:

> 'Engineering is more concrete and there are many possibilities to combine courses and a lot of different job-possibilities afterwards (…) At the University they have a theoretical approach whereas the Engineering University suits me more (…). It is not as traditional as the university – which is very traditional. I like research to be creative and innovative and that is not my impression of the university.'

> (Erika in upper secondary school)

Across the interviews the students who are about to choose engineering describe their expectations to engineering as hands-on learning, cross-disciplinary, problem-based project work, an innovative environment and as having applicability to real (business) life. An example is Filip and Frederik who in a group interview discuss why they both consider choosing engineering:

> 'Filip: Engineering is the only relevant study programme to me (…) It is very lab- and workshop oriented. Practical.

> Frederik: yes it is practical oriented and it means a lot to me in relation to what I heard of other study programmes.

> Filip: And I like the problem-focus. If you have a good idea you can build it yourself in the lab (…) and it is also focused on the job-marked and that is important to me to feel engaged in the business sector.

> (Filip and Frederik in a focus group in upper secondary school)

But when entering engineering, most of the first year engineering students find themselves to be faced with what they describe as traditional lectures and very little project-based, cross-disciplinary, innovative work. Overall the students' first semester experience is to a great extent very much like what the students expected more traditional science programmes to be like:

> 'We had an hour and a half with experiments in a lecture with a professor. But we did not do them ourselves and he did like 20 experiments in an hour and a half – and you couldn't really understand what happened.'

> (Emily first year chemical engineering).

To some of the engineering students it is hard to see the applicability and hands-on knowledge and this is in contrast to what they expected engineering to be like. Some students believe the more hands-on, applicable engineering to come later in the following years of study. But in general the first year engineering students find it difficult to see the purpose of some of their courses, especially the first year course in mathematics:

> Researcher: Why is it necessary to learn mathematics?

> Deniz: I really don't know. I have tried to ask, but no one seems to know. They just say that all engineers need to have math. You just need it, it is just… It is just a law, to become an engineer, you need to have math.

Deniz explains the need of mathematics with arguments outside the study programme; other engineering students use arguments within engineering like mathematics is the basic for everything even thought it might first be visible later on. Finally a couple of the students explain the missing link to applicable knowledge at first year, as a sorting mechanism:

> 'But they tell out here [at campus] that if you get through the first and second semester, you will also become an engineer. It is at this point the sheeps are seperated from the goats. I talked with my teacher in mathematics and he said that it is only nice if students who cannot anyway pass the bar – are sorted out at first when they begin.' (Filip, construction and engineering 2009).

On the contrary most of the engineering students put forward how their course in 'engineering work' where they visit companies and make technology projects in relation to real life problems are interesting, because as Erika tells: "you get to see how it is in real life engineering" (Erika, Chemical engineering 2009). But a minor part of the students also find engineering work to be diffuse. One student Christian tells how: "Engineering work is like a subject, which does not know what to do, because it contains so many elements" (Christian, Software engineering 2010) and Filip describes it as: "a taking-care-of-the-new-students-course", but not as important as Mathematics and Physics. In the science courses he is supposed to learn science content, whereas he perceives 'engineering work' as a less important introduction course and also not combinable with what he learns in science (Flip, Engineering design and applied Mechanics 2009). This might be the reason why the science courses are more present in the students' narratives.

Few of the students do have other experiences when meeting engineering in terms of experiencing a gap in between their expectations and how first year really is like the rest of the group:

> 'We almost do everything in groups and the programme suits groups really fine, and what we are taught is something we can use in the projects (...) I really like this programme.'
>
> (Barbara, first year Design and Innovation Engineering).

Two of the students who find engineering to be like they expected enter programmes that in particular are cross disciplinary and problem based; Design and innovation and Environmental management. This cross-disciplinary, project-based way of approaching the content is what most of the students expected engineering to be. One student at chemical engineering finds the programme to match her interest in theory.

The other students meeting engineering struggle to renegotiate their expectations to what engineering is about.

Meeting Science and Mathematics

The science students experiences are to some extend similar to the engineering students, even though most of the science students actually did expect to meet big lectures and little project based work. One student, Emil in biochemistry, explains what surprises him the most in the first year:

> 'One might be tempted to believe that the purpose of the course in mathematics only is to support social aspects. The older students explain us: The math you will do in this course, there is almost nothing you will get to use later on ... and the math you will need is presented again next year'. We will meet what they call biochemistry in the second year. So it is kind of... I did not know we were to have mathematics in this way. And it was a surprise to me.'

> (Emil, first year biochemistry)

Science students like Emil explains how the curriculum is structured with many lectures with the purpose of providing the students with so-called 'basic knowledge' in the first semester, mathematics being one of these courses. Another student Belal struggle to find out how to use the computers at computer science:

> 'The expectations I had were something about coding a lot and then learn some mathematics along side. But it turns out that computer science origins from mathematics (...) I did not expect this amount of it. And the way we program is not as we expected when entering. It is in a very mathematical way (...) But if you make it through the first year, the rest will eventually come. I did not expect it from the beginning, I thought it would be more graphic – but I can learn it myself later on because computer science is about something else.'
> (Belal, first year at Computer Science)

Both science and engineering students face a lot of mathematics during their first year of study as most Danish STEM study programmes are designed with large lectures in mathematics as a point of departure for learning both science and engineering. The students in this study do in general find it hard to relate the mathematics, to their other courses in particular but also to their study programme in general. But like in the case with Belal, they did not

expect mathematics to have such a dominant role when studying science. Other students find their expectations to be far from the study programme of reasons outside the programme an example is Cecilie who studies Sports Science:

> 'I decided to stop and find out what to do with my future (…). I found Sports Science to focus too much on becoming an upper secondary teacher. We had exams in 'invent your own discipline', 'make a ball game or a show in water' it is stuff I can't see the purpose of.' (Cecilie just opted out of Sports Science)

Finally few students meet what they expect. One is Amalie opted for molecular biomedicine and is very happy meeting first year. Interviewing her, she explains how: „I did not expect the first year to be interesting, where everybody needs to reach the same level" (Amalie, molecular biomedicine 2010). Another is Bastian who during upper secondary school has been part of Society for Students in mathematics where he has been involved in arranging various activities together with higher education mathematics students, and he explains how he had a clear idea of what mathematics would be like beforehand. Finally Birgitte finds the course in biotechnology to be very relevant to her. She joined a group deciding to write a project about diabetes, and since several of the members in the group including herself knew persons suffering from diabetes, she explains how:"I have a personal interest in it (...) it opened my eyes to what I can use biotechnology for, what to become and what to explore. I now know that I made the right choice" (Birgitte, biotechnology 2010).

But in generalt the science and mathematics students struggle to see how their expectations match first year. Not surprisingly, these examples underline the fact that there is a variation between the programmes the students begin at, their expectations when entering the programme. However, the data indicates that most of the students need to undergo intense work on their identities to combine what they meet during the first year with what they expected it to be like.

Discussion and Conclusion

In the report 'Encouraging Student Interest in Science and Technology Studies', OECD stated that students' choices are primarily based upon their interests in a particular field, and upon their perceptions of job prospects in that field. The report concluded that to increase the number of students opting for STEM: 'Students must have access to information about S&T careers that is accurate, credible, and avoids unrealistic or exaggerated portrayals' (OECD, 2008). On the basis of a quantitative study, Schreiner and Sjøberg (2004) concluded that in order to support young people's construction of an identity in a late modern society, STEM should include other aspects of science and technology in the curriculum.

Our study supports both the conclusions of the OECD report and the findings of Schreiner and Sjøberg. Indeed, both the students' identity construction, whether they find the field interesting, and if they consider the career prospects as promising are important for their decisions about whether to pursue a STEM higher education study programme or not. Accordingly, both the OECD call for accurate, credible and realistic career possibilities, and Schreiner and Sjøberg's call for adjustments of the STEM curriculum are important measures for increasing recruitment to STEM programmes. However, based on the present study it becomes clear that to obtain increased recruitment to STEM programmes it is not sufficient to address the content of the curriculum, but also the form, the teaching methods, that is, the way the content is structured and taught and to what extend this facilitates the students' identity work

We have showed that both students choosing a STEM course of study (choosers) and those deciding not to pursue STEM further (non-choosers) find the field of STEM (or parts of it) interesting, and in particular they find that STEM can be used for understanding the world. Likewise, both choosers and non-choosers experience that they can relate STEM to their everyday life. Further, we find that many students simultaneously prioritise an interest in the study and a promising career perspective when they consider their choice of study. Importantly the study shows that, the career perspective is not purely about getting a job, but that the job in question can contribute to the students' continuous construction of an attractive identity. This means that the job should be interesting and have room for personal development. Hence, in addition to the conclusions of the OECD

report, the S&T careers should be interesting and with room to develop as an individual.

Another significant conclusion to be drawn from our analysis relates to the concept of governmentality. This concept emphasises that the young people are not only required to construct an identity that is recognisable and legitimate in the social context of the students' social environment. They should also display the ability to govern themselves, that is, to act as and be perceived as independent, authentic subjects who take on the responsibility to manage their own lives. From the point of view of the students this means that they should experience that there is a room for developing and managing themselves. From the perspective of the STEM programmes it means that they should display a credible choice for an autonomous self-managing individual. The choice of STEM should be self-imposed by the students.

When the reasons given by the non-choosers for not pursuing a STEM programme are considered in this perspective, we find that the students' experiences with STEM in upper-secondary school and their expectations to higher-education STEM have convinced them that STEM leaves little room for self-government. They have met a field of study with rigorous methods and strict rules and procedures the students have to obey, and with very limited room for influencing the content or the teaching formats. Also, even if the non-choosers find that STEM as a field of knowledge is relevant to themselves and their everyday lives, they do not sense this kind of personal relevance in STEM as a field of study. All in all, STEM studies are experienced by the non-choosers as studies where they have to submit themselves to an existing and dominating regime. Obviously, this does not appear as a field for self-development and self-management. However, some of the choosers expect a study of STEM to provide opportunities for self-development, either in spite of or because of previous experiences with science – either in school or in out-of-school activities.

Nevertheless: The characteristics of school science that previous research found to cause students to lose interest in science (e.g. Claxton, 1992; Osborne & Collins, 2001) may also cause students to experience the field of STEM as impeding their self-management. What is more, this suggests that it is not sufficient to include new themes or topics in the curriculum as suggested by Schreiner and

Sjøberg (2004). What is needed is that both the form and the content become more open to the students' processes of self-government. It is not merely a question of what the students are to learn, but also how they are to learn it. For the students to experience that the study leaves them room to construct and develop themselves the teaching format should give the students more control over their activities, providing them with options of choosing topics, of working with content in ways that make the students themselves establish links between the content and their everyday life or interests, and to relate the different elements to each other in a way that makes sense to the students.

At the same time, it is important to notice the variance in the students' experiences. While the fixed form, content and answers in the field of STEM push the non-choosers away from this study course, the same characteristics are by others – some of the choosers – experienced as a virtue that provides them with a stable and secure framework for their study. These students find that precisely these features are assets for STEM as a field of study. These are students who cope with the unstableness and insecurities in the required identity formation and self-government by adopting existing frames that limit the openness. From this perspective, these students manage to construct an identity by complying with existing frames and expectancies. They do not to the same extent as the non-choosers consider the late-modern identity work to be something that should be displayed as independent and authentic choices.

It should be emphasised that the difference between choosers and non-choosers is not a difference between autonomous and confident non-choosers on one side, and dependent and immature choosers on the other. It is a difference between two different ways of coping with the pressure of constructing an identity and different ways of interpreting what counts as legitimate ways of handling this construction; or, as Rose (1998) phrased it, of being entrepreneurs of oneself.

Hence, our study not only supports the findings and recommendations of previous studies of students' attitudes to and choice of STEM study programmes. It further emphasises that the importance of interests, identity construction, and career perspectives should be considered in the larger perspective of being an entrepreneur of oneself and of managing oneself. This is in accordance with a broader tendency within higher education, where, as Wisdom puts it:

'We are seeing a significant shift in ownership – from us to the students. There are many educational benefits when students are able to take a greater role in the crafting of their own education.' (Wisdom, 2011)

Wisdom's statement suggests that in higher education it is not only STEM that faces challenges in the organisation of teaching and learning. This is partly due to the fact that the changes pointed out by the late-modern approach and by the approach of Foucault and governmentality that we have used in the present study, are endemic to society and not just to STEM or higher education.

We consider these two points – that governmentality requires the students to be able to not only find interest, but also to exhibit self-management, and that, as a consequence, the changes of the curriculum should include both content and form – to be the first contributions of this study. Another contribution has to do with the relation between the students' expectations and what the first-year students meet when entering the programmes.

When students' meaning making is studied it is often questioned how and to what extent the students' perception and meanings may inform science education at all (Jenkins & Nelson, 2005) because of the gap there might be between the students' accounts and how it really is. In other words: The claim is that the upper secondary school students may expect higher education STEM to be rigid, fixed and stable, but in reality it is different. Therefore, we have compared the considerations of choosers before they finally chose to study STEM with their experiences as first-year STEM students.

When the students begin at first year at higher education STEM programmes, our analysis shows that they struggle to make sense of what they meet (not only the content, but also the form) in relation to what they expected their programme to be like. This is not least the case for the students who chose STEM because they either expected it to relate to their everyday lives or to engage in the process of science and developing new knowledge. The focus of our analysis in this article was not to analyse first-year students' experiences as such, but to compare the expectations of choosers with their experiences at first year. What we find is that the experiences of the first-year STEM students to a large extent in fact are quite similar to how the non-choosers expected them to be. Most of the students experience a

curriculum that in form and content is as fixed and rigid as non-choosers expected. This is the second important contribution of this study: Students do not refrain from choosing STEM on false grounds. Their notions of STEM as a fairly rigid study with little room for self-development apparently are quite accurate. Therefore, it seems relevant to ask whether STEM is ready for larger numbers of students to apply if those numbers include students with expectations of a learning environment that supports their identity-work of constructing attractive identities.

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6. PAPER III: WHAT DO WE KNOW ABOUT OPT OUT IN STM HIGHER EDUCATION?

Routledge
Taylor & Francis Group

What do we know about explanations for drop out/opt out among young people from STM higher education programmes?

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In this paper we provide an overview of the literature on understandings of drop out/opt out from science, technology and mathematics (STM) higher education programmes. After outlining the literature on students leaving higher education programmes in general, we then explore the research on drop out/opt out from STM programmes in particular, with an emphasis on research since 2000. We show that most of the research focuses on overcoming deficits in students' prior knowledge, but that a more specific focus on identities as an analytical framework for understanding young people leaving STM higher education programmes is also emerging. We show that it is important to shift from considering drop out as an individual problem for the student to regard it as a feature of the relationship between students and their study programmes. In the same way, measures to increase retention rates must shift from focusing on individual student adaptation to studies addressing institutional change. However, this change is difficult since it is entwined with fundamental conceptions of science and teaching.

Keywords: retention; STM higher education; drop out; academic and social integration; identity; individual adaptation; institutional change

Introduction

According to statistics from the Organisation for Economic Co-operation and Development (OECD), one-third of higher education students drop out of their studies before they complete their first degree (averaged across all OECD countries and all subjects), regardless of whether they are following university level education (tertiary-type A programmes) or vocationally oriented tertiary education (tertiary-type B programmes) (OECD 2009, p. 69ff). However, this average hides variations between countries with some countries showing a survival rate of less than 60% (e.g. Italy, Sweden) and others more than 80% (namely Belgium (Flemish Community), Denmark and Japan). These numbers are for 2007 and refer to the estimated percentage of the age cohort that will complete tertiary-type A/B education (OECD, 2009, p. 72). The report also states that these educational systems have expanded significantly, with nearly twice as many people graduating from university in 2007 than in the mid 1990s.

The term 'drop out' is commonly used to describe those students leaving their study before they pass the final examination. The loss of students from science, technology and mathematics (STM) studies to other careers has been described as a 'leaky pipeline'. However, as pointed out by Hovdhaugen (2009), different designations are

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used within distinct research settings: 'In the USA, the phenomenon is described as "dropout" or "student departure" while British researchers usually use the concept "non-completion" or "non-continuing students"' (Hovdhaugen, 2009, p. 2). These different expressions reflect whether we interpret students leaving an educational programme as a push or a pull effect and for whom it is a problem.

Another issue discussed by Hovdhaugen (2009) is that even if a high percentage of university students leave their initial institution before degree completion, the majority of these leavers transfer to another higher education institution, resulting in a smaller percentage of the students leaving higher education without completing a degree at all. Reflecting this distinction within non-completion rates, Tinto suggests identification of 'institutional departures' (students transferring from one higher education institution to another), and 'system departures' (students leaving the higher education system altogether) (Tinto, 1993, p. 36).

That almost a third of students do not complete their degrees must be considered a challenge and a problem for students, higher education institutions and society as a whole. Drop out in relation to STM studies presents a particular reason for concern. Since there seems to be a general agreement in the Western countries that there is a need for an increasing number of graduates in this field, some attention has been given to raise the recruitment of students (OECD, 2008). However, according to the OECD study 'in many countries, S&T [Science and Technology] are among the disciplines where the dropout rates are the highest', with science suffering more than technology (OECD, 2008, p. 74). A study of non-completion in Germany found that of the students entering the sciences in 1999–2001, 28% did not complete their studies, with some differences between the disciplines. Physics and earth science, computer science (in German: *Informatik*), mathematics and chemistry lost from 31% to 36% of students, while pharmacy, biology and geography lost only from 6% to 15% of students. Engineering had a non-completion rate of 25%, ranging from 16 to 34% depending on the discipline (Heublein, Schmelzer, & Sommer, 2008, p. 10f). Even if students of the humanities drop out at a similar rate (27%), losing almost 30%, and for some studies more, of those following STM courses, is a major concern. Students not completing their studies is therefore both of interest to the educational system in general and to the field of STM in particular.

In this paper[1], we address how research has tried to explain and understand the issues related to students leaving higher education programmes with a specific focus on STM programmes. Some of the research deals with retention and non-completion in general while other research focuses specifically on the STM field. By combining both research on higher education in general and STM in particular, we seek to extend and combine knowledge beyond the existing literature. To address this, the paper is organised as follows. First, we provide a short description of the procedures followed in the literature review. Second, we outline how the literature has examined drop out/opt out in higher education in general. The third and main part of the paper addresses these issues within an STM context. Here, we present an introduction and overview of the concept of 'identity' as a way forward in researching these matters. Finally, we discuss the implications of this review, and particularly the differences between considering drop out/opt out as either a question of individual adaptation or institutional change.

The aim of the review is to explore whether research on retention and non-completion in higher education, and in STM programmes in particular, has produced findings that can identify a direction forward for HE institutions and programmes to take

measures to reduce the number of students leaving their chosen HE programme. As a part of this discussion, we seek to point out issues and themes that call for further research and development. The review therefore will be of interest to teachers, planners and researchers of STM programmes in higher education.

Methods

The first section of the review deals with the general trends within higher education. This section takes as its point of departure the works of Pascarella and Terenzini (2005) and of Harvey, Drew, and Smith (2006). These two works provide extensive presentations of mainly US and UK based research respectively on persistence and non-completion in general, not focusing on the field of STM in particular. A seminal contribution, particularly in the US context, but also influencing European studies, is the work of Tinto (1975, 1988, 1993), and therefore this work is given some attention.

The second section of the review focuses on STM education in particular. The starting point for this part of the review is Seymour and Hewitt's book *Talking about leaving* published in 1997. To supplement this work, the rest of this section follows from a literature search using the ERIC (Education Resources Information Centre, http://www.eric.ed.gov/) database. Here the search words: science education and higher education are combined with the following words: retention, dropout, opt-out, persistence, student success, attrition, leaving and non-completion within the timeframe of 2000–2009.

Leaving higher education

In this section, we take as our starting point two extensive reviews, one emphasising US studies (Pascarella & Terenzini, 2005) and the other with a stronger focus on UK research (Harvey et al., 2006).

Examining the US-based research on retention and non-completion reveals a strong emphasis on quantitative studies. Most of the research reported is characterised by correlation and factor analyses on large samples of students. A smaller number of studies explore the qualitative aspects of students' experiences and non-completion. An important factor regarding non-completion appears to be the parents' educational background. Pascarella and Terenzini present a number of studies that confirm that students whose parents have earned a bachelor degree are more likely to pursue and complete a bachelor degree than first-generation students, commenting that for first-generation students 'going to college can be a difficult choice and experience, threatening to both them and their parents' (2005, p. 434). Whether one's parents have a degree or not turns out to have a stronger influence than factors such as race-ethnicity, family income, college qualifications or other factors associated with educational attainment (Pascarella & Terenzini, 2005, p. 435).

However, the effect of different factors seems to vary over time as suggested by Ishitani (2003) and DesJardins and Moye (2000). Both these studies use the event-history approach pointing out that the risks of leaving college vary over time. For instance the risk of first-generation students leaving college is higher in the first year than in the fourth year (Ishitani, 2003). Thus, measures that might be taken to diminish risks should take these timing effects into consideration.

DesJardins and Moye (2000) find an increased risk of not graduating associated with membership of an ethnic minority group, but this effect becomes less strong

when financial aid and grade point average (GPA) are controlled for. Considering the impact of financial aid, they find that, in general, loans enhance graduation probability, but this relation becomes less pronounced as time passes. Conversely, work/study initially inhibits timely graduation, but around year 6 this reverses (DesJardins & Moye, 2000, p. 16). Tinto remarks that if properly organised and within limits, work-study programmes can enhance the chances of persistence because they not only improve the financial situation of the student, but also help the student to establish contact with other members of the institution. On the other hand, there is a risk that the work will isolate the student from life at the institution or take up too much time (1993, p. 179f).

In a large scale event history analysis based on national statistics, DesJardins and Moye find that males are more at risk of not completing than females (2000, p. 18). The review by Harvey et al. (2006) reaches the same conclusion, while Ishitani, analysing survey data of 1747 students in a Midwest four-year university, concludes the opposite, but only significantly for academic years 3 and 4 (2003, p. 444). Mastekaasa and Smeby (2008) find no clear pattern in the dropout rates for male and female students in the research they have reviewed in their work. It is highly probable that these apparently contradictory findings related to gender and retention reflect the diversity of the academic field and to the complexity in how student background (as, for instance, gender, ethnicity and socio-economic status) interacts with different environments and cultures. As we will explore further in the section on identity later in this paper, the different student characteristics intersect, and rather than being either 'male' or 'female', students negotiate and interpret what these labels mean, just like the kinds of study practices and interests they leave room for varies across the academic field. Different disciplinary and institutional cultures are more or less inclusive to different ways of being a student, which could explain the ambiguous evidence on the matter. Distinctions of this nature are difficult to grasp in large scale primarily quantitative studies that go across different disciplines.

Tinto's model of student leaving

A substantial part of the studies reviewed by Pascarella and Terenzini (2005) are strongly influenced by the work of Vincent Tinto (1975, 1988, 1993). This work has achieved an almost paradigmatic stature (Braxton, Milem, & Sullivan, 2000). Tinto's model (1975, 1988, 1993, 1998) emphasises that students leaving university should be regarded as a process. Students enter with a set of pre-entry attributes, and these attributes produce a set of goals and commitments that the students bring with them as they enter university and engage in the social and academic environment at that institution.

Tinto criticises psychological approaches to understanding students leaving college because they tend to focus on traits of the individual, thereby making student success dependant on 'the ability or willingness of the individual' and 'more important, such models invariably see student departure as reflecting some shortcoming and/or weakness in the individual', and thus as the result of personal failure (1993, p. 85). Instead, Tinto emphasises a more sociological approach focusing on the level of the institution. Though previous sociological approaches to the study of retention provide relevant insights, Tinto claims that they tend to leave the actual interaction between students and institutions almost untouched (ibid., p. 86ff). It is precisely this level – the students' interaction with the institution and how this influences student

persistence – that is his primary interest. The student's involvement leads to some degree of social and academic integration that again produces a set of goals and commitments that lead to a decision to depart from or stay at university. In the 1993-version of the model, the process at university is 'nested in an external environment comprised of external communities with their own set of values and behavioural requirements' (ibid., p. 115). Thus the university is a social system that works within a set of other social systems, and the students are simultaneously engaged in more systems.

