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To Choose or Not to Choose Science: Constructions of desirable identities among young people considering a STEM higher education programme

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To Choose or Not to Choose Science: Constructions of desirable identities among young people considering a STEM higher education programme

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In the literature, there is a general concern that a less number of students choose to study science, technology, engineering or mathematics (STEM). This paper 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 an STEM subject as one of their favourite subjects at secondary educational level, but who chose not to study STEM at the 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. The analysis explores the students' expectations of what higher education STEM might be like. These expectations are contrasted with the first-year experiences of 18 of the 38 students who eventually entered a higher education STEM programme. The results show that the students who did not choose STEM, perceived STEM as stable, rigid and fixed, and, hence, too narrow a platform for developing and constructing desirable identities. The experiences of those students who actually entered a STEM programme turned out to be similar to these expectations. However, many choosers would also prefer their studies as less rigid and fixed. If the institutions could adjust to the form and content of the courses, it might both meet the interests of choosers and non-choosers and thereby both increase recruitment and retention at STEM higher education programmes.

Keywords: *Science choice; Higher education; Identity; Transition; Attitudes towards science; Recruitment; Retention*

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In the past decade, there has been a general concern of Europe facing a shortage of engineers and scientists (European-Commission, 2004; OECD, 2008; Osborne & Dillon, 2008). This has sparked extensive research into students' choices of science studies (cf. Bøe, Henriksen, Lyons, & Schreiner, 2011).

Recent research suggests how students' choices about whether or not to study science at the higher education level primarily are made before the age of 14, and therefore this aspect 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 characteristics of scientists (Head, 1997). A qualitative longitudinal study studying students' science choices in secondary school finds the picture to be more complex: '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). According to Cleaves (2005), childhood interests and experiences seem to be influential for some students, whereas they have less or no significance to others.

Previously the literature has put an effort in constructing comprehensive models of student choice by conducting large-scale quantitative studies (Eccles & Wigfield, 2002; Holland, 1973; Hossler & Gallagher, 1987; Woolnough, 1994).

However, the increasingly diverse student body (Reay, David, & Ball, 2005) and the fact that choice of study is shaped different for different students, highlights the necessity of moving beyond identifying variables and reducing choice of study to a general model. Rather focus should be on how the students themselves handle and make their choice meaningful (Archer et al., 2010). In a review of the literature about students choices, it is concluded how it still remains to be studied how the different factors known to influence students' choice of study create 'a sense of fit' for the individual students (Bergerson, 2010, p. 114).

However, during the first decade of the 2000s, some research that addresses this specific purpose has been carried out. By combining a focus on students' identities with their choice, research has aimed to find the reasons why some students with an interest in science refrain from applying for a science-related study programme.

The international quantitative study of the Relevance of Science Education (ROSE) of students' interests in science (Schreiner, 2006; Schreiner & Sjøberg, 2004) shows, from a perspective of late modern society (Beck, 1992; Illeris, Katznelson, Simonsen, & Ulriksen, 2002), how young people do not perceive science to be compatible with their self-realisation. In particular, girls found their interests in science, technology, engineering or mathematics (STEM) not reflected in the curriculum. Other studies point out from the framework of 'cultural border-crossing' (Aikenhead, 1996) how there exists a border between the cultural world of young students in general and the cultural world of science in particular (Krogh & Thomsen, 2005). Taconis and Kessels (2009) have constructed a quantitative approach to capture this relation between students' notions of science culture and their self-image based on self-to-prototype matching theory. Here, students' choices are perceived to be dependent on their cognitive representations of science peer-prototypes and how they conceive themselves.

While the studies applying a late modern framework have been interested in how social structures in our modern society affect a general population of young people in their choices, the studies applying the notion of cultural border-crossing have focused on how various students meet a general STEM culture. Finally, self-to-prototype is an approach to understand how students cognitively relate to their perceptions of science.