In the development of the model, Tinto takes inspiration from two sources. The first is a socio-anthropological theory of rites of passage by Van Gennep that describes the transition from one culture to another as a process of leaving one and becoming integrated in another culture. This transition has three stages: separation, transition and integration. The second is Durkheim's theory of suicide where suicide *inter alia* is understood in relation to the (lack of) social and intellectual integration in society. Tinto compares these elements of passages and integration to an academic and social integration at college (Tinto, 1993). The academic integration primarily refers to those parts of university life that are related to the formal education and to the student learning in the study programmes. This mainly takes place in classrooms, lecture halls and study groups. The social integration refers to the student's interaction in informal parts of university life such as unions, cultural gatherings and informal contact with teachers outside of the classroom.

Comparing the 1975 version of the model with the one from 1993, the student's interaction with staff/faculty has moved from the social system to the academic system, acknowledging that academic integration is not simply about performing well, but is also a matter of interacting with teachers. However, the academic and the social system of the college are regarded as two distinct, but *'invariably interwoven'* systems (1993, p. 109).

Importantly, Tinto also makes the point that the university consists of more than one culture – that there are subcultures, and that students may become integrated in one of these, but not in the dominant culture (ibid., p. 105). These two points, namely, firstly, that the social and the academic systems are interwoven, and therefore influence each other, and secondly, that universities consist of more than one culture, brings Tinto to emphasise educational communities in the classrooms as an important arena for the integration of students at university. This is certainly important for non-residential students where the social integration to a large extent has to occur during class or in relation to class activities (ibid., p. 206, and Tinto, 1997, 1998). In his concluding remarks he states that an institution's capacity to retain students:

> …hinges on the establishment of a healthy, caring educational environment which enables all individuals, not just some, to find a niche in one or more of the many social and intellectual communities of the institution. This view of the effect of institutions upon student leaving highlights the intricate web of reciprocal relationships which binds students to the communal life of the institution. Rather than single out any one action or set of actions as being the primary cause of student departure, it argues that student leaving is affected by most institutional actions regardless of their immediate referent. (Tinto, 1993, p. 204f.)

Tinto's model has several virtues. One is that it regards student leaving as a longitudinal process that involves more than one factor. Another is that it includes both the social and the academic aspect of students' integration.

Evidently, holding an almost paradigmatic position does not mean that Tinto's model of student leaving is uncontested or uncriticised. At one level, it has been questioned whether the claims of Tinto can be substantiated by empirical findings, and on another, it has been argued that Tinto's use of Van Gennep and Durkheim leads to a lack of sensitivity towards especially ethnic minority students' situation in higher education, as explored below.

In their review, Pascarella and Terenzini state that they can find 'moderate' support for the 15 claims they make out of Tinto's model (Pascarella & Terenzini, 2005, p. 425f and 443f). However, as noted by Pascarella and Terenzini, a review by Braxton, Sullivan, and Johnson (1997) reports only 'partial' support for some, and 'frail' support for others of the 15 claims. Based on this, the authors do not recommend abandoning, but revising the model (Braxton et al., 1997, p. 156). Still, the importance of being integrated into the university community is echoed in other findings in the US review.

This is certainly the case when Pascarella and Terenzini report that different programmatic interventions such as supplemental instruction and first-year seminars have an impact on student persistence (Pascarella & Terenzini, 2005, p. 398ff). However, they point out that the dynamics beneath this success are unclear, for instance whether the impact is direct (that is, that the skills developed etc. increases student persistence) or indirect (for instance earlier socialisation into the university culture and increased interaction with faculty, staff and peers) (ibid., 2005, p. 403). Likewise, they find that different experiential and inquiry-based learning approaches increase rates of persistence, not least due to the student–faculty contact and active learning involved (ibid., 2005, p. 406). Similar findings are reported by Braxton et al. (2000), who find that active learning activities have a positive influence on student persistence, and *inter alia* on social integration, and they make the point that 'faculty classroom behaviours play a role in the student departure process' (p. 581).

Another aspect is the importance of interaction with faculty members outside of the classroom. This has an impact due to the process of socialising the students to values and attitudes in the academy, and also due to students creating a stronger bond with the institution (Pascarella & Terenzini, 2005, p. 417); or as Tinto (1993) phrases it, their institutional commitment. This effect is to a large extent based on students' perception of faculty members' availability and concern for the students. Along similar lines is a meta-analysis of nine studies in STM courses that found a positive effect for the persistence of students who were involved in cooperative and collaborative learning activities (Pascarella & Terenzini, 2005, p. 423; cf. Braxton et al., 2000).

On a theoretical level, Tinto has been criticised for making general claims from a model that may only fit some groups of students (Pascarella & Terenzini, 2005, p. 56). Hurtado and Carter (1997), studying experiences of Latino students' sense of belonging at university, state that Tinto's model does not take the importance of racially tense environments at universities into account. According to Tierney (1999), Tinto's model implies that minority students, or students who in other ways differ from the dominant majority culture, should undergo a process of assimilation. Tierney argues that these implications of Tinto's work follow from the theoretical foundations of the model on Durkheim's study of suicide and Van Gennep's of initiation rites, implying that 'the success of the initiates – that is, the students – being dependent upon the degree to which they are able to integrate into the social and academic life of postsecondary institutions' (Tierney, 1999, p. 82).

Tierney argues that the use of Van Gennep is dubious as the theory relates to initiation rites *within* a culture, albeit at different stages, while minority students entering universities in effect are entering a culture that is different from their own. Likewise, the application of Durkheim's theory of suicide implies a cruel fate for minority students who, as Tierney puts it, must commit 'a form of cultural suicide' (1999, p. 82). Therefore, the consequence of the model is that minority students must discard aspects of their cultural background in order to succeed at university. Tierney argues that this contradicts experiences from his own research with students of colour, which conversely indicates that precisely the inclusion of the family and the neighbourhood of the minority students has been shown to increase students' sense of belonging at university, and in that sense the social and academic integration.

Hurtado and Carter similarly found that for Latino students at predominantly white universities it had a positive impact on their feeling at home at the university to maintain interactions both inside and outside campus (1997, p. 338), as did participation in some culturally related activities such as association with social-community organisations and religious organisations (ibid., p. 335). For these students it is not simply a question of being integrated or not, but rather preserving a relation to multiple peer-groups and cultural environments.

Undoubtedly, there is a risk of the notion of social and academic integration to be interpreted simply as assimilation, and that measures taken by the institutions to prevent non-continuation could overemphasise that students should conform to the dominant culture. The research reported by Tierney and by Hurtago and Carter indicates that this could be detrimental to the persistence of minority students. Therefore, it is critically important to be aware of whether support activities and structures at universities acknowledge these differences or not.

On the other hand, the question is whether this in effect is an integrated part of Tinto's model. In our view, this partly depends on whether the model is read as a normative or an analytical statement. In the 1993 version of the model, Tinto identifies some limitations in using the analogies of the initiation rites and of egotistical suicide on entering university (1993, p. 104ff). Likewise, he emphasises that 'the great majority of colleges are made up of several, if not many, communities or "subcultures," each with its own characteristic set of values and norms' (ibid., p. 105) and that for some students 'events external to the college play an important role in community membership' (ibid.). More importantly, what permeates the model is that attending university is a process of socialisation, and as such it is to be regarded as an interactional process between what the students bring with them and the culture they meet. Furthermore, this socialisation does not limit itself to academic features, but affects the tastes and practices of students in a broader context (Huber, 1991). Similar observations are made by Becher (1989, cf. Becher & Trowler, 2001) who – even if his study concerned research communities and not specifically student communities – points at the different cultures (or tribes as he calls them) that exist within academia, and which students need to gain access to (cf. Gerholm, 1990). For students at bachelor level, Hasse (2002), in her study of first-year physics students at a research intensive university, highlighted that becoming a physics student is more than merely learning the content knowledge; it is a matter of acquiring the right poise, or 'sprezzatura' as she calls it with reference to Italian courts. Conceiving studying as a process of socialisation also partly explains the previously mentioned importance of interaction with faculty members outside classroom. Such an interaction has an impact due to the process of socialising the students to values and attitudes in the academy.

Tierney (1999, p. 83) suggests the transition to university can be analysed and comprehended using the work of French sociologist Pierre Bourdieu and his concepts of capital and habitus (Bourdieu, 1984, 1986). Bourdieu argues that we bring with us a set of dispositions when we engage in social interactions, and these dispositions guide how we interpret and make sense of what we experience:

> The habitus is necessity internalized and converted into a disposition that generates meaningful practices and meaning-giving perceptions; it is a general, transposable disposition which carries out a systematic, universal application – beyond the limits of what has been directly learnt – of the necessity inherent in the learning conditions. (Bourdieu, 1984, p. 170)

Our habitus provides us with ways to make sense of what we encounter, to interpret it, and it provides a way to act in the social fields that we are part of, a practical sense. Since the habitus is formed by conditions of living, it has both an individual and a collective dimension. It is particular to the individual, but collective because it relates to material conditions and practices that are shared by other members of a social class.

When students enter university, they possess an amount of different types of capital to invest in the struggle to find a position in the social field she or he is entering. Two of these forms of capital are labelled 'the social' and 'the cultural'. The social capital refers to for instance networks and relations, while the cultural capital can exist in three forms, namely 'in the embodied state, i.e., in the form of long-lasting dispositions of the mind and body; in the objectified state, in the form of cultural goods […] and in the institutionalized state', which not least refer to the formalised educational qualifications (Bourdieu, 1986, p. 243). The embodied capital is 'converted into an integral part of the person, into a habitus' (ibid., p. 245).

A particular habitus can be more or less appropriate for engaging in the social practice of different fields depending on what counts as valuable in the given field. Similarly, some compositions of social and cultural capital are more profitable for establishing and maintaining a position in the educational field of university. Students entering higher education from a background that is socially and culturally remote to the academic field will therefore be more likely to have a habitus that makes it more difficult for them to understand how to play the game in the academic field, and to take part in this game. Presumably, the process of social and academic integration will be more laborious and challenging for students with non-academic backgrounds than for students whose parents hold a degree.

From the perspective of Bourdieu, it could be questioned whether Tinto entirely acknowledges the complexity of the process of transition and integration that minority students face when they try to find their way through the first years of college with cultural and social capital of limited value in the university field. Further, it could be questioned whether he fully acknowledges the resources present in the cultural (as posited by Tierney) and social (as pointed out by Hurtado and Carter) capital students possess – that these possessions could be transformed into resources that students could invest to increase the probability of persistence.

It may be true, that the model of Tinto – at least in the way it has been received – too strongly emphasises the integration into the dominant culture, where the capital students bring with them has little value. However, from the perspective of Bourdieu, we would argue that Tierney and Hurtado and Carter underestimate the significance

of the power dimension and the struggle for positions in the field of academia (cf. Bourdieu, 1990).

It appears convincing that facilitating subcultures at university that could provide a sense of belonging for students who do not feel related to the dominant social and academic culture at the institution, or whose academic aspirations do not necessarily concur with the dominant academic orientations and paths, could increase the persistence of these students. In that sense, not conforming with the dominant culture apparently is a viable way for non-traditional students to survive at university. However, even if the institutions involve themselves in facilitating religious or cultural organisations and institutions at campus, the stance of the institution would still be ambiguous. In his study of the academic field, Bourdieu remarks that the habitus of those holding the dominant positions in the field serve to select those who are to be included and exclude others:

> What may appear as a sort of collective defence organized by the professorial body is nothing more than the aggregated result of thousands of independent but orchestrated strategies of reproduction, thousands of acts which contribute effectively to the preservation of that body because they are the product of the sort of social conservation instinct that is the *habitus* of the members of a dominant group. (Bourdieu, 1990, p. 150)

The socialisation of new students at bachelor or PhD level therefore is not simply to ensure the academic qualification of the newcomers, but rather to make certain that the new members comply with the existing dominant culture. Therefore, when Tierney states that 'educational organizations must also accommodate for and honor students' cultural differences' (1999, p. 83), this may be true if those organisations have an interest in increasing student completion; but from the perspective of the organisations' struggle for position in the academic field, this is not necessarily the case. The interests of the universities are in these cases – from a Bourdieu perspective – at least ambiguous.

This also has significance for some of the measures that have been taken to ease the way for minority students at universities. As indicated by both Tierney and Hurtado and Carter, studies of minority students suggest that for those groups of students to succeed it may be a more viable path to establish subcultures that value the social and cultural capital of the minority. However, following the analysis of Bourdieu, this may well increase the probability of their completing their studies, but it is likely that it will also have the consequence that they are never fully integrated and accepted in the core of the academic community. This should not be an argument for giving up strategies like the ones suggested in Tierney's study, or for calling for a total assimilation in the white, dominant culture. On the other hand, it seriously questions the impact of targeted sub-cultural services and offers on students obtaining equal possibilities in the academy.

In our view Tinto provides an approach to student retention and leaving that focuses on student departure as a process involving students coming to terms with both academic and social aspects of university life. Consequently, integration becomes a pivotal concept. Furthermore, both Tinto's remarks on the multiple communities and subcultures at university, and the critical comments, from amongst others Tierney and Hurtado and Carter, emphasise that the process of integration is a complex one in which the differences in students' background, the composition of capital, the universities' level of inclusiveness and the position in the academic field all influence the students' expectations of success.

The importance of teaching and learning activities

In their review, Pascarella and Terenzini make a strong case that teaching–learning activities involving more student–staff interaction have a positive effect on student retention. Similar points are made in UK research on retention and students' first-year experiences as presented in a review by Harvey et al. (2006). Their review focuses on the first-year experience, but since the literature on withdrawal and retention of first-year students is significant (2006, p. 31), their review provides a valuable introduction to the mainly UK-based research. They note that the majority of the studies they have reviewed are based on single institutions and often with small samples. The research is dominated by quantitative studies although qualitative approaches are becoming more common (ibid., p. 14). They also comment that the US research in the field is highly influenced by Tinto's model of student leaving, and the issue of social and academic integration (ibid., 2006, p. 31), while research in the UK has focussed more on preparedness (including choice of study, expectations and being motivated) and student satisfaction (ibid., p. 37).

Harvey et al. remark that the literature presents an array of different explanations for retention or non-completion 'but none is sufficient and there is no simple socio-logical or psychological model of retention' (ibid., p. 33). Based on both a review of existing research, mainly from the UK, and their own rather large empirical studies, Yorke and Longden (2004) summarise four main categories of reasons for students leaving their study programmes:

- flawed decision-making about entering the programme;
- students' experience of the programme and the institution generally;
- failure to cope with the demands of the programme; and
- events that impact on students' lives outside the institution. (Yorke & Longden, 2004, p. 104)

The first point is supported by Ozga and Sukhnandan (1998) who conducted a quali-tative study at a single UK campus university in the mid-1990s comprising of inter-views with 20 withdrawers and eight students who completed their courses but who had seriously considered leaving. Ozga and Sukhnandan note that students tend to have a rather poor and frequently stereotypical and outdated knowledge of what attending university means, what kind of effort is required etc. (1998, p. 321). This seems to be the case both for those students who leave and those who stay, but those who stay have made a more pro-active choice of the course and of attending univer-sity, while non-completers entered because of expectations from family, peers or others, or because it seemed like the natural thing to do. This does not mean that students whose parents have a bachelor degree necessarily are worse off than first-generation students. It may be that the family pressure or the lack of reflection can be more pronounced in some of the families where the parents have attended higher education, but what the finding of Ozga and Sukhnandan does point out is that even if the socio-economic background of the students ought to put them in a better position to complete a degree, this is still uncertain if the choice is made without any signifi-cant intrinsic interest or educational commitment.

The importance of the socio-economic conditions is suggested by another of Ozga and Sukhnandan's (1998) findings, namely that the reasons for non-completion differ between mature students and what they call conventional students. Conven-tional students are mainly influenced by their preparedness and the compatibility of

choice, while mature students are more influenced by external factors, such as family obligations.

It is a general and important point made by Yorke and Longden (2004), and shared by Harvey et al. (2006), that rather than focusing on retention, institutions (and others) should focus on what could be done to enhance student success, hence taking a student-interest focus rather than applying an institutional-interest focus. As they put it: 'A policy focus on student success in higher education through teaching, learning and assessment, and through institutional support services, is likely to lead to better retention than a focus on retention itself.' (Yorke & Longden, 2004, p. 132).

The point is not only that focusing on teaching, learning and assessment addresses the second and third of the four bullet points above, but also that students' performances in the first year are highly influential on their persistence. Pascarella and Terenzini claim that 'college grades may well be the single best predictors of students persistence, degree completion, and graduate school enrolment' (2005, p. 396), and measures taken to improve student performance therefore are likely to improve persistence as well. What is more, attention to students' experiences in teaching and learning could also affect their notion of being integrated in (one of) the university culture(s).

Main points from this review of general studies of retention and non-completion

Research into retention and non-completion draws attention to the teaching and learning activities; to the students' experiences of success and of being able to cope with the requirements; and not least to the interaction with teachers and teaching methods that support the social and academic integration. The students' socio-economic background is definitely of importance, but not only due to the difficulties in meeting the economic demands of attending university. Also the culture (or *habitus*) of the students plays a pivotal role for students' social and academic integration.

Therefore, some of the findings point at factors that cross disciplinary boundaries and particularities of specific fields or disciplines like STM. On the other hand, the findings also suggest that there may be differences across disciplinary fields simply because the socialisation and the culture play such vital roles. In this perspective the research on retention in general not least underlines that close attention should be paid to both the academic culture of STM programmes and to the teaching and learning activities the students are presented with, especially during the first year of study.

Leaving STM higher education courses
Results from the 1990s: Seymour and Hewitt

> Switching is not defined as a problem when it is believed to be caused, on the one hand, by wrong choices, under preparation, lack of sufficient interest, ability or hard work, or on the other, by the discovery of a passion for another discipline. (Seymour & Hewitt, 1997, pp. 391–392)

As stated in this citation, it is necessary to establish an acceptance of a problem in order to address it. This is also true for the issue of students leaving the STM educational programmes. As discussed in Seymour (2002), the early days of research within this field were dominated by the above views of the situation, namely that it was the

students who were the problem. However, in their analysis of 335 STM students at seven different types of institutions in a four-year ethnographic study in the US, Seymour and Hewitt (1997) found that there was no evidence for those beliefs. On the contrary, their study showed that the most common reasons for students to switch higher education programme arose in response to a set of common problems experienced by both switchers and non-switchers. They did not, as Seymour puts it in a later article, 'find switchers and non-switchers to be two different kinds of people: they did not differ by performance, motivation or study-related behaviour to any degree that was sufficient to explain why one group left, and the other group stayed' (Seymour 2002, p. 82).

One difference they did find between switchers and non-switchers was that the intrinsic interest related to the major they had chosen and to the nature of the academic work was stronger among the non-switchers. Both groups were influenced by other factors as well, for instance the influence of others, but Seymour and Hewitt conclude that these other reasons seemed to be of less importance 'so long as one strong element in their decision is an intrinsic interest in the academic disciplines which comprise the major and in the kinds of work to which they lead' (1997, p. 78) (cf. the findings of Ozga and Sukhnandan (1998) mentioned above).

On the whole Seymour and Hewitt found more similarities than differences between the switchers and the non-switchers. There is a high level of agreement across the whole student sample about the issues that lead to defection by switchers and to dissatisfaction among non-switchers, and there are strong similarities in the importance members of each group ascribe to each set of concerns. They further found that:

> The decision to leave an SME major was always the culmination of a dialogue with self and others over time, in which students were drawn back and forth between the options that seemed open to them. Typically, the process began with poor experiences in SME classes in their first year and, for some, the discovery of under-preparation. It was deepened by a series of academic crises and disappointments that provoked anger towards a particular faculty, advisors or teaching assistants. Students began to experience self-doubt and lowered confidence in their ability to do science. They became disillusioned with science and the science-based careers to which they had aspired, and questioned whether getting the degree would be worth the effort and distress involved. Only then did they begin to consider a switch to those non-SME classes where they had experienced better teaching and/or more satisfaction with their academic work. Potential switchers discussed these experiences with others, and, even at a late stage, some who came very close to switching decided to stay. The process of moving back and forth between thoughts of leaving and staying lasted from a few months to over two years. (Seymour & Hewitt, 1997, p. 393)

Based on their findings, Seymour and Hewitt (1997) state that the problems which arise from the structure of the educational experience and the culture of the discipline (as reflected in the attitudes and practices of STM faculty) make a much greater contribution to STM attrition than the individual inadequacies of students or the appeal of other majors.

All the students in the study had a mathematics SAT (Scholastic Assessment Test) score of 650 or higher, in order to include only students whom could be expected to be able to handle the course work (1997, p. 25). SAT is a standardised test for college admission that *inter alia* tests the mathematical skills of the future students. The test is widely used in the US. Furthermore, even though some switchers reported that they felt inadequately prepared from high school, this was also the case for a similar

proportion of non-switchers, and it was ranked quite low among the different factors reported to influence switching (ibid., p. 36). In effect, the institutions lose at least two groups of students whom the STM faculty might actually prefer to retain, namely the 'more pulled than pushed' and 'the more pushed than pulled'.

The first group of students includes very able, often multi-talented, students who have a strong interest in science and mathematics and who would have stayed had the teaching been more stimulating and the curricula more imaginative. The second group of students includes those who felt they had the ability to complete an STM degree, were adequately prepared, and entered their STM major largely on the basis of interest. They became discouraged by poor teaching and aspects of the so-called 'weed-out process' (an idea and tradition that students should be sorted in order to keep the better and dismiss the less-able students, for instance through high pace in the teaching; we discuss this further below). Although these students would prefer to stay in the sciences, they move into majors which they regard as a poor compromise. Here many women and students of colour are found. They felt their choice of an STM major had been appropriate and that they could have completed it, given some support and a less 'cut-throat atmosphere' (ibid., p. 393).

In other words there seems to be an agreement between Seymour and Hewitt's study of STM students and the more general research on retention and non-completion of students in focusing less on the students' prior knowledge or preparedness, and more on the teaching and learning experiences the students are presented with once they have entered the programmes.

This point, as well the fact that switchers and non-switchers to a large extent experience the same kinds of problem, result in Seymour and Hewitt using the metaphor of an 'iceberg' to represent the experiences of the students: 'Those who switch represent only the tip of a much larger problem' (ibid., p. 31). The differences between the students are not that one group is more or less willing to face the 'hardness' of the study, or are more or less talented or well prepared; as mentioned above all students were high achievers in the SAT tests. The difference between the group of students who stay and those who leave is much more complex.

What Seymour and Hewitt point out is that the metaphor of 'weeding out' implies an incorrect notion of selecting the able and getting rid of those not fit for studying STM. What is more, the idea of 'weeding out', which they claim is a long-established tradition, and holds 'a semi-legitimate, legendary status' (ibid., p. 122) is detrimental for the STM studies for at least three reasons. The first is, as just mentioned, that it does not select the talented and exclude the non-talented. There are no significant differences in the level of performance between those who are excluded through the weeding out process, and those who are not. Secondly, students experienced the system as counter productive, because it eventually caused students to focus on memorisation rather than comprehension. Thirdly, it promotes a student behaviour that, *inter alia*, discourages any collaboration between students that could have improved the learning experiences (ibid., p. 130f).

It seems that the STM programmes lose students with interest and abilities within the field because the pedagogical approach and the study environment are unattractive, and that the learning experiences of the students lead them to lose interest in science. These poor learning experiences to some extent are related to the traditions and ethos of the disciplines, as is the case with the 'weeding out', but also the generally low priority that students experience is given to teaching by science faculty: 'They strongly believed that the source of these problems [poor teaching] was that the

S.M.E. faculty do not like to teach, do not value teaching as a professional activity, and lack, therefore, any incentive to learn to teach effectively' (ibid., p. 146).

For the female science students, the poor learning experiences were also related to the notions about women and science. Female science students had experienced male faculty implying that women were not welcome in their classes, and male peers holding the view that high-achieving female students were considered unattractive. If the female students proved to be skilled in science they would be considered un-feminine and unattractive; if they did not, they would confirm the prejudice that women and science are incompatible. As Seymour and Hewitt put it, the women cannot win without losing (ibid., p. 262).

Leaving STM higher education courses: general research

There have been a large number of studies within the field of drop out/opt out since the publication of Seymour and Hewitt (1997). In her 2002 article Seymour paraphrases Einstein, and states that there is a growing recognition that: 'You cannot resolve a problem in the conditions that created it' (Seymour, 2002, p. 81). However, many of the studies still focus on retention as a matter of increasing students' skills before or during the first year of study and they aim at identifying factors associated with students' academic success (Ariadurai & Manohanthan, 2008; Bonous-Hammarth, 2000; Burnett, 2001; Dyer, Breja, & Wittler, 2002; Mills, Heyworth, Rosenwax, Carr, & Rosenberg, 2009; Yan, 2002). Only a few studies have focused on changing university cultures, including teaching practice. Yet, the field of research that addresses the issue of identity seems to have promising perspectives and as we will outline in the following, several studies have illuminated the significance of addressing the university culture when discussing retention.

Trying to understand the problem

Part of the literature focuses on understanding the problem of students not completing STM-education. Some studies are very context specific dealing with one specific programme and taking as the point of departure the students' experiences at this particular programme. This is the case with the study of Fozdar, Kumar, and Kannan (2006) that found nine factors of significance for students leaving the BSc programme offered by Indira Gandhi National Open University, India. A number of these factors are related to the physical distance between students' home and the university. This causes problems, both in attending classes and in getting to interact with other students. Other factors relate to the support system as being absent or insufficient. One factor related to difficulties with the examination paper.

Another study of this type is Sorensen (2000) who focused on student retention in relation to changes in curriculum policies, in a study of students identifying themselves as life-science majors or undeclared pre-meds (that is, students aiming at a medical career without having selected a field) at University of Austin, Texas. The study shows that no demographic data including gender and ethnicity were found to be predictive for students' success. On the contrary the study finds that the structure of curriculum and the sequence of courses were an important predictor. A similar conclusion is reached in a UK context by Porkony and Porkony at a first year undergraduate introductory statistics module. The study aims at identifying

factors that explain the variability of student performance, but the conclusion is that there are no simple predictors of students' success or failure (Porkony & Porkony, 2005). Other research reaches other conclusions. Research carried out at The University of Western Australia identifies factors to be associated with successful academic performance studying students in health science. Mills et al. (2009) identify a range of influential factors, but they find that the factor of most influence on first year students' academic success was matriculation score and the most influential factor on students' retention was first year marks.

Other studies change the point of view from focusing on students' skills and success to focusing on the institutional level. Daempfle suggests that student success and difficulties are related to incongruity between secondary school and post secondary faculty assumptions about what kind of scientific knowledge is important for first year biology students to be successful at college in North Eastern US (Daempfle, 2002). The conclusion shows that secondary faculty viewed as important that students could find the right answer to a question, to learn to look for important things in a book and that students could be successful without being analytical. The post secondary faculty on the contrary expected students to have a critical approach to science and realize that solutions are not always black and white. The study suggests a gap between secondary and post secondary faculty and that communication between faculties could be helped by paying attention to these epistemological differences and make students' transition to college easier.

Fenwick-Sehl, Fioroni, and Lovric (2009) discuss different efforts initiated by mathematical departments in Canada to increase the number of graduating mathematical students. The authors argue that the way mathematics and science are conceived by potential students and their parents discourages students from applying for these study programmes. But they also point out that some of the ways they found mathematics to be promoted were misleading (e.g. the images of careers in mathematics), and that the emergence of new fields of application in mathematics, such as biological sciences, pose a challenge to the discipline's self-conception. This is not least the case regarding 'applied mathematics', but in order to attract students precisely this should be addressed by the members of the discipline (Fenwick-Sehl et al., 2009).

Studies reporting on initiatives to increase students' skills

A large number of studies are based on the assumption that retention is linked to students' skills and especially their mathematical skills. These studies range from reports on diagnostic testing of students e.g. calculus competencies and development of summer schools to address this issue (Turner, 2008), redesigning the calculus sequence (Keynes, Olson, Shaw, & Wicklin, 1999), using specific tools like Python programming languages in introductory computer programming (Nikula, Sajaniemi, Tedre, & Wray, 2007) to more intensive programmes that combine content lectures, pre-examinations, learning styles assessments and informal sessions to provide the students with a preview of the requirements of biology and the pace of college (Wischusen & Wischusen, 2007) and finally developing a university-wide strategy for mathematics support (Croft, Harrison, & Robinson, 2009).

Another perspective in this group of studies is targeted at women, ethnic minority students and financially impoverished students and their lack of skills and

possibilities, e.g. the effect of financial aid. Research shows that financial aid actually improved minority groups' persistence and graduation rate but these students took a longer time graduating than non-STM minority students receiving similar financial support (Fenske, Porter, & DuBrock, 2000). St. John, Shouping, Simmons, Carter, and Weber (2004) examined the influence of college major field on persistence for white and African American students finding no differences for science and mathematics, but with African American sophomore students in engineering and computer sciences as well as in health and in business being more likely to persist. Other studies have used quantitative analysis to determine factors from high school physics preparation and affective factors to predict female and male performance in introductory university physics (Hazari, Tai, & Sadler, 2007) or the effect of creating a partial single gender environment in a mixed gender classroom during a third-year university software engineering course, where female students experienced improved learning opportunities (Cox & Fisher, 2008).

Studies reporting on other initiatives

Several studies report on projects aiming to ease students' integration into higher education, often focusing on introductory courses (Soh, Ashok, & Nugent, 2007) or the first-year at university (Estaville, Brown, & Caldwell, 2006; Jamelske, 2009). Fishman and Decandia (2006) report on a multi-faceted approach involving several components, e.g. an extensive transition and orientation programme offered prior to the first semester intended to prepare students to meet the challenges of college life (social activities to attain a sense of belonging and connectedness to the college programme and community; a series of success and learning skills workshops to provide students with specific strategies for academic and personal success; mock lectures to allow students to experience the classroom environment and obtain valuable classroom strategies from a learning strategist). Other elements included an on-line portal to allow students to develop their academic strategies and study skills, explore career options and enhance their communication and relationship skills, an early warning system to identify and assist students at risk, ongoing workshops, social activities and electronic communication to promote a sense of connection and support.

A small number of studies have focused on the role of the teacher. Ronco and Cahill (2004) discuss the effect of instructor type on student retention, achievement and satisfaction, and uncovered little evidence that instructor type has a widespread impact on student outcomes. A similar study describes a course for professional preparation of mathematics graduate students to prepare them to become effective teaching assistants (Harris, Froman, & Surles, 2009). They find that graduate students who took the course were viewed by their students as much more likely to welcome and encourage questions and comments, and as more likely to be available for out-of-class consultation and to present information beyond the text. The authors find that taking the course had increased the graduate students' confidence and comfort with related impact on their teaching practice.

The majority of the studies on retention of STM students conducted since Seymour and Hewitt published their work still have a strong emphasis on how to equip the students to meet the requirements of the programmes. The studies address a variety of issues including teaching methods and different compensatory measures (both financial and concerning disciplinary knowledge), some of them following the

points from the 1997 study of Seymour and Hewitt. Very few of the studies seem to address the point that switchers and non-switchers are very much alike.

Leaving the STM higher education courses: research on identity

The research presented in this section represents a different approach to the understanding of what may cause some students to leave their STM programme before graduation. The approach puts 'identity' at the heart of the question.

Identity is a concept which, though originally from the field of psychology, has spread to a range of other disciplines, e.g. anthropology, history, sociology, linguistics and feminist theories (Holland, Lachicotte Jr., Skinner, & Cain, 1998, fourth printing 2003; Wetherell, 2009). Research focusing on identities is rare in the field of science education, but in recent years it has become a subfield in the study of students staying at or leaving STM programmes, as well as being applied to the study of recruitment (e.g. Schreiner, 2006; Archer et al., 2010; Hsu & Roth, 2010).

Identity has been conceptualised from a number of different theoretical perspectives. These positions constitute a continuum from the idea of the individual as stable and coherent to the notion of identity as being multiple, flexible and continually re-negotiated. From the first perspective identity is perceived as an individual's psychological property which is considered to be separated from the social world. This position is mostly adopted by older theoretical positions in psychology, as the work by for instance Freud and Erikson; however, it is also a notion that can be traced in a generally Western understanding of identity (Holland et al., 2003). The second conception of identity is inspired by philosophers such as Foucault, Deleuze, and Lyotard (Stentoft & Valero, 2009; Wetherell, 2009) and adapted to psychology by post-structural and social-constructionist theories (Gergen, 1991; Butler, 1990; Davies, 2000).

Presently, most theories of identity position themselves somewhere along the continuum, understanding identity as being relationally formed and socially produced (Holland et al., 2003, p. 28). According to some identity theories, identity and actions are fully interwoven and therefore conceived as different facets of the same productive flow of social life. Other theories regard identity and action as separate entities, thereby implying that there is a distinction (or boundary) between the social and the psychological (Wetherell, 2009, p. 15). The idea of such a boundary allows for a historical dimension – a kind of historicity in the concept of the self (Wetherell, 2009). Briefly, the construction of identity is still considered as an on-going process, but in a way where the past experiences of the individual is involved in the practice, that is in the way the individual interprets, negotiates and acts in the situations.

Distinguishing between the psychological and the social should, however, not imply that the individual is positioned outside the social or the culture. We understand identity as always being embedded in culture. When entering university, newcomers have to figure out the social and cultural setting which they enter, and relate that to their identity. Accordingly, Hasse (2002), in her study of first-year physics students, suggests an understanding of culture as a learning process, and as related to a social practice. In a similar manner, we understand identity as a social practice, and we are interested in the process of identity-work young people go through when entering a new study programme. In that sense, we focus on how young people are trying to make sense in organising and structuring their experienced life into coherence and into narratives about themselves and their surroundings (Crossley, 2010; Sarbin, 1986; Taylor, 2009). At the same time we are interested in the way people's past experiences

influence their actions and ways of positioning themselves. Both these perspectives, that is, identity as an ongoing process, and identity as a product of past experiences, are found in narrative psychology:

> The narrative psychological approach comprises a useful tool which enables us to recapture the way in which selves and identities are grounded in "cultural" forms of language and sense-making whilst still maintaining a sense of the "internal", "coherent" and "personal" nature of self-experience. (Crossley, 2000, p. 533)

This coherent self is not to be confused with an inner, stable, unconscious self. Rather, is has to be understood as if the stories being told by a subject also enable and limit the possibilities for which stories are to be told in the future (Taylor, 2009). In this paper, we espouse a notion of identity similar to the one formulated by Holland et al.:

> We are interested in identities, the imaginings of self on worlds of action, as social products; indeed, we begin with the premise that identities are lived in and through activity and must be conceptualized as they develop in social practice. But we are also interested in identities as psychohistorical formations that develop over a person's lifetime, populating intimate terrain and motivation social life. (Holland et al., 2003, p. 5)

We posit that selves and identities are grounded in 'cultural' forms of language and that the way young people make sense is grounded in culturally recognised scripts in relation to social practices (Crossley, 2010). At the same time, identity has, to some extent, continuity, inertia and even stability. It is – so to speak – changeable without being volatile. We therefore see identity as an ongoing process embedded in cultural and social practices, but at the same time we focus on how identities develop over time as psychohistorical formations.

Based on the research findings we presented in the section on general research on retention, it appears meaningful to apply an approach to the understanding of drop out/opt out among young people from STM higher education programmes that is informed by a narrative psychological conception of identity. If entering a study programme is regarded as a process of socialisation, then identity is a core concept for understanding how students relate to the study experience and to the culture and environment they encounter. Since the integration into the culture of the discipline *inter alia* is brought about through the teaching and learning activities and the feedback from the teachers (Hasse, 2002), then the relation between these elements in the courses and the identities of the students is of interest. This is in line with the emphasis that both Seymour and Hewitt (1997) and Harvey et al. (2006) put on the students' study experiences – not least during the first year.

The importance of the identity issue manifests itself in the following quote from a cultural-historical and socio-cultural framework:

> As science educators we seem aligned with the view that those who study science education can learn and build identities that reflect an affiliation with science. It is also possible that, through the study of science, participants, might resist affiliation and reject what it stands for. Perhaps then it is about their choice. Throughout science education individuals get to choose whether to affiliate with science or not. (Tobin & Roth, 2007, p. 340)

In the quote from Tobin and Roth it may appear as if identity is something students actively and rationally change, reject, transform and choose. However, following the authors' socio-cultural and cultural-historical approach, this is not the case. Rather

than being rational in the sense of being the conclusion of a conscious process of the mind, it is rational in the sense that it is the meaningful action or practice that is available to the student, being embedded in a culture and bringing with him or her a history and experience of interpretations and practices.

In this section, we give special attention to studies carried out in the field of drop out/opt out that both implicitly and explicitly apply the perspective of identity to understanding students' leaving STM programmes. These studies focus on the effects of a study programme on his or her identity, and the impact identity has on the student's adaptation to the cultural settings of the programme.

Previous research on identity and student persistence in STM has to a large extent applied quantitative methods (see for instance White, Altschuld, & Lee, 2006; Schreuders, Mannon, & Rutherford, 2009; Wasburn & Miller, 2004–2005; Xu, 2008). In a review of studies on women in computer-related majors Singh, Allen, Scheckler, and Darlington (2007) find that the quantitative studies are primarily based on descriptive analyses, individualised measures, and implicit theoretical frameworks.

In their discussion, Singh et al. (2007) critique the treatment of 'women' as a homogenous group in many studies. They argue that in studies where 'female students' are claimed to be the research object, the differences within the group of female students are concealed, for instance differences across study programmes, social backgrounds, ethnicity etc. and they point to feminist theories as a place to look for approaches:

> To begin, the conceptualization of women must be elaborated from a unitary notion of woman to include how gender intersects with race, sexual orientation, nationality, and other ways in which lives are socially constructed and constrained. (Singh et al., 2007, p. 517)

From a feminist perspective the issue of identity is always entangled in a set of power relations where certain gendered identities are included while others are excluded. Likewise, Hasse (2002, p. 73) argues that labelling groups with a mutual identity tag (like 'women' or 'physics students') conceals differences between the individuals, and eventually how they become more or less included in the culture. However, frequently the data available do not allow quantitative studies to take full account of these differences and allow them only to draw up a relatively crude image of the situation.

The qualitative methods used in the research to understand identity issues vary from life history interviews with a small sample of students (Wood, 2002), focusing on already ongoing initiatives (Davis, 2001) to methods involving a range of qualitative methods (Carlone & Johnson, 2007). This research is primarily from a US context and mainly related to minority representation problems, in particular the lack of women or non-white students (or both) in STM programmes.

Identity, in-between subject and culture

In one of the examples of European research addressing identity within STM education, Stentoft and Valero state that:

> The notion of identity represents a way to move beyond the existing debate on whether mathematics learning is in essence individual or social. It can be seen as a notion which may assist researchers providing the missing link for grasping the dialectic relationship between the individual and the social dimensions of learning (Sfard and Prusak, 2005

> p. 15); and therefore it has been taken as a fruitful concept for providing more sophisti-
> cated interpretations of processes of mathematics education practices (Stentoft & Valero,
> 2009, p. 56)

Following Stentoft and Valero, applying a socio-cultural post-structural perspective
on identities is a way of building a bridge between looking at students leaving univer-
sity as being either an individual or an institutional problem. Also, it is a move away
from a dichotomised perception of the problem to a more dynamic understanding
where identity is considered a fragile and ongoing process embedded in the institu-
tional discourses and practices, closely related to the students' actions and participa-
tion. In this perspective identity is a process rather than a stable entity, where the
individual produces culture at the same time as being produced by culture. This notion
of identity is not widespread in research in science education, but there are some
examples of literature applying this approach.

   Based on a study of women of colour working on constructing a science identity,
Carlone and Johnson (2007) discuss identity as something closely connected to recog-
nition, using a socio-cultural framework:

> Identity is not just something an individual feels; it is not even what an individual does,
> although both feelings and actions are components of identity. A science identity is
> accessible when, as a result of an individual's competence and performance, she is
> recognized by meaningful others, people whose acceptance of her matters to her, as a
> science person. (Carlone & Johnson, 2007, p. 1192)

This strongly connects identity to cultural settings and to other individuals, meaning
that the students are not free to construct an identity on their own. They are dependent
on recognition from others, and to obtain this they have to make themselves recogn-
isable as legitimate 'science people'. This recognition has to be obtained in a context
that is derived from socio-historical discourses of science and what science is, and
from historical meanings and societal images of being a woman in science.

   Carlone and Johnson (2007) state that the practices of school science often
emphasise science as a finished body of knowledge. This, at the same time,
promotes students with very narrow science identities and excludes a broad range of
students from constructing a science-identity which is recognisable in the field of
science:

> Broadening students' participation in science requires close attention to the kinds of
> people we ask students to become as they participate in science activities, and to the
> ways girls, women, and students of colour embrace and resist these promoted science
> identities. (Carlone & Johnson, 2007, p. 1189f)

It follows from this that recognition tends to reproduce the existing culture, which in
many STM programmes means the hegemony of a culture of whites and males. Not
being a white male then means that one has to be able to negotiate and redefine culture
and identity in order to be recognised (Carlone & Johnson, 2007), or that non-whites
and non-males have to comply even more with other aspects of what counts as 'doing
science', for instance in choice of specialism or in how strictly one confines the science
practice to traditional methods or themes within the discipline (cf. Søndergaard (1996)
for a similar point within the social sciences).

   In reviewing other research about women of colour in engineering, Tate and Linn
(2005) outline the following as influencing their persistence:

- Women persist in STM fields when they feel welcome, have access to role models and mentors, and form bonds with other women in STM.
- Women persist when they encounter supportive interactions with technology.
- Women are more likely to persist in the computer science field when they can reject the fields' dominant culture.
- Self-confidence is a major factor in the persistence of underrepresented groups.
- Women and ethnic minority students pursuing STM majors deal with differences in ethnic cultural values and socialization, stereotypes, isolation, perceptions of racism and inadequate program support (2005, p. 483f).

In their study, Tate and Linn (2005) use a multiple identities framework that is grounded in situated cognition theory, with reference to Jean Lave and Etienne Wenger, and therefore they pay particular attention to the social relations and communities the students engage in. Rather than talking about 'student identity', Tate and Linn distinguish between three identities: social identity (the view of self in society or through society's eyes), academic identity (activities and success) and intellectual identity (desire to be an engineer and insight in the engineering field). They conclude that:

> The multiple identities framework also reveals the intersections of the identities. Students' social identity may affect their academic identity. For example, a student who feels uncomfortable in an engineering environment may experience difficulty in forming study groups helpful to their academic performance. (Tate & Linn, 2005, p. 491)

The work of Tate and Linn draws attention to the diverse contexts and communities students engage in, and consequently suggests that studies of students' experiences at university that only address one of these identities may provide a misleading image of the students' situation. Furthermore, their work emphasises how these multiple identities influence each other.

Other research taking up a more pronounced post-structuralist perspective emphasises that identity is so closely woven into the social and the cultural that they are inseparable. Hughes (2001), in a study of a group of students consisting of both males and females and of students of different ethnicity in a UK city school and post-16 city college, focuses on how identity is connected to recognition and to which positions are available in the construction of a science identity. She points out that different curricula and teaching methods make different potential identities available to students with gender or ethnicity different from that of the majority of students in STM. Consequently, she cautions against simply linking particular genders to particular sciences. Instead, she concludes that 'socially relevant and more constructivist science can generate a wide range of scientist subjectivities, increase the possibilities for scientist identities and thus open the way towards a more inclusive science curriculum' (Hughes, 2001, p. 288).

Malone and Barabino (2009) in their study also touch on the different positions made available to students, and the struggle of minority students to integrate a scientist identity with how they are recognised (and through that: positioned) by others. They consider this process of recognition to be carried out in every utterance and interaction, and for minority students it meant having to deal with being seen as 'the one' – that is, different from the others:

> Research and our own study suggest that laboratory and educational interactions can lead to and/or provide the conditions for forming an identity as researcher, professor, and

> scientist; yet many times we find that underrepresented minorities face identity impasses rather than opportunities to deepen and integrate identities within a university setting. These difficulties in identity integration are one facet of being the "only one," meaning that a person is "one" rather than brought into a community of practice where one is automatically part of "we". (Malone & Barabino, 2009, p. 505)

Malone and Barabino (2009) conclude that being included in STM is difficult if approaching the culture with a background other than white and male. Not being included in the academic community impedes integration at university and the construction of a science identity (Malone & Barabino, 2009).

As it is, applying identity as a theoretical perspective in understanding students' experiences and student persistence is primarily found in studies focusing on minority students, which in an STM context includes both ethnic minority students and women. However, if attending university, as we argued earlier in the paper, is a process of socialisation (cf. Tinto, 1998; Becher, 1989; Becher & Trowler, 2001), then it seems relevant to address the identity issue for majority students as well in trying to comprehend the question of persistence or opting out. This seems even more relevant considering the finding of Seymour and Hewitt (1997) mentioned earlier that the most common reasons causing students to switch programmes were rooted in experiences shared by both switchers and non-switchers. However, that these experiences were shared does not mean that they were identical. Both in relation to women and to students of an ethnic minority Seymour and Hewitt note that there are particular difficulties for students in those groups. In relation to gender:

> When women first enter S.M.E. classes, they encounter two kinds of experiences, both of which are new and uncomfortable. They share one of these – the weed-out system – with their male peers. They do not, however, assign the same meaning to the weed-out experience as the men and, therefore, do not respond to it in the same ways. […] The other new kind of experience for women arises as a consequence of entering a social system which has been traditionally all-male. This creates problems for women which men do not have to face. (Seymour & Hewitt, 1997, p. 255)

According to Seymour and Hewitt (1997), both women and ethnic minority students experience particular difficulties due to their socialisation being different than the dominant white, male culture, and due to their being positioned and recognised in particular ways owing to their gender or ethnic background. This point is in accordance with the studies addressing identity issues, e.g. by Hughes (2001) and Malone and Barabino (2009). It further suggests the importance, not of individual traits or characteristics, but the intersection of different characteristics and how they are recognised, interpreted and acted upon by both the individual and by others in the academic culture and community.

Curriculum culture

Accepting culture as an important issue for understanding retention not only refers to the study environment, but also to the culture in the curriculum and the discipline. As mentioned previously, Hughes (2009) discusses how science is frequently considered rigid, and thus a solution that has been proposed to favour girls would be a more 'feminine' science curriculum, that is, a contextual, cooperative and student-centred orientation of the curriculum. However, Hughes emphasises that this is a strong generalisation that does not reflect that fact that that not all men are

attracted by the 'masculine' sciences, and that some women favour the 'masculine' domains of science. Ascribing a particular gendered quality to particular areas or approaches in science also runs the risk of essentialising specific aspects of science, that rather are subject to change and negotiation. Likewise, it tends to over-generalise the preferences of women and men.

On the other hand, even if gender and the gendering of disciplines are not regarded as inherent properties of the discipline or the students and faculty involved in it, but rather as dominant discourses and storylines through which the construction of identity evolves (Walker, 2001), then ascribing for instance the adjective 'masculine' to the language or culture of a discipline still influences the process of negotiating identity that male and female students have to engage in. Drawing on interviews with six male and nine female engineers at a Scottish university, Walker (2001) argues that even if students tend to consider gender as something that is not an issue, gender questions still permeate a substantial part of the stories told by the students. However, students' rejection of gender as an issue of concern obscures the power issues related to gender, and makes it impossible for the students to address these experiences, except through ambivalent or inconsistent narratives. A noteworthy point made by Walker is that this not only limits the possibilities for the female students, but also for young men who wish to relate to alternative constructions of masculinity. Likewise, Hasse (2002) concludes that femininity is considered at odds with being a physicist. The female students therefore have to play down markers of femininity in order to reduce the risk of being dismissed as less capable based on their gender alone. Similarly, Seymour and Hewitt (1997) reported that women students experienced having the legitimacy of their studying science being questioned because of their gender.