Summing up, there is an emergent agreement that students' choice of higher education is closely interwoven with their identity construction. Research has yet to capture and contribute to the understanding of the *multifarious factors* concerning students' choices of study and how they make personal sense. This is both due to the fact that the quantitative approach that is used in several studies is restrained in the kinds of details it can unveil. Furthermore, previous research has not been able to capture how *various* students find *various* ways of relating themselves to science. This paper contributes to study why students choose to study or not to study STEM by analysing choice as a complex process of identity construction. In this paper, our interest is how the students 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.

Aim

We aim to understand how students' work on constructing their identities (which we will phrase their identity work) in relation to their perceptions of STEM and how it affect their choice of higher education study programmes, particularly their inclination to enter an 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 chosen STEM.

Theoretical Framework

As a theoretical framework, we apply narrative psychology to understand how identities are produced. In particular, we are interested in the social practices in which this identity work is embedded. By applying Foucault's concept of governmentality, we are interested in approaching the social practices that set the scene for students' identity work when choosing whether or not to study STEM.

Identity Work

In narrative psychology, narratives are perceived as a way to make sense in the complexity of our lives by *relating* to certain events and experiences while others fade out into the background. This selection of and incorporation of events, desires and beliefs into a coherent narratives tell us about the students' identity work; narratives are then both what structures the world, and what relates us to it (Polkinghorne, 1988; Sarbin, 1986). Narratives are meaning-making processes in which we continuously work on relating what we experience in our lives to our identity (Bruner, 1990). 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 (Bruner, 2004). Interviewing students in different points in time therefore tell us something about the process of their identity work.

Students are made and at the same time make themselves recognisable through narratives. It means on the one side that they construct their identities through narratives and on the other side that their identities need to be recognised as legitimate to be viable. To understand the students' identity work, it is therefore not enough to study students' narratives as expressions of individual strategies, rather the construction of identities occurs in a social world where rationales of what is possible or not, are expressed through social and cultural practices (Holland, Lachicotte, Skinner, & Cain, 1998). In their identity work and their construction of a choice-narrative, students have to use, relate and submit themselves to existing social and cultural practices if their choices and reasons are to be recognised as sensible. To understand these social practices and how they set the scene for students about to choose what to continue studying after upper-secondary school, we apply the notion of governmentality.

Governmentality

According to Michel Foucault, subjectivity and hence identity are 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 social 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. Foucault describes a transformation in the way power has interacted with the individuals. From power being exercised as external control which regulates the behaviour of individuals (disciplinary), to a situation where the individuals incorporate the power and exercise it on themselves (governmentality). Inspired by Foucault, Rose (1998) 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. (p. 21)

In other words, this way of constantly having to entrepreneur, and (re)produce oneself is presently considered a fundamental condition, where the individual through her choices is imposed to govern herself (Rose, 1998). Students' choice of study is such a pivotal point, because it is a crossroad where new narratives of who to become are made available to the students to govern themselves through (Ecclestone, Biesta, & Hughes, 2010). 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. However, since one of the dominant discourses emphasises that the choices of the young people should be entirely their own, they need to construct a choice that reflects and integrates these social requirements and make them their own.

Methodology

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 these data.

Conducting Narrative Interviews

Narrative psychology focuses on how individuals make meaning of the world and relate themselves to it. The purpose of interviewing students, therefore, is to gain access to this process of identity work. We do not claim that we by interviewing students map the whole of their identity. Rather through interviewing students about their choices, we learn about how they ascribe meaning to their surrounding world and how they relate it.

When students' narratives are the objects of research, the purpose of conducting interviews is to encourage the interviewee to present stories and descriptions (Andrews, Squire, & Tamboukou, 2008; Hollway & Jefferson, 2000). Attention is paid as 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 emphasise a situation where the interviewee produces a narrative to the interviewer, positioned as a listener, 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),[1] that is, before they had formally made their choice of their further course of study. Data were 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 the 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). Nineteen students were interviewed individually, which in total makes 38 students.

Half of the 38 students were girls and 18 came from non-academic backgrounds (Table 1). 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.