Hughes's (2001) research is focused on gendered constructions of identities within the dominant discourses and practises of science curriculum and draws upon qualitative studies in the UK consisting of in-depth classroom observations and semi-structured interviews with 60 students. Material from staffroom observations and interviews with teachers is not included in this particular article by Hughes. She concludes that 'scientific knowledge in the dominant curriculum discourse is presented to students as detached, incontestable and inaccessible' and that physics is being 'held up as the ideal model for positivist science'. Further, she comments:

> Where these dominant curriculum discourses are very pervasive in physical sciences, available scientist positions subjectivities are likely to be are limited in a manner that is consistent with statistical evidence that physical science is the preserve of high-fliers and/ or middle-class males. However, there are assured scientist subjectivities available for some female students that depend on possible interactions between ethnicity, marginality, educational background/achievement as well as gender, a point that has been underemphasised in many previous studies. […] constructivist, student-led investigations, observed here in biology, offer opportunities for reconfiguration of dominant discourses. Here new scientist subjectivities that do not depend on exceptional achievement and/or adherence to gendered binaries emerge. If competing discourses were also more available in physical sciences, then a similar expansion of available student scientist positions might also develop for females and males alike. A reduction in rigid science/non-science specialism could also support more hybrid identities. (Hughes, 2009, p. 287f)

Internal culture of the subject taught is the point of departure in students' construction of identity as they work to belong in the culture of science (Hughes, 2009).

Academia as working culture

Research focusing on gender differences in academia underlines the importance of support from more experienced students mentoring the newcomers, but also from women who already have established careers and are invited to campus to share strategies and serve as role models for freshmen (Wasburn & Miller, 2004–2005).

Ferreira (2003) studies gender differences among students in two graduate science departments of chemistry and biology at a large US Mid-West research university. She points out that if the goal is to attract more girls to science in general and to chemistry in particular, it calls for a change in the workplace culture where all permanent staff were men, and the culture was based on traditional male cultural norms. Changes in this department would require that more women were hired at the department to serve as role models and mentors. However, findings from the analysis of the other department included in Ferreira's study suggested that hiring more women is not enough; a change in the workplace structure is also needed. This biology department implemented a number of changes to help staff to balance working life with family, but in spite of this the students still perceived the possibility of combining family and academic career as too difficult and the effort needed to be too excessive. The students experienced women hired at university as being stressed and the position to be unattractive. Indeed, the female staff almost served as *negative* role models. In this case, academia is excluding students who wish to combine an academic career with something else (for instance a family life). A more fundamental change in the working culture in academia is needed to attract more female students, but also alternative options for those students who might consider a career in science other than research in academia (Ferreira, 2003).

In her research, Davis (2001) followed a group of women working in a research institution in the Western US. The women met once a week in a self-established network to discuss their everyday environment and to share experiences. These women considered themselves as being peripheral and subversive. In joining the network, the women became aware of their personal experiences as cultural products rather than a result of issues relating to themselves as individuals. The network turned out to be supportive, providing the participants with a critical perspective on the culture of science, constructing a new discourse inclusive of diverse voices, developing a critical view of the science community and legitimising their own positions. Davis concludes that the women in her research did not have access to powerful networks, and the science community must take primary responsibility for constructing inclusive, equitable, and participatory networks, structures, policies, and practices within the community (Davis, 2001). This research demonstrates the importance of changing the perspective from understanding something as an individual and isolated experience to realising it as a structural problem. Making students who consider leaving their study change their perspective on what they conceive as individual problems in order to make them reflect on them as related to the structure as well, could be a useful tool in including not only the minority of girls in science, but for the retention of students in general.

The research focusing on identity draws upon a range of perspectives. Still, it shares an emphasis on the importance of the interaction between the individual student and the culture of the discipline. Secondly, it highlights the importance of being recognised as a legitimate member of the group of science students or 'science people'. Thirdly, it draws attention to the point that some positions are available to some

students rather than to others. Overall, there is an emphasis on the socio-cultural aspects of studying, and the analysis of the under-representation of particular groups of students.

The research focusing on culture and identity gives more attention to cultural elements like discourse, role models, and values. Fewer studies devote their attention to the teaching and learning activities and what, following Bernstein (2000), could be called the pedagogical discourse. This would include studying the curriculum in relation to what content is included and what is excluded, to what extent the different elements of the study are integrated or separated from each other, and how the control over the pacing and sequence of the teaching is distributed (Bernstein, 2000). The limited interest of the identity-focused approach on the teaching and learning activities means that this research is more helpful in analysing the importance of what is surrounding the teaching, than in understanding the impact of the teaching methods the students meet.

What could be done about students leaving?

Our review has shown that there are numerous factors influencing student completion, and that these interrelate and influence each other. Some factors relate to the situation prior to the students entering the university (primarily the students' social background and the programme choices made by the students). Other factors relate to issues outside of the university (for instance housing, finance or personal issues – not least for mature students). Finally there are factors within the study programme itself. The theoretical models (e.g. that of Tinto), and much of the empirical research, place the students' experiences with the teaching and learning environment at the study programme as the pivotal point.

It follows that there is no one instrument or change that can solve all the problems. Yorke and Longden (2004) conclude their book by discussing what the institutions, the students and the higher education system could do, though most of the authors' propositions are aimed at the institutions. Some of those have to do with the information provided to the students that should address for instance course content, methods of assessment, expected time-commitment, costs and more. They strongly recommend that students visit the institution. The student experience is addressed by a number of issues. Some relate to the welcoming and induction process, which should include information about the study (but they also warn of information overload in the introduction). Further, it should aim at making the students feel welcome, and aware that the institution and the teachers are concerned about the learning experiences of the students. The whole of the first year could be regarded as an extended induction process, they claim, while at the same time they note the importance of the very first lecture or teaching activity the students are involved in, and the importance of the signals this lecture sends. There are two issues here. Firstly, it expands the induction process from a few days or a couple of weeks to the entire first year, indicating that the induction process should more or less permeate all the teaching and learning activities during the first year. Secondly, it emphasises the importance of the initial meeting with the faculty, teaching, peers and culture, and that the institutions therefore should be careful with the first activities the students are exposed to.

Other suggestions by Yorke and Longden relate to the teaching, emphasising both the general learning environment that should be supportive and have the student as a

central focus (and should encourage staff to give more attention to teaching), but also the modes of assessment used, not least the importance of formative assessment, and an early and extensive use of this. Another suggestion is to have a 'disproportionate allocation' of teaching resources, so that first-year teaching is allocated more teaching resources than the advanced courses to give room for smaller teaching groups and interaction with staff.

Yorke and Longden's focus on the student experience and student success put emphasis on the interaction between student and study programme, and it places the choice of programme, not least the teaching and learning experience, at the heart of the matter.

Seymour (2002) provides a detailed review of the processes of change in SMT undergraduate education in the US. She shows how views have changed from statements of a 'pipeline problem' linked to a question of students' abilities, to recognising that the pattern of losses might be (unwittingly) engineered rather than reflecting a 'natural' wastage. What was initially seen as a matter of supporting individual students (precollege bridging programmes, personal and academic support, and enrichment programmes for under-represented groups of students) is gradually recognised as a challenge not only for targeted groups, but a challenge to improve the quality of the undergraduate learning experience for all students. It is in this context that Seymour, as mentioned earlier, paraphrases Einstein, and states that there is a growing recognition that: 'You cannot resolve a problem in the conditions that created it' (Seymour, 2002, p. 81).

In the last part of her paper, Seymour (2002) provides an overview of current reform activity and examples of initiatives taken or underway to address the issues of students leaving STM educational programmes. She further links these initiatives to what she calls theories of change. These theories are shortly outlined in the following.

One view is termed: *bottom-up and top-down theories of change*, and reflects the theory that reform across institutions or systems can be transmitted by the spread of grass-roots action between individuals, campus groups, and networks. It argues that change can be built from small local beginnings, first by provoking and maintaining conversations that lead to local collaboration; then by making connections with collaborators on the same or other campuses. Thus, it is claimed that good ideas, supported by convincing evidence of efficacy, will spread 'naturally' – that, on learning about the success of particular initiatives, others will become convinced enough to try them.

This set of theories has however, as discussed by Seymour (2002), not been supported by evidence, and it has not been proven that networks of such collaborations can build into a 'critical mass' in favour of reform. Within this position it is today recognised that: 'System change within institutions requires unequivocal, high-level commitment to promote and reward classroom effectiveness and educational scholarship' (Seymour, 2002, p. 93). Individual efforts of reform-oriented, proactive faculty are necessary, but not sufficient, and require an institutional cultural transformation.

Another view is termed *the blueprint model*: good intentions have to be channelled into actions that are already known to be effective. Time, effort, and resources should not be wasted on strategies that have not worked well in other comparable settings. This approach therefore calls for workshops or other means of facilitating professional development, for instance access to summaries of pedagogical and assessment techniques, the theoretical and research base for these and evidence for their efficacy – including what did *not* work. This view or theory of change is related

to yet another view, namely that *evidence is a necessary (if not sufficient) condition for reform*.

Both these theories of change face difficulties *vis-à-vis* the culture of the SMT faculties and to some extent of the students too; an issue touched upon in the theory labelled *departmental values are key to educational improvements*. Finding the means to leverage relevant shifts in departmental values and practices is the critical factor in determining whether the efforts of faculty – as individuals and groups – and of their institutions, will be able to improve the quality of STM education, or achieve the wider goal of science-for-all.

What is more, there is a history of SMT faculty not valuing teaching which limits teachers' inclinations to enter into pedagogical experiments or investigate new ways of teaching (Seymour & Hewitt, 1997). As DeHaan (2005) points out, this means that scientists trained to demand evidence for their actions when it comes to teaching neglect the evidence that exists, both due to ignorance of the evidence available, but also because of scepticism toward the methodologies underlying the evidence.

Another important issue is resistance from students who have learned how to get good grades through passive learning methods and who find it harder to achieve the same grade levels through a pedagogy that often demands more of them (Seymour, 2002). Furthermore, the fundamental difficulties in providing evidence for specific pedagogical changes notwithstanding, Seymour (referring to Paul Mazur's book, *Peer Instruction* (1997)) asks why new initiatives need to present evidence that they work, when there is a lack of evidence that the established teaching formats are effective.

The cultural aspect is also present in the view which Seymour (2002) labels: *alignment is required at all levels for effective system change*. In order to make the curriculum more meaningful to students, there should be an alignment between learning goals and the teaching and assessment strategies (cf. Biggs & Tang, 2007). However, there should be alignment on a broader level too: attempts to alter single elements in a complex social system will not be effective; each element must be aligned with the others for system changes to prevail.

Hence, it becomes clear that the organisational issue is bound to take the cultural aspects into consideration when suggesting initiatives and taking actions to change the teaching and learning environment in SMT programmes. The two last views, or theories for change, that Seymour presents relate to this point. The first, *rebalancing the departmental rewards system to reflect respect for teaching and educational scholarship*, argues that the fastest and most enduring way to promote a renewed emphasis on teaching in the service of learning in higher education is to restructure the faculty rewards system. Presently, as Seymour reports from her study, staff members are not rewarded for involving themselves in the development of the teaching at the department. She reports examples of staff having been denied tenure because they were considered as investing more experimenting and productivity into teaching than into research. Likewise, tenured staff state that they advise untenured staff not to involve themselves too much in educational scholarship or classroom experiments until they have 'survived' the system; then they can consider changing it (2002, p. 97f). One could say that the reward in itself is a victim of the dominating culture that values research over teaching.

The final view, *change by leverage from external agencies*, could be regarded as another way of trying to force change on the departments, namely through external funding practices, and through institutions that control accreditation or central evaluation systems. These accreditation institutions frequently have a quite conservative

influence on curriculum and teaching in SMT, Seymour claims, but if they took a deliberate stance to improve new teaching and learning formats it might have an impact on the teaching and the curriculum on a larger scale, in addition to the limited number of programmes that get funding for developing teaching.

The seven theories or views of change presented by Seymour all suggest that changes cannot be expected to come from inspired and inspiring individuals or groups of teachers alone. It requires that the institutions and the management take a stance on the issue of the development of teaching and learning. Moreover, the views make it clear that if the cultural dimensions are neglected, and teaching is merely regarded as a technical matter, important issues will not be addressed. In this sense, without actually expressing it explicitly, Seymour touches upon another dimension that the review shows is of importance: who or what is considered as being the problem and who or what is expected to change?

Individual adaptation or institutional change?

In the concluding chapter of his book Tinto writes:

> The answer to the question of student retention which we offer is not simple. […] It springs from the ongoing commitment of an institution, of its faculty and staff, to the education of its students. But such commitment requires institutional change. It requires that institutions rethink traditional ways of structuring collegiate learning environments and find new ways of actively involving students, as well as faculty, in their intellectual life. It requires a deeper understanding of the importance of educational community to the goals of higher education (1993, p. 212).

By this, he touches upon an important issue that underlies the issue of retention, namely whether the problems are fundamentally regarded as a deficit with the students who are unable to adapt and submit to the requirements of the university, or are seen as an inability of the institution to meet the knowledge and expectations of the students. The suggestions of Yorke and Longden (2004) reported above, do not necessarily call for fundamental changes within the universities, but they do imply changes in priorities and conceptions of teaching. In an article on learning communities Tinto sums up:

> What are the implications of these findings for organizational reform? How might colleges and universities be organized if they took these findings on student persistence seriously and used them as guides for their educational reform efforts? Let me suggest several organizational reforms that would follow. First, colleges and universities would adopt a community model of academic organization that would promote involvement through the use of shared, connected learning experiences among its members, students and faculty alike. Second, colleges and universities, four-year ones in particular, would reorganize the first year of college as a distinct unit with its own underlying logic and pedagogical orientation. Third, colleges and universities would reorganize faculty work to allow them, as well as their students, to cross the disciplinary and departmental borders that now divide them. (Tinto, 1998, p. 170)

This programme for change is more radical than what is suggested in most articles and books on the issue. It calls for an entirely different way of thinking about the organisation of the university where the dominant pedagogical model would be different and the organisation of the teaching would not necessarily follow the traditional division of the disciplines. Interestingly, two Danish universities (the universities of

Roskilde and Aalborg) have more or less had these characteristics since they were founded in the beginning of the 1970s, but they have also experienced pressure from the outside world to adjust to a conventional structure. The most extensive experiment has been (and is) in Roskilde where students spend the first two years of study in one of three interdisciplinary basic study programmes (humanities, social sciences or natural sciences), and after that choose a specialisation in (usually) two disciplines. The pedagogical model has the students working mostly in groups on open problems (problem-oriented project work) which can be considered a kind of inquiry learning. The groups all have a teacher allocated as academic supervisor, according to the topic they are working on. In addition to the projects, students attend more conventional courses within disciplinary topics. The courses now take up at least half the teaching activities, but the projects are still the more prominent pedagogical format at the programmes. This model has been criticised and challenged by, for instance, national evaluation and accreditation boards, because it does not comply with disciplinary borders and conventions, and therefore students from these studies are considered less qualified.

We have made this brief digression to point at both some difficulties in applying a programme like that suggested by Tinto (but also showing that it has indeed been done) and to point at an issue that is left almost untouched in the discussion so far, namely the notion of the academic field as a field for power struggle. Both Harvey et al. (2006, p. 33) and Yorke and Longden (2004, p. 80) refer to a Bourdieu-inspired approach emerging in the field, applying the concepts of cultural and social capital and of habitus. However, as referred to in the discussion of critical perspectives on Tinto's model, it seems that the central social field as an area of struggle for power and position, is not that visible in these discussions of Bourdieu. The focus of many applications of Bourdieu's work is on the unequal distribution of cultural and social capital that provides the students with uneven possibilities of acting and succeeding in the field of academia, and on the habitus that means that the students are more or less well disposed for entering the game at the university. Of course, those are two important points. However, when it comes to analysing the potential for change and the possible measures that could be taken to increase retention, it is necessary to consider that capital and habitus are linked to the issue of acquiring and keeping more privileged and dominant positions in the field, both within the disciplines and between disciplines (Bourdieu, 1984, 1990). From Bourdieu's point of view the non-completion rates and the significant social bias shown within this (Pascarella & Terenzini, 2005; Thomsen, 2008) is not to be considered an unfortunate side effect of unequal resources – it is a way of the more privileged classes remaining in their more privileged position.

This power struggle also has an impact on the possibilities and difficulties of educational change. The experiences of the universities of Roskilde and Aalborg relate to the struggle for power and control of what is regarded as legitimate knowledge and procedures in the different disciplines. Attempts at changing these boundaries are basically a challenge to the power balance (cf. Bernstein, 2000). From this perspective, institutional change in order to accommodate students' experiences and difficulties is not simply a question of whether 'the academic level' of the course is compromised; for those holding dominant positions in the disciplinary community it appears as a threat to what is considered as the discipline itself. For those within the dominant culture of the discipline, the situation is not seen as a struggle for power in which some students are included and others excluded. To them it is simply a matter of defending what they consider to be the quality of the only right way to teach and

learn the discipline in question. Accommodating new courses in order to increase student retention will from this point of view threaten what the teaching seeks to accomplish.

This is the point made by Seymour (2002) stating that what is considered to be the universal standard of science is hard to question. It is a point similar to that made by Walker (2001) where the students did not acknowledge gender as an issue and because of this could not discuss or reflect on experiences related to gender differences. In the same way the fact that disciplines are not nature-given entities, but in fact are changeable, remains obscured, partly because culture is difficult to change, and partly because it serves to keep the existing division of influence and power.

Still, the research regarding student retention and success in higher education points in the direction of not merely providing students with a range of supplementary services (even if that is also relevant and can contribute to increased student retention, cf. Swanson (2006) and Harvey et al. (2006)). To fundamentally address the issue of enhancing student success it is not sufficient to try to adjust the students to the way the institutions are now. An institutional or organisational change is essential to a more substantial change. The question is however if that will be possible.

Conclusion and implications for further research

In this paper we have reviewed research on students' dropping or opting out of higher education in general and from STM studies in particular. The reviewed research on retention and non-continuation of students across different disciplines shows that there is no one factor determining student success. Instead, whether students persist or not is influenced by a number of factors and how these different factors interact.

The student's social and economic background and the reasons and processes behind the student's choice of study have an impact, as does the induction into the study programme. Students' preparation for their studies influence persistence, but students' academic level and abilities cannot explain why some students persist and others opt out. Conversely, the teaching and learning environment and the teaching methods applied prove to be highly important. The teaching and learning activities students are engaged in, the design of the curriculum and the interaction with faculty and peers are also important.

In a substantial part of the research included in this review, the problem of retention is being framed as located in either the student or located in the institution, respectively. However, another research approach to retention highlights the issue of identity construction and of being recognised as a legitimate member of the group of 'science people'. The inclusivity of the study environment and the disciplinary culture provides possible positions for the students to take, and makes some identities more legitimate and recognisable than others. Apparently, the STM culture is still to a large extent distinguished as being competitive, detached, white and male dominated. Students who for one reason or another (for instance gender, ethnic origin or the part of the discipline the student takes interest in) differ from what is considered normal within the field will often have more difficulties in being socially and academically integrated, and in developing an identity as one belonging to the discipline.

Suggestions of how to increase retention within the field of science education tend to focus on adjusting the students and leaving the institutional or disciplinary side stable and untouched. A few papers move in the direction of organisational change,

where the study programmes and the teaching and learning activities are adjusted according to students' background and experiences, but these kinds of measures risk being rejected because they are considered to be detrimental to the quality of the study programmes, as described in Seymour (2002). This claim, that the disciplines are stable and also objective entities with a fixed curriculum leads any suggestions of changing the curriculum to be regarded as a setback for the science discipline and student achievement. If the discipline is not regarded as an object of negotiation, the point of departure for changing drop out must be the students. This perspective makes it very difficult to introduce any measures that challenge the identity problem.

Firstly, this provides an explanation for why so few studies have followed the research ideas set out by Seymour and Hewitt (1997). In their work, they rejected the idea that the problem should be located in the student and instead framed it in relation to the match between the institutions and the students. We find that this is one of the prime reasons why it is so difficult to really address the problem of retention in science education. Science educators often demand a retention check list that can be imposed without changing the existing framework for teaching and the faculties' relation to the students. Evidently, these are precisely factors that according to research focusing on identity and the relation between students and institutions need to be addressed. Further, it is likely that this is the reason why some research addresses this highly complex problem of retention by focusing on the straightforward variables of students' behaviour and capabilities.

Secondly, it makes it even more urgent to further develop research into the culture(s) of science disciplines and science programmes, in the formation of identity during the study, and to expand the scope of this research to all groups of students – not just the minority groups, but also the dominant white male culture. This approach further suggests that the problem of retention should be rephrased from focusing on how to adjust the students so that they can meet the requirements of the existing science programme to a broader perspective on students' experiences with studying science, where not least the question is of how STM programmes can become part of students' identity formation. Will it be possible for STM programmes to convince future and present students that being integrated into an STM discipline is an attractive perspective for a young individual trying to find out who she or he is, and what direction her or his life should take?

Thirdly, there is a need to combine research addressing identity issues with pedagogical research approaches that address for instance the purpose and objectives of science studies, what content is included and what is excluded in science programmes and the teaching and assessment formats of the study programmes. Future research as well as future initiatives in higher education institutions addressing the opting or dropping out of students therefore needs to adopt a broad perspective on both the teaching and learning activities, and on the possible identities made available to students. However, what from our perspective stands out as perhaps the most important finding in this review is that a substantial part of the measures that could be taken to increase student retention do not necessarily go well with the self-conception, culture and tradition of STM disciplines and environments. Consequently, if STM programmes and institutions genuinely wish to increase the number of students completing the STM programme they enter, these programmes need to turn their focus from the students alone and on to themselves and the culture and values that are revered there, and consider whether they are perhaps a part of the problem. In our view, this is indeed most likely the case.

240   *L. Ulriksen* et al.

Notes

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244   *L. Ulriksen* et al.

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7. PAPER IV: A JOURNEY OF NEGOTIATION AND BELONGING

A journey of negotiation and belonging:
Understanding students' transitions into higher education science and engineering

Henriette Tolstrup Holmegaard, Lene Møller Madsen, Lars Ulriksen

Abstract

The paper presents results from a longitudinal study of students' choices of, and their experiences with, entering a higher education science programme. The aim is to give insights into students' transition process and negotiation of identity. This is done by following a cohort of 38 students in a series of qualitative interviews during a three-year period beginning when they were about to finish upper-secondary school. We find that the students' choice of study is an ongoing process of meaning making, which continues when the students enter higher education and continuously work on their identities to feel they belong in their higher education science or engineering programme. The use of a narrative methodology provides access to an understanding of choice of study as involving both changes in future perspectives and in the interpretation of past experiences. Further, we gain access into how this meaning making process through the period of time reflects the students' negotiations of belonging to higher education and their coping-strategies when their expectations of their new programme interact with their first year experiences.

Students' transition into higher education

This paper investigates the transition processes that students go through when they are enrolled in higher education science and engineering programmes. Our methodological focus is students' narratives. Therefore, we begin this paper by introducing Emil – one of the Danish students whose narratives form the basis of this paper. The first quote is from an interview with Emil shortly before he finishes upper-secondary school:

> **Researcher:** What do you think it will be like [attending higher education]?
>
> **Emil:** It's going to be hard, I guess. But I think ... then again it won't, because I'm aiming for it to be something I find interesting, and then I could, like, study as if it was a hobby. When I'm at home I will be studying. That's what I hope at least, that it will be as interesting as I hope, that I'll just say – then I read a book, and it will be so interesting rather than watching television or something [...]
>
> **Researcher:** What do you think the study programme needs to be like for you to get to like it?
>
> **Emil:** I am not sure, but I would like it to be social. And with a lot of theory combined with some practice […] I thought of choosing biochemistry because I am interested in chemical processes in micro-organisms.
>
> **(Emil in upper secondary school, April 2009)**

In an interview five months later, Emil is a few weeks into his first year of university biochemistry studies:

> **Emil:** We will finally meet what they call biochemistry at the second year. So it is kind of... I did not know we were to have mathematics in this way [as the major course]. And it was a surprise to me. And there are also many of the other students who said that they had probably chosen something else if they had been aware of it.

> **Researcher**: Would you have chosen something else too?
>
> **Emil**: No I don't think so, now that I settled for biochemistry. But I might have reconsidered engineering; if I began considering stuff like, what to use it for later on (...) I understand why somebody would want to study something else because first year is like "you can continue if you manage to get through it".

(Emil, Biochemistry, September 2009)

Emil experienced a gap between the expectations he had of his future study programme while being in upper-secondary school and the actual experiences he made upon entering higher education. If Emil should experience his study programme as meaningful, he would have to reconsider the reasons he could give as to *why* he is studying biochemistry. In other words, Emil would need to *bridge the gap* between on the one hand his expectations of biochemistry being as interesting as a hobby, being about chemical processes and including practical work, and, on the other hand, his experience of biochemistry as being something quite different from that, namely as dominated by a course in mathematics that he finds it hard to relate to.

Our aim in this paper is to explore and understand this meeting of student's expectations of the higher-education programmes by analysing the students' narratives about why they chose a particular study programme, and how they negotiate these narratives with their actual first-year experiences. Our interest in this process is how students negotiate their identities and retell their expectations in a way that fits into their understanding of what is required to belong at their new study programmes. We study the transitions as *processes* between the two educational levels, and our aim is to focus on student integration, engagement and empowerment, rather than on retention and withdrawal. Hence, the approach of this paper differs from much of the previous research on students' transition from upper-secondary school into higher education in two ways. First, by studying the transition as precisely that: as *a process* of moving from one place to another, and, secondly, by the role ascribed to identity in this process. At the same time, we contribute to a research approach that has emerged over the past decade.

Sara Goldrick-Rab, Debrorah Faye Carter and Rachelle WinkleWagner (2007) show that research on the transition to postsecondary education is dominated by two foci in particular: college entry and college completion, themes that Peter Scott states both relate to an economic interest of higher education institutions (1995). However, in a large review of students' choices Amy A. Bergerson (2010) highlights how other studies with a focus on social inclusion devote their attention to the different opportunities students have for entering higher education according to their social and cultural backgrounds.

In general, studies on students' transition to higher education have primarily tended to focus on either the transition *from* or the transition *to* with a focus on either upper-secondary school or higher education.

Most of the research literature focusing on the transition *from* upper secondary school has in particular influenced by a North American concern for students' different chances for getting access to higher education with a particular concern for how students' financial, social and ethnic backgrounds influence their transition to higher education. An example is Clifford Adelman (2006) who in a U.S Department of Education report found that certain institutions, courses (in science/mathematics and languages) and students' course levels in particular in mathematics, turned out to be key predictors for their higher education attendance. Patrick T. Terenzini, Alberto F. Cabrera and Elena M. Bernal's (2001) report is an example of how the whole of the transition process to a larger extent is included, by showing how financially poor students meet higher education. In a British context, research in students' transition *from* upper secondary school has been dominated by studies focusing on students' educational choices and preparedness for entering higher education. An example is a longitudinal study of students' pathways in London, Stephen J Ball, Meg Maguire and Sheila Macrae (2000) who, similar to Adelman (2006) in a US-context, conclude that choices are not only influenced by class, ethnicity, and gender but also by institutional cultures and expectations.

The research literature focusing on transition *to* higher education is to a large extent dominated by studies that address students' success and retention by mapping their preparation, interests, abilities, amount of work etc. However, as we have shown in Lars Ulriksen, Lene M. Madsen and Henriette T. Holmegaard (2010) recent research shift the

focus from perceiving success and retention as solely a question of students adapting to the institutional requirements, towards retention as a relation between the students and the culture of the study programme they enter and also an increasing concern for issues of identity. We see the present paper as an empirical contribution to this shift towards identity.

Throughout the research literature there are calls for investigations that do not merely reduce the problem as one that is situated in *either* upper secondary *or* in higher education:

> Many researchers argue, therefore that it is only possible to understand transition through a focus on agency and identity together with an account of how they are shaped, constrained and sometimes determined by the material conditions and normative expectations of different structural factors.
>
> (Ecclestone, Biesta, and Hughes 2010, p. 12)

Thus, to understand transition we must gain knowledge of how people work on their identities in the process of moving from one cultural context to another. Kathryn Ecclestone, Gert Biesta and Martin Hughes (2010) suggest that focus then should be on the identity processes, the process of becoming somebody, across institutional and cultural contexts.

This is mainly a theoretical statement; and it is supported by a large review of existing research – primarily from the UK – performed by Mantz Yorke and Bernard Longden (2004) who are concerned with a large number of students leaving their higher education study programmes. Leaving higher education is a process taking place over time, and the authors conclude that the following reasons are crucial for students considerations of staying and leaving: students' reasons for entering the programme in the first place, their experiences when meeting the programme, their coping strategies when meeting difficulties, and finally factors outside the institutions (Yorke and Longden 2004)

Against this background, the aim of this paper is to understand transition into higher education first as a process of *both* a transition *from* one educational level and *into* another educational level. Secondly, transition is understood not just as transition into a new

institutional context, but also as a transition of the students' expectations and identities. In other words, this paper explores the transition-processes through which students need to learn to become students within science higher education.

Research frameworks

To understand students' transition – process into their first year higher education science and engineering study programmes we combine ideas from various socio-cultural approaches to extract the theoretical concepts with which we approach the analysis. By socio cultural we understand, in line with the emerging thoughts of James V. Wertsch (1993), a range of theories with an interest in the reciprocity and constituting processes between subjects and culture(s). In this paper we wish to understand the aspects of social-cultural thinking at two particular focal points in the process of students' moving from upper secondary school and into higher education: Identities in transition and integration into Academia. We unfold the concepts by drawing on narrative psychology and post structuralist thinking. In this section we present our research framework, and how it will enable us to approach our research aim.

Identities in transition

Transition is more than a linear process of moving from one institutional context to another in which the student needs to make sense of a new social and cultural arena. Kathryn Ecclestone, Gert Biesta and Martin Hughes (2010) underline how transitions is processes in where students ongoing work on their identities to become 'somebody' to fit into what they recognizes as institutional and cultural accepted pathways and reach a sense of belonging. In this perspective identities are perceived as fluently, dynamically constructed through the discourses available in the cultural setting. Identities are *always* in transition. This post structuralist approach to identities as constantly negotiated gives access to perceiving students meeting with their new study programme as a continuous process in where they on-going work making meaning of- and relating themselves to the new cultural setting.

In narrative psychology meaning making processes is perceived as cultural embedded in the sense that the students' draw on cultural available storylines when they construct their narratives. Jerome Bruner (1990) describes these ways of making meaning as culturally shared in the sense that '*we live publicly by public meanings and by shared procedures of interpretation and negotiation*' (1990, p. 13). Also Donald Polkinghorne (1988) highlights how we – through cultural embedded narrative configurations – understand our existence as an expression of a single progressive story and achieve a sense of self and identity. One of these cultural shared available storylines is how identity is seen as a core of self-carried within each of us. Therefore individuals perceive of themselves as possessing a coherent self. Fitting into a new cultural setting as higher education therefore also is a process in where the students need to construct new coherent narratives about how they belong at this particular study programme and how it fits with their perceptions of themselves. As Wolf-Michael Roth and Kenneth Tobin explain '*events in our lives may provide us with resources to understand ourselves differently, leading to changes in our biography*' (2007, p. 1). And in the same line transition into higher education also makes new narratives possible through the cultural *resources* available at the giving study programme.

But in accordance with the work of Jerome Bruner (1990) there is a limitation to how flexible and fluently our narratives can appear as to be reliable and valid. This does not mean that we do not change. Donald Polkinghorne (1988) explains how we reverse the plot in our narratives as new events occurs and as new perspectives of how these events will end and of who to become becomes visible. But rather the point is that we need to align the new perspectives in our lives with our sense of self.

So how can we on the one hand state that identities are required to appear to be relatively stable to be culturally recognized, and on the other hand perceive identities as dynamic and continuously in transition? We are interested in how this exact dilemma takes place in the students' transition into higher education.

We understand the new coming student to on the one hand need to work on *becoming* a recognized student to feel she belong to and get recognized in the cultural context of her new study programme. In this process she will have to negotiate her expectations to what studying will be like, and work on her identities to gain a sense of

belonging. On the other hand she needs to be recognized as herself, and therefore, she cannot construct new narratives without somehow being related to who she perceive herself as being and how her surrounding social relations perceives her.

There might be a mismatch between how the students perceive themselves and their expectations of who to become at their study programme, the perceptions and expectations from family and friends and finally the expectations and the pathways made available at the study programmes. From this perspective, Helen Colley (2010) argues how the process in which the students' work on their identities (so as to belong to their new study programme to when the students retain a sense of self) is a learning process in which the students learn who to become and where to locate and position themselves in the new study programme. In this paper we are interested in this exact learning process

Integration into academia

To understand how the above described learning process takes place, and how students follow different pathways in it, Vincent Tinto used the notion of *integration* in his longitudinal model of student leaving college (1993). A key component in the model was the process of getting integrated in Academia, both into social and academic communities. These communities are closely interwoven and they could consist of various subcultures. Further, the integration could both be formal and informal, occurring in the teaching settings, in social activities organised by the institution or in informal interaction outside class – either with fellow students, with staff or with both.

Tinto's model has been criticised for being insensitive to the particular difficulties that non-traditional students experience when entering a culture dominated by a white, male, middle class or upper class norms and codes. According to the critique made by William G. Tierney (1999). Tinto's model of student leaving presupposed that minority students should commit cultural suicide through adopting the majority culture. Although we do not agree that this to be an implication of the model, we find that the critiques stress the importance of linking the model to how the students negotiate their identities in various ways in the variety of cultures in Academia.

Therefore we first need to unfold the notion of culture, to get to use Tinto's notion of integration in our research framework. As stated by Dorothy Holland, William Lachicotte Jr., Debra Skinner and Carole Cain (1998) there is a tendency to treat cultural discourses and practices of a group of people as:

> (…) indicative of one underlying logic or essence equally compelling to all members of the group. Instead, contest, struggle, and power have been brought to the foreground. The objects of cultural study are now particular, circumscribed, historically, and socially situated "texts" or "forms" and the processes through which they are negotiated, resisted, institutionalized, and internalized. As Foucault insisted, significantly for the study of culture and self, "cultural forms" are presumed to affect and shape subjectivity, and these cultural forms come in great variety.
>
> (Holland, Lachicotte, Skinner, and Cain 1998, p. 26).

We understand identities and students narratives as always embedded in culture. Culture can be understood as a range of social practices one have to learn to become recognized within it, like the approach by Cathrine Hasse (2002, 2008) in her study of first-year physics students. Another approach to culture is analytic, like Dorte Marie Søndergaard in her study of gendered positions in Academia (1996). Rather than social practice, Søndergaard move her focus to discursive practices, with a focus on how the culture set the scene for the students gendered positioning of themselves and each other. In this study narrative interviews are conducted and we do not claim to get access to the students' social practices why our approach is in line with the one of Søndergaard.

Aligning Vincent Tinto and his model of students leaving college into this set of thought, we find ourselves in line with Karen L. Tonso, who understands the process of belonging as:

> (...) a process through which persons' sense of themselves as engineers led to performances of engineer selves that were viewed through lenses of cultural forms for campus engineer identity, and where

> recognition *as* an engineer conferred belonging (Tonso 2006, p. 303)

We perceive the social and academic integration suggested by Tinto as students' strategies for gaining a sense of belonging. By combining Tinto's model with a socio cultural identity perspective we develop a concept to approach and understand students' negotiations of their identities.

Against the background of the theoretical perspectives, we can specify the research aim into research questions:

1. We wish to explore how students work on their identities and produce narratives across the transition from upper secondary school to higher education science and engineering study programmes.

2. In particular we seek to describe in detail their negotiation strategies of on the one side their narratives of why they consider choosing a particular study programme. And on the other side when having entered the new cultural setting of their study programme; their narratives about why they are enrolled at the particular study programme.

3. What they perceive as legitimate integrations strategies of becoming a recognized student within higher science education.

Situating the study in a Danish context

The students' in this study are all enrolled at Danish STEM higher education study programmes. We will provide a brief contextual background, to support the reader in interpretation the students' narratives presented in the analysis.

Two significant conditions set the scene for Higher education institutions in Denmark; all study programmes are free of fees and all students get government funding every month (about 1000 $). A results of a EU-funded project called IRIS (Henriksen, Dillon, and Ryder expected 2013), found that these two conditions might be one of the reasons why Danish students require of higher education to

make personal sense.. Furthermore a study by the present authors (2012) shows how Danish students choice of study to a large extend based on what they find to be interesting even it is also adjusted to for example whether the students find the study culture or the future career prospects to be attractive.

A finally issue worth mentioning is how most higher education STEM-study programmes are mono-disciplinary; if choosing to study computer science, what you get is computer science. During the first couple of years most courses are mandatory. Until recently most higher education students continued from their bachelor programme to an extending master study programme. This is still embedded in the culture at some study programmes as the right thing to do.

Research design

Setting and participants

The study is set within the Danish educational system where 6 science classes in Danish upper secondary schools[11] were selected in spring 2009. The specific schools were selected due to a particular large amount of students from their science classes continue to study science at higher education levels. Further, the classes were selected to create variation in student-population (ethnicity, gender. socio-economic background, city closeness and distance to schools).

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[11] 4 STX and 2 HTX classes were selected. In Denmark we have four types of upper-secondary schools giving equal possibilities for entering the higher education system (HTX, HHX, HF and STX). STX is a non-vocational type of upper secondary schools. HTX is a more vocational type of upper secondary schools.The higher education system in Denmark is free of any fees, and students receive government financial assistance every month to cover their most basic living expenses. Students are therefore in principle free of any economic obstacles, but access to certain higher education study programmes is limited to students who complete certain subjects at specific levels at upper-secondary school and obtain specific marks. When choosing higher education students must choose a specific study programme, for instance Biology. Once a programme is chosen it is rather difficult to change to other programmes and there is only a narrow possibility to combine different study programmes. Change of the students' study programme is considered as drop out both by the institution and the student.

In total 134 students completed a questionnaire concerning their socio-economic background. Further, they were asked to express their interests in and experiences at upper-secondary school and in particular with science and their plans for the future. Based on these data, 38 students were selected to resemble the diversity in the group of students concerning gender, socio-economic background, ethnicity, but also the student's interests in science-subjects and plans for the future. Based on the information perceived from the questionnaire we invited two students from each class to join a focus group interview. Each of these students was encouraged to take with them a friend from the class, to make the setting as safe as possible, and the students to feel comfortable by sharing their views in a group. Not all students succeeded in bringing a friend, but, in total, 19 students were interviewed in groups. Furthermore three students from each class were selected for in-depth interviews. In one class, an extra student was interviewed because only two students showed up to the focus group interview. 19 students were interviewed individually and 19 in focus groups. Half of the 38 students were girls and 18 of the students came from non-academic backgrounds. Of the 38 students, 25 entered a science education programme within the first two years after they left upper secondary school. All of these are shown in Table 1, and in this paper we analyze the choice-narratives of those 20 students (indicated in Table 1) that we managed to keep in contact with during the period between spring 2009 and autumn 2011.

Narrative interviews

Both the focus group and the individual interviews were conducted as narrative qualitative interviews. In order to access the students meaning making and identity construction the purpose of narrative interviewing was to encourage stories and descriptions in accordance with Molly Andrews, Corinne Squire and Maria Tamboukou (2008). The interviewer is positioning the student as the expert of her life, and asks questions into the narratives and notions the interviewee presents. In that way, the narrative is the point of departure for the interview and focus is on how the student make and ascribe meaning as highlighted by Dorte Marie Søndergaard (1996). Therefore the researcher asks 'how' and 'what do you mean when saying...' emphasizing descriptions rather than engaging in a dialogue. The researcher pays attention to how she positions and recognises the

Interviews

Pseudonym Female/ male	Interviews in upper secondary school 2009 (US)	Gap year(s) (g1)	HE First year (h1a)	HE First year (h1b)	HE First year (h1c)	HE Second year (h2)	Gap	Negotiation strategy[1]	Leaving	Choice of higher education STEM study programme
Coya (f)	1		2				1	A	X	Opt out of BA of engineering to Architectural engineering
Cecilie (f)	1		1				1	Z[2]	X	Opt out of Sport Science to BA in social work
Christian (m)	1	1	1	1	1		1	A		Software engineering
Barbara (f)	1		2	1	1		1	C	X	Opt out of Literature to Design & engineering
Benjamin (m)	1		2	1			1	A	X	Opt out of History to Computer Science
Bastian (m)	1	1	1				2	E		Mathematics
Belal (m)	1		1	1		1	1	B		Computer science
Birgitte (f)	1		1				Z	Z		Bio technology
Erika (f)	1		1	1		1	1	C		Chemical engineering
Emily (f)	1		1	1	1		1	B	X (2 int.)	Opt out of Chemical and biotech engineering
Ebbe (m)	1	1	1				1	Z		Bio technology
Emil (m)	1		1	1		1	1	A		Bio chemistry
Elisabeth (f)	1		1			1	2	E		Environmental management
Deniz (m)	1	1	1				1	Z		Biotech engineering
David (m)	1		1				1	Z	X	Opted out of nature management to Medias & design
Djemal (m)	1		1	1		1	1	A		Design and innovative engineering
Emma (f)	1		1	1			1	C		Veterinary Medicine
Frida (f)	1	1	1	1	1		1	B		Bio chemistry
Filip (m)	1		1	1		1	2	D		Engineering design and applied Mechanics
Amalie (f)	1	1	1	1			2	D		Molecular biomedicine
Fie (f)	1	1					Z	Z		Chemical engineering
Aksel (m)	1						Z	Z		Geography
Daniel (m)	1						Z	Z		Computer Science
Frederik (m)	1						Z	Z		Architectural engineering
Dan (m)	1						Z	Z		Sports Science

[1] The concept negotiation strategy is defined in the section 'research framework'. In the section 'analysis' a description of each of the strategies are provided.
[2] Z: Not able to identify a negotiation strategy due too few interviews on first year

Table 1. The students' interviewed in upper secondary school and during their STEM higher education study programme.

student during the interview as a co-constructer of the narrative. This means that the interviewer is a co-constructor of the narrative, since her presence and the entire setup is an unusual setting with asymmetric power relations as pointed out by Steiner Kvale (2006). By reflecting upon these issues the researcher can be aware of her position, and thus limit narrowing the responses by recognizing and encouraging the students' narrative.

The number of interviews with each student is indicated in Table 1. Each interview lasted between one to two hours. The narrative psychological approach was combined with a semi-structured interview guide as described by Steinar Kvale (1996). In upper secondary school, the interviews concentrated on the following two pivotal themes: Upper secondary school experiences in general and with science in particular and the students' considerations about their future. Under each theme some sub-questions were listed. Some were introduced during the interviews (e.g. 'please describe your experiences with science during upper secondary school' or 'will you please tell about your considerations for the future'). The students themselves addressed others in the interview – for example job opportunities. When interviewing the students during their gap year(s) and during their first year programme the interview was also following a narrative interview approach. Each interview began with 'Please tell me what happened since we met last time'. This question was followed by questions into the students' narrative e.g. 'please explain how you experienced your first weeks of studying chemistry' or 'you said meeting mathematics was a bit weird, what do you mean by weird?'.

Analytic approach

All interviews were transcribed verbatim and approached with the following analytical questions:

1.   How do the students narratives about how entering higher education science and engineering study programmes will be like correspond to their actual meeting with higher science education?

2.   Which negotiation strategies do they use to transform their
      narratives into what they recognize as a legitimate way of
      belonging to their study programme?

To address the first analytical question, all interviews conducted with
a particular student were read through one by one (by the first author
of this paper). From their narratives and expectations in upper
secondary school and their narratives when meeting higher education,
the students were categorized in two groups; the ones who
encountered a big gap and the ones that encountered a small. The
students were categorized in terms of how much they needed to
struggle and negotiate their narratives and sense of self to fit in to
their new study programme and gain a sense of belonging. More
precisely we compared their narratives and expectations to higher
education while in upper secondary school with their narratives about
their actual experiences when meeting higher education. Within each
of the two categories, the students were further categorized in terms
of the character of their gap; for example did they struggle with an
unexpected content, study culture or motivation? This was done as
suggested by Virginia Braun and Victoria Clarkes' thematic analysis
(2006). The analysis in this paper is organised according to these
themes. The second and third author validated the analytic categories
by reading selected interviews, and by discussing the categorisation.

In presenting the analysis, we selected students representing the
maximum variation in the data to show the differences in students'
transition processes and to unfold the analytical process for the
reader. A summarize of the selected students' narratives will be
presented in the analysis to ensure transparency. Approaching the
second analytic question, we categorized the students in terms of
what we label their *negotiation-strategies* across first year of higher
science and engineering education. With negotiation-strategy we
mean; the ways in which students negotiate their identities into what
they recognizes as institutional and cultural accepted pathways to
gain a sense of belonging. To approach these negotiation-strategies,
we use 'turning points' as an analytic tool.

Turning points as analytic tool

From a personality and developmental narrative psychological point
of view it is studied how life storytelling consists of sequences

produced by turning points; Dan P. MacAdams, Ruthellen Josselson and Amia Lieblich states how a sequence can turn from emotional bad to emotional good (redemption) or the other way around (contamination) (2001). Or like interpreted by Corinne Squire (in Andrews, Squire, and Tamboukou 2008, Chapter 2) a life turning point is a significant event that set the scene for retelling the entire narrative like 'when I found out I was gay'. Translating this notion into our theoretical point of view where identities are perceived as on-going processes, we perceive turning points as *dynamic sequences,* More precisely turning points are sequences in the students' narrative where they redefine who they were, who they are and who to become; in particular what kind of students they are, and how studying will be like in the future. From a post structuralist view these turning points are constantly taking place as the students constantly work on and negotiate their identities and their strategies for belonging. But as stated in our research framework identities is not totally re-negotiated all the time, and through narrative psychology we perceive some stability embedded in our cultural perceptions of selves. Therefore we understand turning points as sequences in students' narratives that indicate a change of perspective in terms of the students' considerations of their past and expectations of the future. Like suggested by Jerome Bruner (2004), the narratives are being retold as new resources becomes available. As an illustration of this way of conceiving the concept of identity, imagine a car driving down a winding road. As the road turns new images and landscapes becomes visible through the front window, but additionally also the road behind the car appears in a different angle through the rear-view mirror. The same is happening as students move in time. As theymeet their new study programme, get new friends and new perspectives of the world they get resources to understand themselves differently both prospect and retrospect. In this paper we are interested in these turns in the roads, and how students re-construct their identities throughout their transition through higher education.

  First of all our analytical approach to the second analytic question then is to identify sequences of turning points in the students' narratives over time. These are coded into five negotiation strategies (for an overview see table 1 and for illustration see figure 1). Second we use our theoretical framework to relate those negotiation strategies to the students' identity-work and integration-strategies of becoming a recognized student within higher education science and engineering study programmes.

To ensure transparency, also this part of the analysis is presented by providing summaries of the students' narratives.

Analysis

The analysis is divided into two parts. The first part presents how the students' narratives about what to study in upper secondary school relate to their narratives when they enter their higher education study programme. The second part of the analysis is devoted to understanding the students' strategies when encountering a gap between their narratives and what they meet when entering their first year higher education programme. In the latter part we wish to understand the students' negation- and integration strategies when working on their identities in the process of bridging that gap and gaining a sense of belonging to their study programme.