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 recognising 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 by arguing about something else? According to Kitzinger (1995), the group processes taking place during a focus group interview often support participants to explore and clarify their views. In that perspective, the focus group may take the interview in new and unexpected directions. The participants work alongside the researcher by engaging in asking questions to each other in ways that would be less easily accessible in a one-to-one interview.

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. In the individual interview, the researcher can use the lack of shared culture to ask questions to basic cultural assumption like: what do you mean when you say you need to know mathematics to study physics? Individuals' interviews encourage informants to explain their 'folk knowledge' to the interviewer, whereas the participants in group conversations simply use their 'indexed knowledge' without any need to explain themselves to one another (Holstein & Gubrium, 2001, p. 152)

The narrative psychological approach was combined with a semi-structured interview guide (Kvale, 1996). The interview guides for both the individual and the focus

Table 1. The students' interview in upper-secondary school and during their first-year STEM higher education study programme

		Study plans for the future in upper-secondary school					First-year STEM
Pseudonym	Sex	Science and mathematics	Engineering	Other	Favourite subject in upper-secondary school	Interview in upper-secondary school	Choice of higher education STEM study programme and numbers of interviews during first year
Coya	F		X		Chemistry and mathematics	Individual	Architectural engineering: 4
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 and Danish	Individual	Opt out of literature to design and engineering: 4
Benjamin	M			X	Mathematic and 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 and religion	Group	Non-STEM chooser
Birgitte	F			X	Mathematics	Group	Biotechnology: 1
Erika	F		X		Chemistry	Group	Chemical engineering: 2
Emily	F		X		Chemistry and mathematics	Group	Opt out of chemical and biotech engineering: 3
Emma	F			X	Technique, Danish and psychology	Individual	Non-STEM chooser
Ebbe	M			X	Chemistry, Biology and mathematics	Individual	Biotechnology: 1
Emil	M	X			Biology	Individual	Biochemistry: 2

(Continued)

Table 1. Continued

		Study plans for the future in upper-secondary school					First-year STEM
Pseudonym	Sex	Science and mathematics	Engineering	Other	Favourite subject in upper-secondary school	Interview in upper-secondary school	Choice of higher education STEM study programme and numbers of interviews during first year
Elisabeth	F		X		Mathematics	Individual	Environmental management: 1
Daniel	M	X			Physics	Individual	Computer science: 0
Dorte	F		X		Mathematics	Individual	Gap year
Deniz	M		X		Physics, Chemistry and 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 and philosophy	Individual	Design and innovative engineering: 2
Frida	F	X			Science in general	Individual	Biochemistry: 2
Fie	F			X	Sports science	Individual	Chemical engineering: 0
Frederikke	F			X	Chemistry, Danish and music	Individual	Gap year
Freja	F				Danish	Group	Non-STEM chooser
Filip	M		X		Physics, Mathematics and history	Group	Engineering design and applied mechanics: 2
Frederik	M	X			Physics, Mathematics and psychology	Group	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

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 min to 2 h. 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., 2008), 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 the last interview' 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, for example, 'could you please say something more about your meeting with the courses'.

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 and 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).

Table 2. The process of the thematic analysis (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	Systematising 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 recontextualising 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 data set 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

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 arguments of the students 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 recognised among the students.

Analysis

The results of the analysis are structured into 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); Science as giving access to understanding the world, the way of thinking within science and towards an interesting future. 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, that is, first-year students' experiences with meeting higher education STEM with the choosers' and non-choosers' expectation of higher education STEM.

Science as Giving Access to Understanding the World

Almost all of the upper-secondary students stated that they had a STEM subject among their favourites because they perceived 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 relates to their *everyday life*, but apparently the students have different ways of interpreting what this means. An example is Bastian who stated: 'It is stuff I can relate to, and stuff that influences upon my everyday life (...) Science explains about all the things humans can do. It is very present in my life' (Bastian in upper-secondary school). For Bastian, science provides knowledge that makes him more competent in understanding his own life and the world surrounding him.