Part 1. Expectations meeting experiences

The majority of the students experienced a gap between what they had expected and what they experienced. The gaps frequently relate to the content, meaning, academic level of the courses or the teaching methods used, but some also experience gaps in relation to external factors (e.g. transport, housing, economic challenges). In the following, we first present students who clearly experienced a gap, followed by a section about students where the gap was less pronounced.

Group 1: Students who encounter a gap.

The two citations from the interviews with Emil in the introduction to this article leave no doubt that he was surprised by the content of the study. It contained far more mathematics than expected, and he struggled to see how it related to biochemistry at all. Biochemistry, he explained, would not be part of the curriculum before second year, and the lab-coats all students had received during the first week still lay unused in the students' closets because they had not been to the laboratory. Emil had concluded that the first year was something he needed to get through.

This acceptance clashed with another expectation, namely what he experienced studying to be like: a hobby and driven by interest. Instead of a hobby, Emil struggled to keep up his motivation, and after few months he reflected whether he would have *'reconsidered engineering if I began considering stuff like, what to use it for later on'*. At the same time, he had a strong determination to complete the bachelor's programme because he would consider it a waste of time to leave and begin a new study programme, e.g. engineering.

Emil experienced a gap concerning at least two points: the content and the motivation. A third point – that the future perspective might not be that attractive – appeared to be something he had not considered previously, but that occurred to him after he had entered university. In all events, his expectations were not met.

Other students had similar experiences– both concerning experiencing a gap and this being related to the content. An example was the male student, Djemal, who entered an engineering programme in design and innovation and was surprised by '*a lot of courses where we need to draw, I did not expect that at all and it came as a surpise to me'* (h1a) [12]. Djemal found it hard to see himself in the programme: '*it does not suit me'*. He experienced that he had difficulties with the courses he liked (the science course), but was doing well in the more social science oriented courses that he did not like in particular. During the first semester he considered leaving the programme, but since '*it takes five year, nothing more'* he decided to stay, and further he told that '*I stick to this study programme because I know what I want to do when I finish it'* (h1b).

In upper-secondary school Djemal had considered applying for physics and engineering to combine his interests in astronomy with a sense of a realistic career prospect, but also because engineering was a legitimate choice of study in his family. In the last moment before sending the application he changed his mind, and opted for design and innovation due to his interest in mobile-phones, striving to

[12] The letters in parentheses after the quotations indicate when the interviews were made. The abbreviation 'us' means upper secondary school; 'g1' means the first gap year; 'h1' means first year at higher education; 'h2' means second year. If the students was interviewed more than once in a given period, interviews are numbered with letters, e.g.,' h1a' being the first and 'h1b' being the second interview during the first year at higher education.

become a mobile-phone-designer. However, when entering the design programme they were not allowed to work with mobile phones in the assignments at all.

For other students, the gap did not relate to the content, but to the difficulty of the courses. David opted for nature management, and had a clear idea of which courses he would meet, and how many hours of teaching a week he would have. Meeting the study programme he struggled with what he explained to be the level of the courses:

> Mathematics is really at a high level, and I think everybody find it difficult and fear the exam (…). When I am sitting at a lecture and think: 'I never heard about this before', and he [the teacher] says 'this is something you ought to know from upper secondary school' (…) and everybody is nodding, then it can be hard to get going, because it is additional stuff and I do not even know the fundamental (David h1a).

David's experience is[13] ambiguous. On the one hand, he articulates that *everybody* has difficulties in mathematics, but, on the other hand, how *everybody* except David has the prior knowledge from upper secondary school to understand the content. In any event, the experience appears to weaken his motivation.

At the same time he found it difficult to organise his study practice, because he found it hard to find out on his own what was important and what was less important. However, the need to organise the study practice also related to the university programme not being his sole interest. He explained that to continue being motivated at his new study programme he needed to '*learn to study the right way, so I get most possible time alongside studying, so I do not have to use all my time on it, and don't feel it being so hard*' (h1a).

The experience of a gap between the academic preparation and the requirements of the programme was shared by many students.

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[13] In most of the presentation of the results we use the conventional past tense. However, occasionally when presenting the concerns and dilemmas of the interviewees we use the present tense to emphasise the process of reflection of the students.

However, as for David, this experience was interwoven with other elements such as study strategies and teaching methods.

For one of the interviewed students the challenges of entering university was not related to the content, but to the economic resources required – even in a tuition-free educational system. Emma had a disadvantaged background and was already during upper-secondary school living alone, taking care of her herself. Through a determined effort she managed to enter veterinary science, a highly selective programme.

In the interview right after her entering veterinary science she told about being stressed by the books being much more expensive than she could possibly afford, and she needed to move to a cheaper room to be able to continue studying. Finding a cheaper room had taken some time and effort away from her studying, and she told how she was lucky that her first course in chemistry was one of her A-level subjects from upper secondary school, so she could keep up with the pace without using a lot of time on it. On the other hand, she had not yet had the time to participate in the social part of the study life, which she hoped she could do now she had found a cheaper room.

Group 2: Students who to a minor extent encounter a gap

A second group of students only to a minor extent experienced a gap when meeting first year higher education. Of the 20 interviewed students, four were coded as belonging to this group. One of these students was Amalie who told that choosing molecular biomedicine seemed obvious to her. Her parents studied biochemistry and molecular biology and two of her grandparents were engineers and one within biochemistry. In upper secondary school Amalie told she considered studying molecular biomedicine because it offered a way into researching the body, health and diseases, without including the clinical part of medicine. During her gap year, Amalie visited the molecular biomedicine programme at the university and in the interview during her gap year she told how the study programme was very research oriented and her description of the courses she would take during the first year, the content, the teaching and the organisation of the study was very concrete and accurate. That level of accuracy was unusual in the students' narratives.

When interviewing Amalie again after entering molecular biomedicine she had experienced the academic requirements in organic and inorganic chemistry as suitable. During most of the interview Amalie talked about the social environment and the culture at the study programme which really fascinated her. She explained that she spent a lot of time and effort with her fellow students, something she perceived as a future investment:

> The more you feel committed to your studies, the more you feel like you want to stay and make an effort. People who didn't really do this, they've been sitting kind of alone or maybe considered, not actually dropping out, but thought that it was boring. When that's how you feel, it's the social that helps you keep committed (Amalie h1a).

When asked whether the study programme had met her expectations, she explained that she was positively surprised by the social part of the study programme and had become much more involved than she had expected.

Concerning the academic content she told that she '*did not expect to meet anything interesting during first year where everybody needs to get the same level*' (h1a). These parts of Amalie's expectations were apparently formulated in retrospect rather than in advance. At least she did not during the interviews made in upper secondary school and during her gap-year mention that she expected first year not to be interesting. Hence, it is difficult to say whether Amalie only encountered a small gap between her expectations and actual experiences due to a clear match between expectations and experiences (and only in the interviews did not mention that she expected the first year to be boring) or if it was a result of a successful renegotiation of her expectation (cf. the second part of the analysis). In any case, Amalie was content and believed to have met what she expected.

Also Bastian and Elisabeth had clear ideas about the studies they were to enter, and experienced an alignment between the expectations and the experiences. During upper-secondary school Bastian had been involved in a youth science association organising extra-curricular science related activities (seminars, camps, etc). Through this he had met students at the university and heard their perceptions and descriptions of what university mathematics was like before he

decided to enter the math programme. Elisabeth had very carefully read through a lot of material, talked with career counsellors and called the study programme to ensure that she made the right choice. Her expectations and what she experienced at university matched pretty well. The only thing that surprised her was the level in mathematics: '*It goes much faster than I have been used to. But I am happy, because I was often bored at upper secondary school, where it went a bit slow – so this pace suits me fine*' (h1a).

Both Bastian and Elisabeth had moved to a university in a different part of the country, leaving their friends and families behind. Elisabeth had decided on a particular programme that was only offered at one particular university and therefore had to move. She felt settled in the new city, and experienced an inclusive social life at the rather small programme (less than 20 students started together with her). Elisabeth was satisfied with the content, the level, the social life, the career prospects, and the housing.

Bastian deliberately chose a university where he had to move away in order to try something new, but was surprised how hard it was to find accommodation close to campus. Eventually, he had to settle at some distance from the campus which had hampered his participation in the social life at university because the last bus left early in the evening to his hall of residence. Moving to a new city made him feel a bit lonely sometimes, but academically his only surprise was how easy the weekly assignments were. Therefore, when asked to rate his sentiments towards the study at a scale from 0 to 10 (10 being very enthusiastic), he rated the study programme at 10, but the social experience between 2 and 3, because it had been hard moving, and he had not made any new friends yet. The interviewer asked if this took much of his energy, and he replied that it did: '*It's almost more important than doing well at the courses. Because, if I don't feel comfortable then I don't think I can complete it [the study]*' (h1a).

Summing up

The majority of the 20 students interviewed in both upper-secondary school and during first year at university experienced a gap between what they expected and what they experienced. The gaps mainly related to the content and the academic level of the programmes,

relating to the students motivation and the experience of what it was like to be a student. However, for some, the conditions outside the courses proved more challenging than expected.

Thus, the gap-experiences of the interviewed students are very similar to the points listed by Yorke & Longden (2004) as factors frequently mentioned as influencing non-completion: the decision-making (some of the students in our study made quite sudden decisions about what to study), the academic requirements, experiences with the programme and institution, and events outside the study (e.g., financial issues). We also find that more of these factors may be present for each student, and that they may interrelate.

The students experience difficulties with the academic integration (Tinto 1993), both in meeting the requirements (and hence being acknowledged by the formal system) and in experiencing the programme content as relevant and interesting (hence questioning whether the programme is right for them). The experiences of the students could both suggest that difficulties with one side of the academic integration could lead to difficulties with the other: Disappointing content could cause weakened motivation and less effort, which could cause decreasing achievements. Some students also experience difficulties with the social integration, while it for others (e.g. Amalie) is a way of getting through the challenging or disappointing academic experience. Similarly, Bastian's emphasis on the importance of improving the social life is related to the social integration as important for staying at the programme.

This leads us to two points: First, that the gap experience is the rule rather than the exception. Higher-education institutions should consider how to deal with this gap rather than to keep asking whether it is there. Second, that what may appear as insufficient academic preparation within higher education could be the consequence of disappointing experiences with the programme, or vice versa. The relation between expectations and experiences is a dynamic and a multidimensional one and should be considered as such.

The focus of the following section is how the students' experiences are related, how they cope with them, and with what results.

Part 2. Negotiation-strategies to bridge the gap between expectations and experiences

The first part of the analysis showed that the students in this study all, but to various degrees, experienced a gap between their upper secondary school narrative and their actual experiences with higher science and engineering education. In this second part of the analysis we will explore how students, when meeting a gap, use various negotiation strategies in order to become integrated and follow institutionally and culturally accepted pathways and reach a sense of belonging.

We divide the analysis into three sections each presenting five different negotiation strategies. The five different strategies are illustrated in Figure 1:

I. Students who encounter a small gap using few adjustments to align their identities and narratives to their experiences at first year. These are the four students from group 2 in part 1 of the analysis, and they use negotiation strategies D or E.

II. Students who encounter a big gap using few adjustments to align their identities and narratives to their experiences at first year. These students apply negotiation strategies A or C.

III. Students who encounter a big gap using many adjustments to align their identities and narratives to their experiences, applying negotiation strategy B.

None of the students in our study encountered a small gap using many negotiation strategies to align their identities to their experiences. When presenting the analysis we will zoom in on a few students' narratives across their transition process to higher education study programmes in order to provide a more thick presentation of the negotiation strategies.

A: Coya, Christian, Benjamin, Emil, Djemal,

B: Belal, Emily, Frida

C: Barbara, Erika, Emma

D: Filip, Amalie

E: Bastian, Elisabeth

> I.   Students who encounter a small gap using few adjustments to align their identities and narratives to their experiences at first year (strategies D and E)
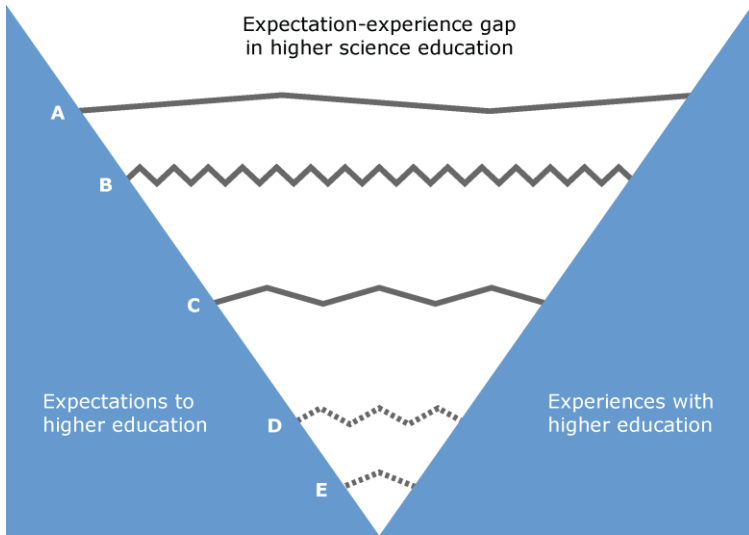

Figure 1: Students' negotiation strategies in their transition to higher education.

In upper secondary school, Filip explained how studying engineering was the only right way to go for him. He was not yet sure which study programme to choose, but in any event he expected engineering to be problem based, hands-on applicable and related to real-life engineering business. His uncle was a professor at the technical university and he had other relatives who were in engineering as well. Asking him about what kind of academic content he expected to meet he replied that it would be science combined in different ways depending on the study programme, but with a large amount of mathematics no matter what.

Filip belongs to group 2 in the previous analysis consisting of students who to a minor extent encountered a gap. He had articulated

expectations of the academic content he expected to meet even though he was not sure of what study programme to choose. In his narrative he drew on his knowledge of what engineering is some gained from his family: '*Of the universities providing science this is the one which is ranked the highest on all those lists, and the one having the biggest budget to use on their students. Then I have a family who are related to it, an uncle who is professor – different things which means that it is in the family'* (Filip, us).

Like other students in this group, Filip had incorporated this knowledge in his narrative and his expectation of what studying would be like. He ended up choosing mechanical engineering, and he was not in any way surprised by the content of the programme. He explained how his motivation for studying was cross disciplinary:

> I have a dream of opening my own business. I am looking forward to work with management. How to manage craftsmen when building something? I'm interested in the human aspect, too. People don't think engineers work with humans, but I think they just do it in another way than doctors or therapists (Filip, h1a).

Filip explained how first part of Mechanical Engineering is about cars, turbines, windmills and mechanics whereas management would come later: '*It is that part [management] which interest me and the first part is more something I need to go through' (h1a)*. When interviewing Filip one month later, his narrative had completely changed. Now he explains how he primarily wants to focus on energy and secondarily on management – quite reversed of the month before:

> My tutor (a professor) says don't focus too much on management. It is too arrogant to enter the labour market as a new engineer and say "I want to be a leader". Get some more clear-cut engineering skills instead, he said. My conclusion is to study energy and then combine with some management later. It is an important challenge for the world to face in the future (...) I also began recognising that management is also tough and hard work (…) (Filip, h1b).

Filip explains how energy is important to know about in terms of the expanding focus in society on windmills, hybrid cars etc. There will be a lot of future jobs to get in the energy-business too he explains, where he as an energy engineer will be attractive to the employers. He tells how this business will suit him fine: '*I like the thought of participating in an important area, which can change something in society'* (h1b).

Even though Filip's expectations to a large extent were met, he still needed to renegotiate his expectations when his narrative was questioned by his tutor. This represents a turning point from where his narrative is negotiated in terms of what he perceives as being recognized by the institution as a legitimate content and perspective, namely to focus on clear cut engineering skills rather than considering the engineering disciplines to be stepping stones towards an interest in management.

Filip ascribed new meaning to his perspective with studying engineering from '*being interested in working with humans like therapists do*' (h1a) to '*doing something important for the society'* (h1b). Furthermore, he made management less attractive, and hence less interesting in his narrative, by noting that it was 'also hard work'. In that sense, the change in focus presents itself as the result of his reflections of what is attractive.

When Filip was interviewed during his second year, he did not mention management at all, and when asked when he became interested in energy he replied:

> I've probably been interested in many many years. When I was a kid I found motors to be really cool and once I found nuclear power to be really awesome. And thats energy business too, so it's really many years ago (Filip, h2).

In using the word really *many years* Filip emphasises the authenticity in his choice of becoming an energy engineer. Based on narrative psychology this is an example of how Fillip's change of future perspective also affects his narrative retrospect. Maybe he has been interested in motors before, but it was not an important part of his narrative before he entered the university. In Filip's narrative a negotiation takes place during the first year where he redefines why

he wants to study engineering, what he wants to work with and why. The negotiation runs through a process where he:

1. Recognizes that his narrative does not fit into the culture of his new study programme.

2. Makes new sense of what a proper engineering student is.

3. Finds a way to become a proper engineering student which requires him to make new meaning of why he is studying engineering and what he wants to do with it.

4. Eventually gain a sense of belonging.

The example shows how students' choice-narratives do not stop when entering higher education, but are re-negotiated as new choices take place. Further, the example shows how Filip performs substantial identity work when bridging the gap in between his upper secondary narrative and his experiences. Not only does he shift his focus from management to engineering, but also shifts from issues related to people to technological and societal issues.

However, even though the gap may appear relatively big from the outside, Filip does not appear to perceive it as problematic to bridge. It seems uncomplicated for him to transform his narrative and to relate himself to what he perceives as the requirements of the study programme. What is more, he apparently succeeds in renegotiating his strategy in a few rather short processes. This is why we in figure 1 categorized Filip's negotiations as type D. The narrative of Elisabeth, that we presented in the first part of the analysis, is an example of a student who only to a limited extend encounter a gap and smoothly gets integrated in both the social and academic part of the study programme. Therefore, she needs very little adjustment of her narrative and her negotiation strategy is labelled E.

II. Students who encounter a big gap using few adjustments to align their identities to their experiences at first year (strategies A and C)

We will now continue to explore students encountering a big gap and their negotiation strategies. This section presents negotiation

strategies where students make few adjustments even when facing a big gap when entering higher education. We will present three examples of these strategies.

During his gap-year, Christian considers studying computer science. He explains how he is interested in solving computer problems, and that is what he expects to meet when choosing to study computer science: '*We will get to make some solutions for companies. If a company need some stuff to work together, then we can make a project out of it*' (g1). When meeting him right after the summer holidays he has just entered software engineering at the technical university. Christian explains that *'to me my study programme is about programming'* (h1a). In the following interview after he has been studying a couple of months he tells that the only programming assignment he has had so far was too hard to solve, and it seems to him as if everybody has more programming experience than him. Further, programming is only a minor part of the first semester, and Christian struggles with the course in general mathematics, which he finds too hard to relate to his interest in programming. Christian explains how he needs to pull himself together in mathematics, and he is really articulated about how he needs to organize his time better. Only, he just has not done so yet, he explains, because he is too lazy to keep up the pace. However, that interview also suggests that his laziness might be related to his lack of interest in the study programme:

> Researcher: What do you consider being most interesting academically right now?
>
> Christian: Nothing really… [lowering his voice] uhm no, right now I find it all kind of boring because it is quite much up hill at the moment, I do not find anything in particular to be funny. (Christian h1a)

Christian tells how he expects programming to make a difference in his experiences of studying '*when I begin for real to do programming and I can make some programmes myself, then I will consider it just as cool as playing computer and much cooler than watching the television*' (h1a). Here, Christian both note that a change in the teaching content could affect his motivation, and he mentions two rival activities to studying: playing the computer and watching television. When interviewing him again two months later, he is still struggling to find his motivation and keep up the pace in

mathematics. He likes the course in programming where he learns different programming languages, but there is little room for actually making programs himself, he tells. Instead of making the assignments in mathematics he has begun making his own projects at home:

> Yesterday I used my entire evening annoying my friends on their computers by putting in some files to open Internet Explorer at a particular homepage after some time- or to delete their password and delete their administration password from their computer and stuff like that (Christian, h1b).

Interviewing Christian the third time during his first year he is finally taking a course in software engineering, but he finds it extremely boring partly because he cannot see any use of it. The course is about programming small pieces of larger software programme, but as Christian is seeing it, *'we would never be doing that [the larger programme] for a long time. So,it just seems so unreal, so irrelevant' (h1c)*. The other courses he is taken appears equally pointless: '*I have software engineering, statistics and probability theory, algorithms and then mathematics, and I feel kind of – what's the use of them?'* (h1c).

Christian eventually stops attending most of the lectures, and he only hands in the absolutely necessary assignments, some of which he copies from other students. Instead, he spends all of his time doing, as he says, small projects like penetrating testing with a group of friends at his hall of residence and going to social cafés and parties at campus. Actually, he explains, 'penetrating testing' means hacking, but it can be used to secure companies, too. The holiday to come he is planning to take a private computer course to learn even more. In their latest informal project they made a programme that monitored the campus network, and listed the most popular porn-sites accessed from campus.

> What I find cool about penetrating testing is that there are always new challenges. If somebody says 'find an entrance' you really have to work for it, new challenges all the time, and you acquire a lot of new knowledge (Christian h1c).

Christian's narrative shows that software engineering does not meet his interest in programming. He finds the programming he learns to be interesting, but it is not applicable enough to enable him making his own computer programmes. When finally getting software engineering as a course, he cannot see the use of it.

All in all, Christian finds it hard to recognise the study programme he imagined in the courses he experience. Although he passes the exams and hence is formally academically integrated the content of the study fails to catch his interest and motivation and he distances himself from the programme. Instead, he creates a parallel subcultural software engineering programme with the 'penetration-testing projects' as a core activity. Hence, he is not academically integrated in the official academic community at the university, but is deeply involved in an academic subculture. Through this he is also socially integrated, both with friends at the residence hall and being involved in the planning of the university's official induction programme for the students who will be entering the university the following term.

 Christian finds a way to keep his narrative of applicable programming being his major interest even though he finds it hard to realize at his study programme. His negotiation strategy consists of changing his academic focus from the formal teaching to the informal learning environment of the hacking community, something that he also conceives as being academically relevant for his future career. His adjustment does not concern his interest or perspective, but the context on involvement. Christians negotiation strategy is A. He is facing a big gap, but his narrative does not undergo major negotiations – it is merely adjusted a few times in terms of the activities involved and because he can fulfil his interests in the parallel community he endures the formal programme as well. This strategy does not appear to conflict with Christians perception of becoming a 'proper' engineering student, except for his sense of being 'lazy'. Whether it is a viable strategy in the longer run achieving an academic integration in the hacking community instead of in the formal academic community is an open question.

Djemal and Emil who has been presented earlier in this paper are examples of students who also have a negotiation strategy A, but in a different way than Christian. As mentioned previously, Emil finds it hard to recognize the biochemistry he opted in for. In an interview at the beginning of his second semester he tells that he does not attend the lectures any more, but come in to do the exercises, but he does not

feel motivated for the study. Furthermore, he has no study group since one of the members left the study and the other has a different lab-schedule than Emil. However, he finds it easier to study by himself than finding a new group. He does not attend any social activities at the study programme either, but prefers spending time with his girlfriend and friends outside campus. He says that as long as he believes things will become better he can endure a period with little or no motivation, and hopes second year improve. This is what retains him at the study:

> But if I were to opt out it should be because I found that this was the wrong study I had chosen. Otherwise, I think I could easily choose to say 'well, it will get better'. As long as I expect ... or think it will be better, then I can do it (Emil, h1b).

Emil still hopes his study programme will one day meet his expectations and in some of the courses he occasionally catches a glimpse of that which he considers interesting. At the moment the only thing that Emil highlights in his narrative as being interesting is his book in organic chemistry, and he explains how it is supporting his motivation for keeping on studying '*this is interesting and there are some really great things in that book, and then I think it is great and some day it will be fine'* (h1b).

In the beginning of the second year he still is not involved in the social life at university, and he had to do a project alone because everybody else already had a group beforehand through their social network. In spite of his finding more visible relations between theory and practice at the second year teaching he believes he made a wrong choice and he cannot imagine himself continuing at Master's level at the study programme: *'If I could turn back time 1½ year, I would have chosen the technical University'* (h2) and his plan is to move there after having completed the bachelor's programme.

Emil has renegotiated his narrative a couple of times during his time at the university. First, he had to change the narrative of him being a student from the highly motivated and absorbed Emil to the Emil patiently waiting for the lab work and the teaching to become interesting. Then he had to develop a narrative where the horizon for change was a bit more remote, and where the reason for staying was a combination of his idea of the programme still being what he wants to

do and of dropping out being a waste of time. In the final interview he has developed a narrative of it being a waste of time to leave the study, but he will change to something interesting at the master's programme. This final narrative both contains the field of study as in principle being the right one (only the programme was wrong) and it draws on his persistence – that he can stand it, because it would be a waste to quit.

The same idea of endurance is present in Djemals narrative that we presented earlier. Both Djemal and Emil experienced disappointment in the academic content and they did not become socially integrated either.

Emil, Christian and Djemal are examples of students who stay in spite of a big gap between expectations and experiences, with a hope that things will get better. They share this disappointment and that they do not expect to become academically integrated. However, while Christian develops an alternative academic integration, Djemal and Emil remains isolated. Likewise, Christian is socially integrated at the programme while the Djemal and Emil are very peripheral in the social life at university. Christian actively develops integration into an alternative academic and social community, while the two others merely stand back, give up on integration and hope for things to improve. What the three of them have in common, though, is that they succeed in renegotiating their narratives in one or a few processes. This is why we categorize them as having a negotiation strategy A. In total five of the students are categorised in this negotiation strategy making it the one strategy with most students in it.

Another strategy where the students only experience few renegotiations is the one labelled C (figure 1). Students with this pattern experience a smaller gap than the students in strategies A and B, and their strategies to a large extent are similar to that of Filip (strategy D). However, the students with negotiation strategy C differ from strategy D in terms of whether they experience it as problematic handling the gap or not. Emma (cf. the previous section) is an example of a student having the negotiation strategy C. She had clear expectations about what to expect, but to some extent met something else – something she experienced problematic to bridge.

III. Students who encounter a big gap using many adjustments to align their identities to their experiences (strategy B)

Another group of students encounters a major gap and engage in an almost continuous renegotiation of the narrative of becoming and being a student (that is, negation strategy B in figure 1). Emily is one such student.

Since upper secondary school, Emily had been sure that chemical engineering was the right study programme for her, and she visited the technical university to be sure she was about to make the right choice. Nevertheless, a couple of months after having entered the programme she is frustrated by what she has experienced:

> The first semester is supposed to be hardest. We have assignments and tests all the time, and it is hard to keep track of all the concepts and you also have to get used to the books being in English. And we will soon have an exam and it's a bit stressful with this 'everybody fails this course' all the time. Yeah, great! (h1a)

Both the academic content and the academic culture with many tests stress Emily. Further she explains how she is confused by most of the courses and the teaching:

> He [the teacher] derives some crazy formulas by doing all kinds of exaggerated stuff and you can't recall all the rules in the world and he is really bad at writing down each step and then all of a sudden he is finished (h1a).

Emily spends all of her time on studying – sometimes together with other students, but usually alone since there are no formal study groups. She is frustrated by the content not always making sense to her, and she finds it difficult to learn by heart the way she feels she is expected to. She consents that it can be useful to know things by heart, but she is not happy with the way it is practiced at the programme.

In the second interview two months later, she is still frustrated by her study experience, both about the content and her own participation. Her interest in engineering is '*that you describe real life, and find out*

how things work to make them better' (h1b), but so far she has not met much of that yet. She explains that, '*you need to start at a low level, but uhm well…l I think it will come later'* (h1b). Furthermore, she still experiences the teaching to be difficult and the amount of work to exceed what she could manage causing her to experience not understanding anything at all.

Apart from expecting that she would meet the content she found interesting later, Emily believed that to become more satisfied with her studying she needed to improve and to study even harder than she already did. When asked what she hoped things would be like in the spring she replies that

> I will have everything under control concerning preparing myself and asking questions to the lectures and to use my time more constructive instead of coming home, collapsing, and being stressed, and not just getting it over with (h1b).

During the autumn semester, Emily kept her thoughts about her difficulties in meeting first year to herself. Emily for the first time articulates them by talking to another student about what to do if failing the first semester exams. The other girl explains how she thinks one need to get through first year before being able to make the decision of staying or leaving. Through this talk, Emily realises that she is not the only one facing difficulties, and getting her problems recognized seems to give Emily believe that it might be possible after all to get through the programme:

> I was so overwhelmed by it being really tough and when you have the feeling of not understanding anything it is hard to find it fun to study. But I would really like to work with this afterwards and now already half a year has passed and it might be possible to get a bachelor after all (h1b).

Emily's motivation for becoming an engineer and her interest in chemistry eventually is not enough to keep her at the study programme as was the case for Emil and Christian. During January she seriously considers to opting out because she finds it too hard to cope with the gap between what she considered herself to be like and the engineering programme and eventually do so in February:

> I felt myself being stupid in all the courses and I couldn't figure things out. I was not motivated to study and it became too tough and I did not feel that I could keep my self-confidence and self-respect when I got the feeling of being stupid every day. Then I thought I needed to make a plan about what to do (h1c).

For quite some time she had doubts about whether to continue studying or not, and at the end she had attended classes without studying for them, and then after a couple of weeks decided to stop. In an interview some six months later, she told that it had been a difficult decision because she experienced leaving as a huge defeat and she was emotionally quite affected by the decision.

In Emily's narrative we see how she struggles with negotiating a narrative in where she can keep an understanding of herself as being a 'good student'. Across the interviews during her first year there were both changes and consistence in the way she described and reflected on the first-year experience. On the one hand, she was critical of the teaching and learning experience: She struggled with making meaning of the content and she experienced it to meet her interests, she found the teaching confusing, and found it difficult to learn by heart which she conceived as being the way of learning expected of her. On the other hand, she internalized the problems relating them to her not being clever and hardworking enough, and the solution to be that she just needed to put in some more effort.

During her six months at the programme and the three interviews the emphasis of her narrative shifted from focusing on the pace and quality of the teaching delivered, to increasingly perceiving herself as someone who not just have some difficulties she needs to overcome, but as one who finds it hard to understand the content. Along with her concerns regarding the content and the teaching she was also grappling with the social relation to group members in her study groups. This gradual change undermines her idea of herself and after having left the programme she told that by the time she decided to leave '*I just felt that I was the weakest person in the world*'. After leaving, Emily worked at a café, and even if she expected to enter some educational programme later, she was very unsure about which direction to pursue, while she immediately after leaving the

programme expected to return to the technical university she six months later was certain that she would not.

Emily was continuously reflecting and renegotiating her experiences with the programme and in this process she adjusted and changed the interpretation and explanation of these experiences. Hence, her negotiation strategy follows the pattern labelled B.

Another example of a student who experiences a huge gap in between his expectations and actual meeting with higher education is Belal who studies computer science, and whom we also categorized as having a negotiation strategy B. Belal expected computer science to be '*a lot about coding and then some mathematics alongside'* (h1a), but he was surprised to find the opposite. He found it difficult to figure out how to study and how to make the assignments: '*It was like standing in an abyss looking up without being able to get up because you don't really know what you are supposed to do with the assignments' (h1a).* Belal describes how he '*panicked and did not know what to do'* (h1a).

Many components come together in Belal's narrative of how he managed to bridge the gap. He explains that when being the most frustrated he attended a presentation organised by the union for computer scientists about job perspectives, and he got motivated by one of the presenters working in the computer gaming industry: '*I might do something boring right now but when I finish I can go out and do game programming, graphical things or stuff'* (h1a), something that 'people' (he did not specify if it was staff or students or both who told him that) at the study programme had told him the computer science programme was not really useful for.

Another turning point in his narrative related to the social integration. In the beginning, he made a lot of the assignments by himself at home, and when meeting with his study group he felt he was the one having the most difficulties. He felt he needed to do something about it, and therefore changed to a study-group that did their assignments together at campus instead of individually at home: '*Sitting together makes it easier to explain and work together to solve it'* (h1a). Working in groups also made a difference in terms of being aware of his performance by getting feedback from the others. Belal's parents are from Yemen, and they prefer him staying at home in the evening, but he agreed with his parents to stay at campus studying in the evenings. He then used most of his time at the university, meeting

with his study group and getting involved in arranging theatre and movie-nights etc. He explains how he during the first semester learned to study properly. When the new courses began just before Christmas, Belal, used another study strategy, partly because older students had told him that the most important was to learn the basics of the course during the first two weeks, then the more complicated stuff later in the course will seem less difficult. Therefore, Belal and his study group prepared themselves carefully before the courses started, finding out what they were supposed to learn, and beginning to study before the course started. It worked: *'When we came to the first week we might just as well have skipped the lectures because we were so much into the stuff' (h1b)*. Still, during the winter Belal fails both his courses, and interviewing him again at the beginning of second year he tells how he after that point engaged himself even more socially and by attending more presentations of 'What to become with a master in computer science' he felt sure that he still was on the right track: '*I decided to stay even things went (smiling) well, not so good' (h2)*. Finally reaching the summer holiday, Belal decided to work on his lack of programming experience, without it being a formal explicit requirement, he finds it to be crucial for attending the study programme.   Despite there are no formal requirements of having programming experience when entering computer science, he still perceive it to be one of the reasons why he failed:

> Being in Yemen, we spend most of the time with our family. And they have this thing with resting after lunch and I don't really. So I just sat programming 2-3 hours a day (Belal, h2).

Belal found a book with some assignments online, and bought another book and taught himself how to programme in two languages during his holiday.

Throughout Belal's narrative we see how he negotiates how to bring together, on the one hand, his own expectations, experiences, and perspectives and, on the other hand, the formal and the implied expectations and requirements of the programme. This negotiation occurred in several steps where Belal tried different means and strategies to deal with what he perceived as the causes of his difficulties in order to succeed at the programme. These strategies included changing his own study habits (staying at the university,

trying to read in advance), changing his social integration at the programme (changing his study group, involving himself in social activities at the campus), defining an end goal that could give meaning to enduring the courses (the prospect of working in the gaming industry), and adjusting his own knowledge base so that it matched the implied rather than the formal requirements (learning how to programme). These strategies were developed and applied along the first year in relation to a number of turning points. These turning points both related to the formal academic integration (e.g., failing the courses), to the informal academic integration (e.g., being surprised by the amount of mathematics), and to the social integration (e.g., experiencing that the study group was of little help, and of the informal student environment at the department provided a resource for getting through the courses). These turning points also related to changes in the way he perceived himself as a student.

Hence, like Emily he was forced to continuously renegotiate his conception of and interaction with the programme and like her this both included issues related to the content, the teaching and the sense of self. However, as opposed to Emily Belal succeeded in adopting strategies (both in relation to the academic and the social integration) that meant that his experiences did not develop into a fundamental lack of believe in himself, just as he managed to establish an end goal that could compensate for the disappointment in the study content. What is noteworthy is that the support and ideas for the strategies adopted by Belal came from older students or from somebody outside the programme – not from teachers or the programme curriculum or teaching-learning activities.

The examples of Emily and Belal show how some students negotiate their narratives when they face a gap and their choice-narratives are being challenged by their study programmes. In both cases, we see how these students continuously change their point of view of what they should do to become a 'proper' student are and how they negotiate their identities to become one. This group of students experience huge frustrations of being in this gap why they ceaselessly try out different strategies to bridge it.

Discussion

The previous sections have presented an analysis of the narratives of twenty students at different stages in their transition from completing upper-secondary school into a higher science and engineering education programme. A result of the analysis is the far from the trivial point that all the students to some extent experienced a gap between what they expected and what they experienced when entering the programme. Therefore, it is the rule rather than the exception that the students need to adopt negotiation strategies to cope with the gap.

A focus of this paper has been to study the way students negotiate their narratives when meeting the study programme they enter and experience a gap between their expectations and experiences. We identified five negotiation strategies that both differed in terms of the gap, the strategy needed to bridge and in terms of whether the students managed to renegotiate the narrative in few steps or whether the renegotiation occurred continuously through the first and even second year (cf. Figure 1). The renegotiation in some cases helped the student to stay at the programme while others opted out at the end. These findings raise a question as to why some strategies are successful for some students and not for others, and why some students employ one negotiation strategy and other students another. We emphasise that our discussion of these two questions is precisely that – a discussion – rather than a conclusion. Answers to a 'why' question in this kind of study can only be tentative, albeit rooted in empirical evidence.

The foci of the negotiation strategies

The analysis showed that the experienced gaps were mainly related to the content at first year, the difficulty of the courses, and the teaching and learning methods applied at the programmes. The content-related gap partly had to do with the sequence in the curriculum, frequently a mountain of auxiliary disciplines (typically math) and the content of the programme the students had applied for only being visible somewhere in the distance. However, the negotiation strategies applied by the students differed in focus.

Some students renegotiated the content of the course – either their conception of interest or by organising supplementary content. Filip (strategy D) succeeded in transforming his interest to something legitimate and hence recognisable from the academic community at the discipline (from management to energy engineering) while Christian (strategy A) gave up on adjusting to the expectations of the programme, but set up an alternative study programme of hacking. Through this, he avoided having to negotiate the content of the course. Conversely, Djemal (strategy A) persistently tried to meet the expectations of the programme and through this becoming a legitimate student at computer science, but did this partly by moving his focus from the programme to what he would meet after graduation. A parallel between the strategy of Christian and Djemal was that they used other students as facilitators, not teachers or other staff members. However, the three of them all succeeded in constructing a narrative that could include their interests, their experiences and their expectations.

Other students refrained from renegotiating the content and instead directed their attention and narratives towards the social life at the study programme. Some had adopted that strategy before even entering university, while others did so after having experienced the gap between their expectations and what they met. These students as for instances Amalie (strategy D) who did not expect to meet interesting content in the educational programme instead planned to prioritize the social felt both at home and with her fellow students. This could be done by for example prioritizing study groups, which turned out to be crucial for the survival of some of the students. Even students with strategy B who needed to put some effort into the renegotiation of the narratives could succeed in reconstructing it in a way that made the experience positive, even when it meant accepting that the exams were passed, but the matter examined is not understood.

Compared to this, Emil had renegotiated his narrative as one of deferral, waiting for the bachelor programme to end so that he could change to another programme. He was an example of a student who had adopted an air of resignation (strategy A). This highlights that less negotiation activity is not necessarily a better strategy. So far, the different strategies could have foci at the content, at the social life, and at postponing the expected. For some students, however, even these strategies were not enough.

The most pronounced example of this was Emily (strategy B) whom we have already presented at some length. She did not settle with learning by heart but wanted to understand the content taught, even though she found it difficult. Through the consecutive interviews ran a continuous negotiation that included her being unsure if she was clever enough, if the quality of the teaching was the reason for her difficulties in understanding the content, if the study was the right choice for her and her difficulties with seeing the end goal of the programme. In the final interviews, social disagreements in her study group emerged, too. That she also failed her exams at the end of the first semester was not what made her decide to leave. What eventually made her leave the programme was a fear of losing herself that was reinforced when she experienced difficulties understanding the second-semester courses. Staying at the programme would require major negotiations which she did not find possible to align with her sense of self. All in all, the foci of students like Emily were to construct a consistent narrative that included a sense of meaning in the programme, a sense of perspective in the content, and a sense of identity being a student able to tie theses ends together.

Components affecting whether the strategy is successful

Which strategy the students apply does not in itself predict whether a student will opt out or not. Of the students having left their study programme we both find some applying strategies A and B. None of the students applying strategies C, D or E had left their programmes at the end of the first year, although both Emma (strategy C) and Bastian (strategy E) showed some vulnerability due to economic and social difficulties. Therefore, it appears that the size of the gap is of importance to students' non-completion, but also whether a large gap at one parameter (e.g., the content being different) could be compensated for by other parameters (e.g., the social life at the programme).

Some of the students who experienced extensive difficulties at their programmes had a strong determination to get through. One of those, Djemal (strategy A) , consciously integrated himself in the social life at the programme, while both Belal (strategy B) and Emil (strategy A) remained socially peripheral, although it was difficult to decide whether it was a deliberate strategy or if they would have liked to

participate in the social relations at the programme. As it turned out in their narratives, they were examples of students who did not seek to become integrated to the programmes. Both of them reconciled themselves to wait for the study to be over and then they could move on to something interesting.

The question why some students applied certain strategies and other students adopted others cannot be answered in full. The students who experienced a minor gap had some kind of insight into the study programmes. It was not necessarily detailed knowledge about the programme, but a sense of the field based on the parents' own backgrounds as graduates within science and engineering or from extracurricular activities. Only one (Elisabeth, strategy E) had acquired detailed knowledge from study counselling or information material, but students whose parents had attended university themselves provided their children with a sense of what university would be like and what they would encounter. This could indicate that students' socio-economic background is of importance by providing the students with general sense of what studying is like.

Even though the reflections behind the students' choices differed markedly between the interviewed students, we could not conclude that students who had been careful in searching information were less exposed to non-completion. Likewise, we found no indications of students entering university sciences being more or less disappointed, confused, or adopting different strategies than those entering engineering. The line of study did not seem important as such – but in relation to the different students' different expectancies.

Tinto's model of institutional departure revisited

The results of the analyses of the students' narratives are generally in agreement with Vincent Tinto's model of student leaving (1993). First of all, the focus on time as a key element in student leaving is found in both the model and has proved important in our analyses. Furthermore, the students' renegotiations when they encountered the university could be considered as a part of the social and academic integration, and the different negotiations strategies depicted in Figure 1 could be considered different ways students could handle the integration process.

The gaps between the expectations, the experiences and the foci of the renegotiation strategies were for most of the students related to the academic system whereas the social system in many cases served as a part of the strategy to cope with the gaps. Some students consciously prioritised the social life (both arranged and spontaneous events as discussion groups, game groups, parties) at the study to increase the probability of staying at the programme, and other students experienced the social integration as an important resource for untangling the difficulties of the academic system.

As for the academic system, the needs for renegotiation were both related to the academic requirements (and, hence, the system accepting the students) and to the gaps related to the content of the programme (that is, the students accepting the academic system). Further, difficulties with the academic performance (e.g., passing the exams) interacted with students' experiences of the content.

Precisely the interrelation of the different elements in the model has to be emphasised in the light of the present study. Tinto's model indicates interrelations at each stage; however, some of the elements in the renegotiation strategies are not fully captured in the model.

First, the renegotiations taking place in relation to the institutional experiences and the integration were in some cases multifaceted and the students tried different ways of coping with the gap. Second, the academic system should be considered in the plural. Even if the programmes had dominant conceptions of the proper content, interest and way of being a student, some of the students related to different academic communities, some of which were informal subcultures. It seems that one viable way of dealing with the gap is to relate to an academic subculture, but that is not visible in Tinto's model.

Third, the issue of identity is absent or strongly downplayed in the model. Some of the students in this study experienced that the study programme had damaging effect on their identity and at the end they had to leave in order to preserve their sense of identity. That academic and social integration means more than finding a way into the discipline. It means renegotiating the identity in a way that is both sensible and legitimate for the student him- or herself and for (one of the cultures at) the study programme.

As we commented previously in this article, we do not consider the issue of identity as incompatible with Tinto's model. However, the analysis of the different renegotiation strategies in relation to the students' narratives, and the importance of identity emphasises that this is indeed a highly important element, yet not highlighted in the model.

A revision of the model would, in the light of our study, emphasise the presence of more than one academic system, of the question of identity, and of the dynamic nature of the renegotiations, not just occurring through a number of stages, but going back and forth. This could also make it more sensitive to the difficulties of students with a social, cultural, ethnic or economic background that makes the integration process more laborious.

Conclusion

In the present study we have showed that students arrive at university with expectations about what to meet and what to experience, and that virtually all students experience a gap between their expectations and their experiences. The gap can relate to the content of the programme, to the academic requirement, to the teaching and learning activities, but also (but less common in our data) to the social environment or to financial requirements attending the course. The students apply strategies for renegotiating their narratives of why they are at the programme, about what kinds of students they are, about what the programme is like, etc., in order to construct a narrative that can include both their experiences and their identity.

Some students succeed in constructing a narrative where they change their own focus of interest, while others defer from expecting the study to be interesting until later or even at all. In that case, they can focus their narrative on the social integration at the programme, or they can refrain from expecting to become integrated at all.

The renegotiation involves several elements of study life (both academic and social) and as such is a complex endeavour. For some students it is a continuous process through at least the first year of study where the students strive to make sense of what they meet. As such, it is also a vulnerable process where students even if they enter the programme determined to complete it experience difficulties in

constructing a viable narrative and therefore often need to consider leaving the study.

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8. GENERAL DISCUSSION

The longitudinal study presented in this dissertation has provided a window to understand the complexity of upper secondary school students' choices, and transition into higher education STEM study programmes, and their considerations of staying or leaving. Through a narrative psychological methodology it contributes to the field of science education with an understanding of students' choices as continuous identity processes over time, where choices are repeatedly negotiated. The work presented here dealt with following research aims:

- To understand Danish students' choices of what to continue studying after upper secondary school and in particular how their perceptions of- and expectations to STEM higher education relate to their choices.
- To explore the relation between students' STEM-choices, their experiences of the transition process into higher education and their considerations of leaving and staying.

The Discussion is organized around the research aims in three parts. The first section (8.1) relates to the first part of the research question, and concerns students' higher education choices in general. The part of the first research question that concerns students' STEM-choices is discussed in the second section (8.2) and finally the second research question is being discussed in the final section (8.3). In each of the sections I point to some of the implications of the results in my dissertation, although I am fully aware that my findings cannot directly be implemented in practice without carefully considering the context and culture of the particular practice. Rather the implications are to be understood as recommendations that need to be adjusted in order to be applicable in practice. Finally, I will end the general discussion by reflecting on and evaluating the strengths and weaknesses of the applied methodology in the dissertation.

8.1 How do young people choose what to study?

This dissertation meets the call for research to move away from constructing comprehensive models that attempt to map the components that direct students' choices (Bergerson, 2010). Rather the dissertation offer qualitative explorations of what makes *a sense of fit* for the individual student (Bergerson, 2010 p. 114), i.e. what makes a student feel that a choice is right. By applying a narrative psychological methodology, I show how upper secondary school students' choices are embedded in their identity-work, and how they struggle to reach a *sense of fit* of various interests and still keep their sense of self.

When choosing what to study after upper secondary school, young people face an important turning point where new meaning becomes available, and where they are faced with a requirement to reformulate their narratives about themselves and incorporate what they recognise as their future pathway in their narrative. The students describe the choice of study as something that must be unique and authentic. They require it to suit their perceptions of themselves, why they perceive it to be their *own personal* choice. This internalization turns out to have some consequences. The results show how the students balance rather complex and sometimes ambiguous considerations by themselves, which they struggle to formulate into a coherent choice-narrative. First of all, the students try to identify their interests, and to match them with potential study programmes. Second, they struggle with accessing and making sense of the character, differences and content of various study programmes. Further and third, they attempt to figure out what kind of life in general and working life in particular these programmes eventually will lead them to. Not all of the students pay equal attention to all three, but in general they balance various interests with various future prospects in their identity-work, which they need to combine into a proper choice-narrative of whom they imagine themselves becoming; their future selves.

As a consequence the students digest rather complex considerations alone. However, the student's social network emerges in their narratives, but as tacit knowledge and not as explicitly as resources contributing to the choice-narrative. Rather the social network is used as a platform for trying the choice-narrative out; it is told, revised,

and adjusted based on how the social relations meet and inform it, but also according to whether the narratives are being recognised as suitable to whom the social network perceive the student to be.