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 'appetisers' during a lesson, can also function this way:

> 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. 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 Raffnsøe's (2010) point that in order to able to govern themselves, individuals are imposed to understand themselves as the point of departure. 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 desirable identities.

The Way of Thinking Within Science

For both the choosers and non-choosers, the special way of thinking within science characterised by logical and rigorous methods of approaching a problem was identified as central to school science. This was both the case concerning the students' upper-secondary school experiences and their expectations of what STEM higher education was like.

The choosers. A large group of the students, who considered choosing STEM, recognise 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 are 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. 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 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 a 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 as to what to do, and there was a right way of doing science. 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 (cf. Bøe, 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 responsibility of governing themselves to STEM. Following Foucault, this way of relying on an institutional authority to facilitate one's identity work is a way of 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-choosers in the 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 a desirable 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. Louise's example shows how she makes meaning of what higher education STEM programmes are like, is in opposition to her expectations about how a study programme ought to support developing competences and identities. Louise internalised this requirement of developing and governing oneself as a personal need.

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 unable 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 a poor fit with the students' understanding of constructing a desirable 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 (cf. Rose, 1998).

Another kind of reason for experiencing STEM as an unattractive choice was shared by fewer students, namely the teaching and learning experience. One was Benjamin. 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 were really good and he liked solving problems in mathematics, but he did not find that the subject supports him in his identity work and in self-development. Benjamin also likes history and eventually after much consideration he decided to study History 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 listening 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 did 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 why these students find interesting. Other students mention a particular teacher as one of the reasons for not feeling engaged in certain STEM subjects and for not wanting to continue studying STEM. Frequently, the students mention that they need to be able to see what a particular subject or topic can be used for. If the teachers cannot provide examples or explanations, the students tend to lose interest because it makes no sense to them. At a more personal level, many of the students emphasise the relation between the students and the teacher, which should be one of mutual respect and interest. The teacher should be skilled in the subject but should also show involvement in the content as well as in students' learning. To the non-choosing students in this category, their perceptions that STEM insists on right answers and that one needs to learn some elements by heart, does not correspond well with the students' understanding of constructing a desirable 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 at the management level, 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—for example, 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 Ím 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 considers choosing molecular biomedicine, which she finds to be the choice of study that combines her interests in chemistry with a whole lot of job possibilities.

To most of the choosers, it is an important part of their identity work to be able to relate themselves to some kind of career prospects in the future. However, the students differ in terms of how concrete these prospects need to appear. Some need to see very clear career paths with specific 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. To both groups, the career prospects relate to their interests in science and act as a support to their identity work and choice of study. Although the non-choosing students talk about STEM careers, they ascribe 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 an 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, laboratory work is understood as being unattractive 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 what he considers to be an attractive working life. To find 'an interesting career 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.

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 an STEM programme. The examples illustrate 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 careers in STEM are not consistent with their construction of a desirable identity and with who they wish to become as persons. They want a future job to be meaningful to them, and they hold ideas of careers that seem incompatible with choosing STEM. One example is when Jacob describes how choosing an STEM career will prevent him from managing the entire engineering process. Another example is Allan who imagines engineers as working in isolation with no other company than their calculators. In other words, it becomes a crucial element in the students' choices that their ideas about STEM have convinced them that following that course of study will prevent them from not just managing their future job, but also limiting the possibilities of who they might become.

A career in STEM is not perceived to provide room for governing and entrepreneuring oneself (cf. Foucault, 1997; Rose, 1998). A minor part of the interviewed students find it hard to see that their STEM interest could lead to a job at all, and they find it hard to see the purpose of applying for an STEM higher education programme:

> If I study astronomy, I can't really use it afterwards. Not astronomy in itself. Except if it's a master's 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 of 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 a follow-up of the 18 students who in our study opted for an STEM programme (see Table 1) after upper-secondary school, we outline the students' expectations to engineering, science and mathematics and how these 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.

Meeting engineering. Students who in upper-secondary school had their minds set on choosing engineering 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 (. . .)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 market 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 from outside the study programme; other engineering students use arguments within engineering, like, for instance, that mathematics is the basis for everything even though it might not become visible until 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 sheep 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 interviewed 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 (Filip, engineering design and applied mechanics, 2009). This might be the reason why the science courses are more present in the students' narratives.

A few of the students have other and more positive experiences of the engineering programmes:

> 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 of chemical engineering finds the programme to match her interest in theory.

In general, however, the students meeting engineering struggle to renegotiate their expectations of what engineering is about. If the students find it hard to make meaning of why they are presented with the courses and content they meet during first-year engineering, and how they relate to their overall idea of the study programme, they are urged to negotiate their identities and change their narrative of themselves in terms of why they came to study at this study programme, the kind of student they are and their prospects of the future.

Meeting science and mathematics. The science students experiences are to some extent 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 explain how the curriculum is structured with many lectures with the purpose of providing the students with the so-called 'basic knowledge' in the first semester, mathematics being one of these courses. Another student Belal struggles to find out how to use the computers in 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 originates 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. (Belal, first-year 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 the other courses they take in particular, but also to their study programme in general. As was the case with Belal, the students did not expect mathematics to have such a dominant role when studying science. Other students found it difficult to see the relevance in the content presented to them at the study programme. This was the case for 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 who 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 general, 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 and their expectations when entering the programme. However, the data indicate that most of the students need to undergo intense work on their identities to combine what they experience during the first year with their expectations..

Discussion

The two aims of this study were, first, to understand how students' work on constructing their identity together with their perceptions of STEM affected their inclination to enter an STEM higher education study programme. Second, we sought to explore whether students opting away from STEM did so based on misconceptions about what they would encounter if they entered a study programme within that field.

Identity and Governmentality

Based on the analysis of the interviews, we found that students who chose not to pursue STEM higher education programmes to a large extent did so because they expected it to be difficult to construct a desirable identity within those disciplines. This was in spite of their holding STEM disciplines among their favourites in upper-secondary school. This finding is in accordance with the study of Schreiner and Sjøberg (2007) who among 15-year-old students found the identity issue to be of pivotal importance to their interest in science and technology, and (Bøe, Henriksen, Lyons, & Schreiner, 2011) point at a number of studies emphasising the identity component in students' attitudes to the learning of science.

We found that the students' experiences with science in upper-secondary school and whether they experienced the content as making sense to them influenced their interests in science subjects and their inclination to pursue an STEM course of study in higher education. Similarly, Aschbacher, Li, and Roth (2010) found that high school students who in spite of being capable in science dropped out of the STEM pipeline perceived teachers as 'uncaring and poor' and experienced 'no personal connection between the curriculum and their daily lives and dreams' (p. 579). Krogh (2006) compared the curriculum of Danish upper-secondary school physics with dominant values among the students and found a pronounced discrepancy between the ethos of the school (both the content and the forms of teaching) and the values of the students. This discrepancy was related to the students' wish for autonomy and self-reliance in contrast to the closed and determined content, the teacher-centred teaching and the absence of student influence on the teaching. In a study of two US middle-school girls, Tan and Calabrese Barton (2008) argued about the importance that the classroom offered the possibility of developing different kinds of identities that could allow different students to participate in and enjoy science teaching in different ways.

We did not find any particular gender differences in the ways the students reflected on their future within or outside science. Generally, it appeared to be similar factors both genders ascribed meaning as important for their choosing or not choosing an STEM study programme. This may seem somewhat surprising since other studies have found clear differences in gender interests and orientations in relation to science. For instance, Schreiner and Sjøberg (2007) found gender differences in 15-year-old students' interests in science—both whether they would consider pursuing a science or technology career and the topics they experienced as interesting. The limited gender effect in our study have several (not mutually exclusive) reasons.