Finally, the choice-narratives are continuously negotiated and this includes the students' perspectives of their future as well as of their past. Throughout the papers that contribute to this dissertation I, together with my co-authors, show how the choice of study-programme is not an isolated decision that takes place at one particular point in time. Rather it is a process which continues as the students enter their higher education programme and their choice-narratives are re-considered and re-negotiated.

From wrong choices towards match of expectations

In the introduction of this dissertation I show how the excising literature suggests that students' wrong and poor choices when entering higher education seem to be related to their departure and that *the making of a good choice is primarily the responsibility of the intending student, implying a significant level of personal research* (Yorke & Longden, 2008, p. 48). These conclusions are based on the premise that choosing what to study is the students' responsibility and that the students' efforts are related to whether they make good and bad choices. The same premise is in this study found to be predominant among the students themselves, when they point out the choice of higher education to be a personal responsibility (paper 1).

The research in this dissertation does not conclude that students make bad choices. Rather the students' choice-narratives in general are *carefully* constructed. Very few of the students make spontaneous choices. Instead, they strive to do their best to find a study programme that will suit them. The analysis in Paper IV illustrates how some of the students *in their transition* into first year STEM higher education change their perception of their choice and now perceive it as wrong. These changes occur when they decide whether to stay or leave their study programme. Wrong and poor choices, therefore, are also a retrospect way of making meaning of 'why I don't belong' when meeting the cultural context of higher education, hence a relation between the students' and their study-programme.

This does not mean that all students meet their study programme in the same way, even though all of the students in this study experienced a gap between their expectations to their study programme and their actual experiences with first year. Some students encountered a bigger gap than others. These students entered higher education with expectations that were hard to match with their actual experiences (paper IV). An important question, therefore, is why some students construct expectations in their choice narratives that do not match what they meet at higher education. Is this, as suggested by Yorke a Longden (2008), a question of whether or not the students do a proper job gathering information? The short answer is that more information is not enough. It is also a question of the character and content of the information, and the students' ways of making sense of this information. A more elaborated answer to the question is the following:

First of all, many of the interviewed students use their personal network as an important source for gathering and validating information about what kinds of study programmes exist, what it is like to be a student in that programme, and what kinds of jobs the study programme leads to. Some students therefore seem to get support in making meaning of information about study programmes, and use their social network as a place for adjusting their expectations, no matter how accurate this information they have access to might be. If we want students to hold realistic expectations of the study they choose, this is not only a question of whether the students find and read the right amount of information; it is also a question about their access to obtain, digest and make meaning of it. Thus, one recommendation is to work on creating support that includes the students' social network as legitimate and an explicit source of information. Counselling initiatives could address the social network both in terms of what it can be used for (for example, providing ideas for career perspectives) and what it cannot be used for (for example, family members' experiences of being a student at a particular study programme 30 years ago). In that way, the students could use their network more strategically, but indeed also more critically relate themselves to the information they access. However, attention must be paid to social reproduction. When the social network is used as a place to gather information and adjust expectations, students who do not have any persons with a higher education background in their social network are left alone. Therefore, counsellors are urged to find other ways to support this

group of students, a way to act as an alternative social network where the students can try out their choice-narratives.

In terms of counselling, a group of the students' choice-narratives reveals how the counsellor is not perceived as somebody to go to except for advice on specific formal issues such as formal requirements to gain access to a particular programme. One reason is that the students do not know the counsellor, and they explain how they consider an un-personal counselling to be incompatible with a very personal decision. Another reason is that the counsellor is perceived as somebody with an agenda striving to affect the choice of the student. Therefore, a recommendation for counselling is to *carefully* establish a room in where the counsellor can take the position as somebody who does not have the answer, and does not dictate the choice, but who supports the students in reaching their own conclusions.

Second, in choosing what to study at higher education, the students relate themselves to their potential study programmes in their choice-narratives. Choice of study programme not only has to do with the particular content and courses, but also to the (working) life recognised as becoming available when getting a degree. Most of the students seem to hold very general expectations of the study programme and only a few of the students express concrete expectations of the content. An important question seems to be how much students are required to know about the content they are about to meet? Do we require of the students to hold accurate expectations of what courses and content they will meet during their first year at university? The students already balance complex decisions in their choice; they should know which study programmes exists, what the differences are between them, what kinds of jobs they get access to etc. If higher education institutions expect students to know about what content to meet when entering first year, they are challenged with the fact that when upper secondary school students make meaning they do so from their current position. Hence, what is meant by 'lectures in mathematics' or 'solve exercises independently' can be difficult to imagine from the student's position in upper secondary school. Therefore it might be too optimistic to expect of the students that they on their own should become better prepared for what content they are about to meet.

In relation to this, a third relevant question seems to be what kind of information is provided by the institutions who are facing a still more market oriented competition for attracting students and the degree to which recruitment material seems to paint a realistic picture of the study programmes. One example of this is the picture on the front web-page of Biochemistry study programme at the University of Copenhagen. Remembering the case of Emil entering Biochemistry (presented in paper IV), it seems reasonable to question whether his expectation of meeting biochemical courses and lab-work in the first semester was due to insufficient research (cf. Yorke and Longden above)? Figure 4 shows the first visible picture at the homepage of Biochemistry, University of Copenhagen. The picture illustrates a student in a laboratory. Lab-work is one of three teaching activities mentioned on the front webpage. Therefore the question of poor choices not only concerns the student, but indeed also the knowledge made available to them, and the extent to which recruitment material and initiatives reflect what first year looks like.

Fig. 4 Front webpage at Biochemistry, University of Copenhagen

This dissertation shows that choices are embedded in *social* processes between the students and their social network, the student and political discourses, the students and the higher education institutions and between the students and various sources of information. Accessing, making meaning of and relating oneself to a potential choice of study is a complex process, also continuing when the students enter higher education where the choice-narratives are tested when the students expectations meet first year. Adjusting expectations in this meeting is considered to be the students' own responsibility. However this dissertation points out that higher education does indeed also have a role in how the students construct their expectations. To support future students in their choices, higher education could benefit from considering how to give the students an accurate idea of what they can expect to meet at first year. Picturing a large lecture in the recruitment material might not attract more

students to STEM, but the students who enter might have an idea of what they are going to meet. If we expect students to be better informed, we must consider telling them - and consider telling them in a way that is both accessible and truthful.

8.2 Students' STEM-choices

In paper II, students' reasons for not studying STEM are explored by applying Foucault's notion of governmentality. The analysis takes it point of departure in a group of students who point at a STEM-subject as one of their favourites in upper secondary school, but do not consider choosing studying it at higher education.

The group of non-choosers do not find STEM to be a point of departure for constructing an attractive identity. They expect higher education STEM to require them to submit themselves to certain ways of doing STEM; rigorous methods, strict rules and procedures, learning by heart. Their reasons for not choosing STEM are found within higher education STEM, which they expect to leave little room for governing their selves.

The students that do consider choosing a STEM higher education study programme, can be divided into two groups: 1. A group of students who expect STEM to be a point of departure for developing themselves and relate STEM to their everyday life and to themselves. 2. A group of students who expect STEM to be strict rules and procedures similar to the expectations of the non choosers. However this group of students' ascribe another meaning to these expectations, which they find to be a safe room with limited possibilities for interpretations and also a clear guideline for how to govern themselves. Comparing the non-choosers expectations while in upper secondary schools to the experiences of first year students at higher education STEM programmes, they are to a large extent quite similar. Their notions of STEM as a fairly rigid study with little room for self-development apparently are quite accurate compared to the first year students' actual experiences.

Recruiting students for STEM – not a question of branding

In the literature there is little agreement on which recruitment initiatives actually work (Boe, et al., 2011; Sjaastad & Jensen, 2011). In my dissertation I did not aim at researching the effects of recruitment initiatives, but based on the results of this study I would like to discuss what considerations might be beneficial for STEM higher education study programmes that wish to recruit some of the students who actually have an interest in upper secondary school science, but end up choosing non-STEM study programmes.

First, I would like to return to my previous argument of how recruitment material needs to give students an accurate idea of what is going on at a particular study programme for students to construct accurate expectations, and to act as a support in their transition process. However, this might present the institutions with a dilemma since what might increase retention might decrease recruitment. If the recruitment material reflects first year STEM, it might support the students in their transition process and even retain more students, because in those cases their expectations would match their actual first year experiences (paper IV). On the other hand, the results in paper II point towards that a proper presentation of higher education STEM would not be the way to convince the students who in upper secondary school hold a strong interest in STEM, but do not consider it as a future pathway.

If STEM study programmes wish to attract this group of students, the students call for STEM to provide a platform for managing their selves must be taken seriously. One suggestion could be to give students various options for engaging themselves in STEM. This study suggests that such changes would not only support the students that already choose STEM. The same changes would also attract the students who are interested in STEM, but who end up choosing something else. Opening up for a wider participation in STEM at the same time respects the group of STEM students who describe their attraction towards STEM, referring to the rigorous methods, the fact that there is a right and a wrong way of doing science, and one correct answer to each question. These students might not be ready to govern themselves and their own study. Teaching students with various expectations of STEM requires of the university teachers to

differentiate their teaching and include students with different ways of engaging in STEM. Recruiting more students to STEM, requires STEM to *include* more students, and hence various ways of participating in and engaging with STEM.

To give the students an accurate idea of what STEM is really like, might support the students in adjusting their expectations to the study programmes and increase retention, but it is not likely that it is the way forward to recruit more STEM students. My findings suggest that if STEM programmes wish to attract more students to higher education, STEM must look inwards to the way higher education STEM is structured and taught and strive at not only to attracting more students, but also to including more students.

8.3 Transition and retention in STEM

In the first part of the discussion I argued that 'wrong choices' might appear so in retrospect when the students had difficulties with finding a way to belong. An important question therefore is how to avoid that some of the students consider their choice of study to be wrong, and some eventually decide to leave their study programme?

A result of the review of the literature made on students opt out/ drop out in STEM (paper III) was the identification of a need for research to find a way out of reducing opt out/ drop out to be *either* located in the student *or* in the institution. It was suggested as a way forward for research to adopt a social psychological identity approach, perceiving identity as being a social process. This study has taken such an approach by studying students' identity-work and negotiation strategies during students' transition process into first year at a higher education STEM study programme (paper IV). The study shows that all the students experience a need to renegotiate their narratives of why they chose the particular study programme, how they belong to it, about what kinds of students they are, about what the programme is like etc., in order to construct a narrative that can include both their experiences and maintain their sense of self. As such, it is also a vulnerable process where students even if they enter the study programme determined to complete it, experience difficulties in constructing a viable narrative and therefore also often need to

consider whether or not they belong, whether their choice of study was right or wrong, and whether to stay or leave the study programme. When encountering the gap between their expectations and experiences the students apply different negotiation strategies to make meaning of the new study programme and to relate themselves to it. These findings are in line with Seymour and Hewitt (1997) who found that the students that leave and those who stay meet the same difficulties when they enter higher education. The results in paper IV show that both students who continuously engage in many renegotiations and students who need to negotiate their narratives and expectations fewer times before they gain a sense of belonging – consider leaving. However, the students differ in terms of how they make studying meaningful. Some students succeed in constructing a narrative where they change their interest, while others defer from expecting the study to be interesting until later or even at all.

Keeping more students in STEM

This dissertation points at three important issues that could help study programmes to support students in the process of gaining a sense of belonging at the study programme they have entered.

First, study programmes might consider if the content - particularly the first year courses - are explicitly related to what the programme in general is about, and whether the course sequence is right. Only few students in upper secondary school had clear ideas of the content they were about to meet at higher education. Some of the students were surprised and found it hard to make meaning of the content they met. A number of the students could not see the use of auxiliary courses such as mathematics until one or two years into their study programme, some could not see the point at all. One might wonder why these courses are the first that the students meet; and one might wonder if the purpose of the course in mathematics could be made more visible to the students and hence easier for the students to make meaning of.

Second, higher education institutions need to assume that new students face a gap between what they expect and what they meet. In other words, teachers at higher education must be aware that transition is a process of negotiation in which the student's narrative is continuously adjusted and thus changed, and that students' not

easily gets integrated in their new study programme. Students struggle with aligning their academic experiences and aspirations with their sense of identity. This means that attention should not only be paid to the students' abilities to meet formal academic requirements at a certain point in time. In terms of retention, the broader academic context of the study programme, and in particular the future possibilities of the study programme, opens another and just as important way for students to make meaning of the study programme and for the students to relate themselves to it. The latter point turns out to be particularly relevant for students who struggle to make sense of their courses.

Third, as reported in paper IV, only one student experienced that the academic staff supported him in renegotiating his narrative (Filip). This does not necessarily mean that no counselling is offered or that the students have not talked with their teachers at all; but it does highlight both the importance of the informal academic integration addressed by Tinto (Tinto, 1993) and that students turn to their peers rather than the institution when working on belonging. Consequently, higher education institutions seem to have little access to the process where the students consider whether to stay or leave, and are often not included until after the decision has been made. It could be worth considering how the student-staff interaction could be a factor in supporting the students' identity-work, both through formal academic initiatives as counselling/ -mentoring services and through the informal part of the academic system as student/ staff cafés.

8.4. Methodological considerations

Implications for future research

A key contribution of the dissertation is the longitudinal methodology combined with narrative psychology, which opens new viewpoints for understanding the *process* of choosing what to study.

This dissertation demonstrates that studies that perceive students' choice of study as an event taking place at one particular point in time, only give access to understanding part of the picture. First, such approaches fail to understand the process behind the students' choice of study. Second, focusing on the choice of study as an event in a

particular point in time, precautions need to be taken in terms of interpreting students' statements. In this dissertation I show how students retrospectively re-construct their narratives about how they *always* wanted to study a particular study programme. But this *always* serves as an indicator of the choice being authentic rather than meaning that the student *always* strove for a particular choice of study. Interpreting students' choices therefore need to be perceived as a process over time. For example, when students are asked how they came to study or why they decided to leave a particular study programme, the answers need to be interpreted as *rationalized explanations* from the present position of the student. These explanations need to be understood as expressions of the context in which they occur. That is, a choice might turn out to be wrong, but only in the light of the particular experience.

In this dissertation I show, how a narrative psychological longitudinal approach opens for such an understanding of *contextualizing the choice*. Any choice of methodology will highlight some perspectives while leaving others in a blind spot. The next section is about the limitation of my methodology.

Methodological limitations

Before concluding the dissertation, I wish to point to some of the blind spots that I do not cover in my research. First, the longitudinal design of my study made it impossible for me to control which study programmes the students entered. Therefore, I do not have any students at Physics or Biology - which are some of the larger study programmes in Denmark. The weakness of choosing an upper secondary population is the lack of predictability in students' choice of higher education. Future attempts to investigate students' transition into a particular study programme, would have to select a larger population to ensure that some students' would eventually choose to study that particular programme at all.

Second, the purpose of this study was to study the transition -process from a student perspective, having the students' narratives as the research object. This means that I only have had access to the surroundings through the students' narratives. Future studies could

benefit from combining students perspectives with other perspectives. For instance by attending to teachers or by highlighting how a particular study programme's design, curriculum, or academic culture facilitate students' narratives in certain ways.

I have not been focusing on differences between study programmes. Rather, my focus was on students' transition into STEM in general. Although the students in my study only encountered some study programmes I use STEM as an umbrella covering all study programmes, and therefore a third limitation presents itself. However, I expect that the findings of this dissertation are recognizable within STEM higher education study programmes in general, because many STEM study programmes, share common ways of structuring their first year. I do not, however, claim that my findings are generalizable to *all* STEM study programmes.

A fourth limitation is that I did not distinguish the group of students' in terms of social categories of gender, ethnic background and social background. A more nuanced picture of students' choices, transition and retention at STEM higher education study programmes might be achieved by doing so.

This dissertation aimed at extending our knowledge of the challenges students encounter when meeting science, engineering and mathematics. This approach proved valuable in understanding students' identity work over time when encountering STEM higher education study programmes.

9. CONCLUSION

This dissertation aims at providing knowledge about students' higher education STEM choices and transition and retention into first year STEM higher education study programmes.

The investigation of the first research aim suggests that the choice of higher education is perceived by the students to be an individual task, and that they struggle to construct a personal choice-narrative. In this process of identity-work, various interests coincide; Interests in and expectations of study programmes and ideas of an attractive life in general and of working life in particular. The choice -narrative is informed and adjusted in terms of whether it is recognized by the students' social network or not. While in upper secondary school, some of the students found it hard to match their interests in STEM with an attractive identity. This group of students did not expect higher education STEM to meet their interests and to provide a platform for constructing an attractive identity. They expected that higher education STEM would engage them in rigid methods, strict rules and procedures, which would provide them little room to develop and govern themselves. This is why they did not choose to pursue their interests in STEM into higher education.

The investigation of the second aim shows that the students who actually entered higher education STEM faced a gap between what they expected and what they met. This meant that, they were required to negotiate their narratives to gain a sense of belonging. Five negotiation -strategies were identified. These demonstrated how the students in different ways coped with bridging the gap and making meaning and relating themselves to the content of the programme, the academic requirements and the teaching and learning activities. In this process some of the students struggled to find meaning in staying. This identity-work of making meaning and matching expectations with experiences are left by the higher education institutions for the students' themselves to take care of.

This dissertation aims at widening our understanding of students' choices and their transition into first year higher education STEM. It

demonstrates how this is a social process that takes place *between* the students and higher education STEM. Higher education institutions do have a responsibility to assist prospective students in their task of choosing what to study, but also in their transition into first year. Institutions should not encourage internalization of this process as the students' personal task, but recognize the common responsibility and thus support the students in making sense of- and giving them various possibilities for relating themselves to   first year higher education STEM.

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11. EPILOUGE

11.1 IRIS

This dissertation is partly founded by the European project IRIS (Interests, Recruitment in Science) supported by the EU Seventh framework programme (FP7). IRIS concerns *Factors influencing recruitment, retention and gender equity in science, technology and mathematics higher education* (http://iris.fp-7.org/about-iris/). However the methodology and project aim in this PhD-project was constructed before entering the IRIS-project, and the IRIS-team was a valuable platform for receiving feedback and developing new ideas rather than predefining this project. One difference between this work and the IRIS is the gender aspect of the IRIS project not being an aspect explored in this dissertation. The four papers which constitutes this dissertation all contributes to the aspects of the IRIS-project concerning students' choices of- and retention at higher education study programmes in Science, engineering and mathematics.

Being part of the IRIS-project has been a privilege, getting the opportunity to learn from the five amazing partners; University of Oslo, Norway; University of Leeds, UK; King's College London, UK; Associazione Observa, Italy and University of Ljubljana, Slovenia.

11.2 Summary in Danish

Denne afhandling baserer sig på et kvalitativt længdesnitsstudie af unges valg af længere videregående uddannelser med et teknisk, naturfagligt og matematisk (STEM) indhold. Gennem en narrativ psykologisk optik undersøges de studerendes valg-narrativer, og den forhandling disse løbende udsættes for i overgangen fra gymnasium

til universitet. Afhandlingen består af fire artikler, der beskæftiger sig med forskellige aspekter af denne overgang: Valg, fravalg, frafald og transition i det hele taget.

Den første artikel undersøger, hvordan unges uddannelsesvalg betydningtilskrives i slutningen af gymnasiet, og hvordan valg-narrativer konstrueres og transformeres over tid. Denne artikel baserer sig på interviews med 38 elever i gymnasiet, alle fra gymnasieklasser med en teknisk eller naturfaglig tonet studieretning. Derudover inddrages interviews med den samme gruppe elever et halvt år senere, efter de har afsluttet deres gymnasiale uddannelse. Denne artikel bidrager både til den empiriske og teoretiske forståelse af unges valg ved at understrege, hvordan valget løbende forhandles og justeres over tid. Unges valgovervejelser vil således altid være efterrationaliseret i relation til den kontekst, de befinder sig i. Denne efterrationalisering sker prospektivt ved en forholden sig til fremtidsudsigterne, men også retrospektivt dvs. valghistorien justeres efter den meningssammenhæng, den unge her-og-nu befinder sig i. Det betyder, at når en elev fortæller, hvordan hun *altid* har villet være dyrlæge, så er dette altid en efterrationalisering af et valg her-og-nu, og den samme elev kan få måneder efter fortælle et nyt valg-narrativ om, hvordan hun altid har ville være fysiker, uden det nødvendigvis konflikter med hendes selvforståelse. I artiklen analyseres dette processuelle aspekt af valget. Derudover vises, hvordan de unge oplever valget som en personlig opgave, hvilket betyder, at de unge selv skaber mening i komplekse overvejelser om, hvilke uddannelser der bedst matcher interesser, og hvilken adgang disse uddannelser giver til livet i det hele taget – og til arbejdslivet i særdeleshed. I dette komplekse identitetsarbejde trækker de unge på erfaringer fra deres sociale netværk, som bliver brugt til at afprøve, validere og justere valget.

I den anden artikel fokuseres på de elever, der i gymnasiet udpeger et naturvidenskabeligt, matematisk eller teknisk fag som et af deres bedste, men som alligevel ikke overvejer at vælge en uddannelse inden for dette fagområde. I artiklen vises, hvordan denne gruppe af elever tilsyneladende ikke adskiller sig i deres interesseprofil fra den gruppe, der ender med at vælge en naturvidenskabelig, teknisk eller matematisk lang videregående uddannelse. Derimod adskiller de to grupper sig i forhold til, om de forventer at få deres forventninger indfriet. Gruppen af unge, der ikke overvejer at vælge en uddannelse med et naturvidenskabeligt, matematisk eller teknisk indhold,

forventer ikke, at disse uddannelser vil give dem en platform for selvudvikling og selv-styring – elementer som de mener, er væsentlige som studerende på en lang videregående uddannelse. Derimod forventer de, at disse uddannelsers faste og strenge metoder og krav vil give dem en snæver ramme for deres identitets-arbejde. I den gruppe af unge, der vælger en naturvidenskabelig, matematisk eller teknisk lang videregående uddannelse, oplever kun få af disse studerende, at uddannelserne giver plads til selv-styring og selvudvikling – i hvert fald ikke på første år. Dermed kan fravalget af naturvidenskab, matematik og teknik synes velbegrundet. Hvis disse uddannelser ønsker flere studerende peger undersøgelsen på, at det ikke er nok med branding og rekrutterings-strategier, men at det er mere grundlæggende elementer ved uddannelserne som sådan der skal justeres.

Den tredje artikel, der bidrager til denne afhandling, er et litteraturstudie over de tendenser, der præger forskningen i frafald på længere videregående uddannelser med naturvidenskabeligt, matematisk eller teknisk indhold. Studiet viser, hvordan der primært har været en tradition for at installere problemet i de studerende. Uddannelserne i denne forståelse beskrives som stabile objektive enheder, og forslag om ændringer af curriculum bliver i denne optik forstået som et tilbageslag. I litteraturstudiet identificeres studier, der benytter identitet som et redskab til at forstå sammenhængen mellem den studerende og institutionen, som en vej fremad. Derudover identificeres et behov for at undersøge frafald i gruppen af studerende i det hele taget, og ikke som hidtil at fokusere på særlige grupper af studerendes møde med universitetet.

I den fjerde artikel følges de studerende, der påbegynder en lang videregående uddannelse med et naturvidenskabeligt, matematisk eller teknisk indhold. Her undersøgelses deres overgang til første år på uddannelsen. Resultatet viser, hvordan samtlige af de 20 studerende, der påbegynder en uddannelse, oplever en afgrund mellem deres forventninger til uddannelser, og selve mødet med uddannelsen. Denne afgrund handler primært om mødet med det faglige indhold. Det betyder, at alle de studerende i forskellig udstrækning skal justere deres narrativer og forventninger til deres nye uddannelser for at få et tilhørsforhold. I denne artikel udvikles en analyse-metode til at indfange de studerendes forhandlings-strategier af deres narrativer i møde med deres nye studie. I alt identificeres fem

forskellige strategier, der dels adskiller sig i form af afstanden til at føle sig integreret, og dels i selve intervallet af forhandlinger.

I denne samlede afhandling relateres og diskuteres disse fire artikler i en international kontekst.

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Henriette, April 2012.