One is related to the sample: in contrast to the sample of Schreiner and Sjøberg's study, the students in our sample had already opted for science when specialising in upper-secondary school. All the students in our sample, therefore, were sufficiently interested in science to choose an A-level in one or more STEM subjects. The baseline in terms of STEM interest among both boys and girls would probably be higher in our sample than in the ROSE study.

A second reason is that the gender difference may not be exposed in the students' narratives concerning their experiences and choices. In the interviews, the students emphasised that the disciplines should be interesting, they should make sense outside the specific teaching context and the job perspectives should appear interesting and suitable for developing their identity. These descriptions were in some sense generic. When we consider the study the students eventually chose to enter, the gender difference becomes discernible. There are both male and female students opting for medicine, but while some of the men go for computer science or software engineering, most of the women in our study chose an STEM higher education programme related to topics to do with helping others and improving human life (e.g. biomedicine, biotechnology) or with a high proportion of female students (e.g. chemical engineering), fields of study that correspond with issues that previous research has reported to appeal to girls in particular (cf. Bøe et al., 2011).

Hence, the pivotal role of identity in young people's choice of study and their interests related to STEM subjects is confirmed. It is, however, an important addition to the existing research findings concerning identity that the students not only consider the possibilities of identity work in a study context. They extend this expectation to a future job and career. The career perspective is not purely about getting a job. The job in question should also contribute to the students' continuous construction of an attractive identity. This means that the job should be interesting and with room for personal development.

A further contribution of the present study is that we through the concept of governmentality found 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 perspective of the STEM programmes, this means that they should display a credible choice for an autonomous self-managing individual. The focus on identity, therefore, is not about spoiled and self-absorbed kids; it is about presenting oneself as a legitimate citizen in a modern society.

From the point of view of the students, this means that a particular course of study should be experienced as leaving room for developing and managing themselves. This, however, seems to contrast the typical form and content of school science and science teaching.

A review of literature on students' attitudes towards science found a contradiction between students' positive attitudes towards science in general and their more negative attitudes towards school science (Osborne, Simon, & Collins, 2003). One reason had to do with school science offering a backward-looking theoretical, de-contextualised perspective of the well-established scientific landscape, that the students found it hard to relate themselves and their interest to. Another reason was that science offers 'little space for the pupil as an autonomous intellectual agent' and instead presents its students with education which is *authoritarian, dogmatic and non-reflexive* (Osborne et al., 2003, p. 1074) .

Other studies have found that the characteristics of school science cause students to lose interest in science already at an early age (Archer et al., 2010; Osborne & Collins, 2001). This may also fuel the students' experience of the field of STEM as impeding their self-management. It is, therefore, not merely a question of what the students are to learn, but also how they are to learn it.

Choosers and Non-Choosers

A noteworthy and new result of our study is the relation between chooser and non-choosers. As mentioned in the previous section, the students deciding not to pursue a STEM course of study in spite of their interest in science did so because their experiences with STEM in upper-secondary school and their expectations to higher education STEM had convinced them that there would be very little room for self-government. These non-choosers had met a field of study with rigorous methods and strict rules and procedures that the students had to obey, and with very limited room for influencing the content or the teaching formats. Also, even though the non-choosers found that STEM as a field of knowledge was relevant to them and their everyday lives, they did not sense this kind of personal relevance in STEM as a field of study. All in all, STEM studies were experienced by the non-choosers as studies where they had to submit themselves to an existing and dominating regime. Obviously, this did not appear as a field for self-development and self-management.

Some of the choosers, conversely, appreciated the rigour and stability of the STEM field. For these students, precisely these features were assets for STEM as a field of study. In order to cope with the instability and insecurities in the required identity formation and self-government, these students adopted existing frames that could limit the openness. Hence, these students managed to construct an identity by complying with existing frames and expectancies. They did 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.

What is interesting, however, is that we found a group of choosers who had more similarities with the non-choosers than with the other group of choosers. This second group of choosers had the same orientations, hopes and interests as the non-choosers, but in contrast to them these choosers believed that the STEM higher education programmes would in fact provide space for their desired reflections and identity work. They believed that the higher education programmes would, indeed, leave room for discussions and reflections. The difference to the non-choosers, therefore, was not what they hoped for at the programmes, but whether they expected to meet it or not.

The question then (and the second aim of our study) was whether the non-choosers were ill-informed or the hopeful choosers were disappointed. The findings suggest that the latter is the case. The first-year experiences presented in the analysis tend to confirm the expectations of a fixed and de-contextualised teaching that is sometimes difficult to make sense of. A review on research on non-completion in STEM higher education, found that retention and non-completion to a large extent are related to the students' overall learning experiences at their first-year programmes and that identity appears to be important in both recruitment and retention (Ulriksen, Madsen, & Holmegaard, 2010). This suggests that the choosers who hoped to make room for identity work are at risk of opting out.

What Could Be Done?

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 an STEM higher education study programme or not. Therefore, it is highly appropriate when the OECD use the words credible and 'avoids unrealistic and exaggerated portrayals'. The same could be said about the presentation of the higher education programmes. What are needed are not flashy commercials or glossy advertisements. The focus should be on presenting accurate and credible images of what different STEM programmes offer, both in terms of form and content. Should the recruitment and retention still appear insufficient, then the attention should probably be directed towards the curricula of the upper-secondary school and at higher education. This follows the suggestions of Schreiner and Sjøberg mentioned above to include more aspects in the science curriculum. This could be content relating to the everyday life of the students, relating to health issues, to environmental issues, etc.

However, based on the present study and the students' emphasis on how they experienced the relevance and quality of the teaching, the focus should be on both the content and form of the curriculum. Here, content denotes the structure and sequence of content as well as the selection of content within the curriculum whereas form denotes the teaching approach. At higher education, the relation between auxiliary disciplines and what students consider core courses of the programme is an example of an issue related to the sequence and structure of the curriculum. The use of teaching methods that allow students to explore on their own, and to influence the content of the teaching in order to strengthen the link between their study and their interests could be in focus concerning the form (cf. Johnston, 2010). Measures that would increase links between the different elements and that could leave more room for the students could both attract some of the non-choosers and hold on to some of the choosers who may be disappointed in the present curriculum.

Precisely the possibility of variation is of importance because the group of choosers is diverse. Turning the whole of the curriculum around runs the risk of losing some of the choosers who are happy with the present state of affairs. Hence, the point that middle-school students could need room to develop different identities (Tan & Calabrese Barton, 2008) appears to be relevant to higher education students as well.

Conclusion

The present study confirmed previous research findings that students when choosing a higher education programme emphasise the possibility of forming a desirable identity within the frame of the study in question. In order to attract and hold on to students, STEM programmes should, therefore, provide such options. Drawing on the concept of governmentality, we showed that the students' request for room for their identity work, they also needed a context where they could exercise self-management and become entrepreneurs.

We showed that the students' emphasis on identity work extended to their thoughts concerning a future job and career. STEM programmes should, therefore, not only provide a prospect of interesting studies but also for interesting jobs and careers.

Further, we found that even though the non-choosing students differed from some of the choosers in terms of how they valued the rigour and stability of the STEM teaching and programmes, another group of choosers were more similar to the non-choosers. This group of choosers shared interests and perspectives with the non-choosers, but unlike the latter, the choosers believed that the STEM programmes would provide a viable platform for identity work. The comparison between the students' expectations and the actual experiences of the first-year students indicated that the non-choosers apparently were the more realistic leaving the choosers at risk of opting out of the programmes.

If the STEM programmes and the higher education institutions should address some of the problems and dilemmas presented in this study, they need not only to direct their attention to adding more topics and issues to the curriculum. They should also consider changes in the teaching and learning activities the students are engaged in.

Some of the problems may be particular to the field of STEM. On the other hand, there is no reason to believe that only STEM programmes experience them. 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 (2011) 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'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 are endemic to society and not just to STEM or higher education.

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Note

1. 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.

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