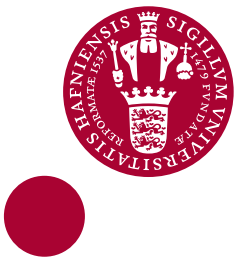

Balancing Cost and Value: Scandinavian Students' First Year Experiences of Encountering Science and Technology Higher Education

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Abstract

This paper investigates the experiences of students in science, technology, engineering and mathematics (STEM) during their first year in higher education, based on 874 Danish and 1314 Norwegian students' responses to an online questionnaire. Rather than focusing on averages, we compare the experiences of two distinct groups of students: those who rated their overall study situation as better than expected (the satisfied group) and those who rated it as worse than expected (the dissatisfied group). Although the satisfied group were more positive to many aspects of their study situation, the dissatisfied group were also relatively positive to many aspects. All respondents expressed that the study cost more time and effort than anticipated, but only for some students (notably the satisfied group) was this high cost counterbalanced by a high value in terms of subject interest and social integration. Implications are discussed in terms of future research directions and how educational institutions can improve students' meeting with higher education.

Introduction

Most Western countries are concerned with securing a sufficiently large workforce within Science, Technology, Engineering and Mathematics (STEM) (EU, 2004; Henriksen, 2015). In order to increase the number of STEM graduates, keeping students on the STEM track is just as important as recruiting new ones. One-third of higher education students drop out of their studies before they complete their first degree (OECD, 2009). This is a challenge not only for individual students, but also for the higher education institutions and society as a whole.

Students' dropping out of STEM has often been attributed to uninformed choices or to factors in the students' life outside university (Yorke & Longden, 2004), poor or wrong academic skills, under-preparation and lack of engagement and hard work (Alemán, 2010; Seymour & Hewitt, 1997). However, recent research moves away from looking for reasons for dropout in the students alone. In order to understand why some students leave and others stay in higher education STEM, dropout must be approached as an *interaction* between the students and the culture of the study programme they enter (Johannsen, 2012; Ulriksen, Madsen, & Holmegaard, 2010). Moreover the students leaving and the students staying cannot be approached as two distinct groups. Seymour and Hewitt (1997) found more similarities than differences between the two groups, leading them to suggest that retention should be approached as a more general question of the students' first-year experiences and the strategies they employ to cope with the difficulties they encounter. A similar point was made by Harvey, Drew and Smith (2006).

Looking into students' first year experiences in higher education STEM, it is a continuous process of negotiations between expectations and experiences (Holmegaard, Madsen, & Ulriksen, 2014) or indeed a survival course (Zeegers, 2001). They struggle with figuring out the academic (Ulriksen, Holmegaard, & Madsen, 2017) as well as the social culture (Hasse, 2002, 2008) of their new study. This encounter between the students' background and expectations and the culture and design of the study programme shapes the students' experiences. Hence, to understand students' non-completion we need to investigate how students experience the STEM study programme they enter and what sense they make of these experiences. On this basis, this paper describes some aspects of the experiences of Danish and Norwegian students during their first year of STEM higher education.

Theoretical Frameworks for Understanding Choice and Persistence in STEM Education

Previous studies of students' first-year experiences have particularly tended to focus on how the students' preparation (Adelman, 2006), the students' social background (Reay, David, & Ball, 2005; Watson, Nind, Humphris, & Borthwick, 2009), and their considerations about what to study (Yorke & Longden, 2004) interact with their first year achievements. While these approaches stress what the students bring with them, in this study we combine two different theoretical approaches in order to examine the students' experiences during their first year in STEM programmes: Eccles and colleagues' expectancy-value model (Eccles et al. 1983) and Tinto's Academic and social integration (Tinto, 1993). The two approaches complement each other in our attempts to understand the processes influencing retention and non-completion, as they highlight different aspects of students' socialisation into higher education and their considerations about how to proceed.

The Expectancy-Value Model

The expectancy-value model of achievement-related choices has been developed by Eccles and colleagues (Eccles et al., 1983; Eccles & Wigfield, 2002). The model has been widely used to understand students' choice of STEM education (e.g. Simpkins, Davis-Kean, & Eccles, 2006). In this model, 'choice motivation' consists of two main aspects: 'the expectation of success' and the 'subjective task value' attributed to the option in question. *The expectation of success* is the individual's thoughts about how well he or she will do, and has much in common with self-efficacy (Bandura, 1997). The *subjective task value* is the individual's balance of four components: Attainment value, interest-enjoyment value, utility value and cost. *Attainment value* is related to identity: 'How well does this activity match my perceived identity? How important is it for me to be engaged in this task and do well?' *Interest-enjoyment* value is related to intrinsic motivation: 'How enjoyable is the task? Am I interested?' *Utility value* is related to extrinsic motivation: 'How will this task help me reach other goals I have set for myself?' The greater the expectation of success, attainment value, interest-enjoyment value, and utility value, the greater the probability of choosing the educational option in question. The fourth subjective task value, *cost*, is related to negative aspects: 'Will this activity be at the expense of other things? How much time and effort will it take?' The greater the perceived cost of a choice is, the smaller the probability of choosing it.

Recent research has shown that students' STEM choices should be understood as a process rather than as a single decision (Holmegaard, 2015; Holmegaard, Ulriksen, & Madsen, 2012). However, when students have decided to enter higher education their choice process continues. Their first-year experiences lead to renewed evaluations of the expectancies and values involved in their decision about whether or not to continue in their chosen STEM programme (Holmegaard et al., 2014). Hence, the expectancy-value model offers a way to comprehend the way the students' first-year experiences shape values and expectancies, how these may be balanced against each other, and how this eventually affects their considerations about staying in or leaving the chosen STEM programme.

Academic and Social Integration

When students move from upper secondary school into higher education, they are required to make sense of a new social and cultural arena and relate themselves to it, to gain a sense of belonging in their new study programme (Hurtado & Carter, 1997). Tinto (1993) has constructed a model that has been significant for understanding the process of students' integration into Academia. Despite critique of the model (Pascarella & Terenzini, 2005), Tinto's model has achieved an 'almost paradigmatic' status (Braxton, Milem, & Sullivan, 2000). For Nordic examples, see Hovdhaugen and Aamodt (2009) and Herrmann, Bager-Elsborg, and McCune (2016).

In the present paper, two concepts from the model are addressed; namely social and academic integration. Although they are often discussed separately, the two integration processes should be considered as interwoven (Tinto, 1993).

A*cademic integration* is the part of the socialization process that takes place in relation to the academic context of the study programme which both includes the subject matter addressed and the types of teaching activities used. Further, academic integration relates to "the students' identification with the norms of the academic system" as well as to how well the student complies with the academic requirements in terms of performance (Tinto, 1975, p. 104). *Social integration* is the students' interaction in the informal parts of university life, for instance through student unions and study groups, café visits, parties or sports activities.

In the present study the students' social integration has been approached in terms of how they experience the relation to other students and how they find themselves fitting into the social culture of the study programme. The academic integration is captured by how the students experience studying in terms of how interesting they find the courses, how well they find that the course suits with their experience of who they are, and whether they can keep up with the pace and requirements (see tables 2 and 3 for examples of items). Thus, we analyse the students' perceived match between themselves and the social and academic environment.

Research Questions

The overall aim of this research is to characterise central aspects of first year experiences among Danish and Norwegian students enrolled in higher education STEM study programmes and to investigate how these experiences may contribute to academic and social integration or, on the contrary, increase the risk of leaving before graduation. We address the following research questions:

- How do Danish and Norwegian STEM students evaluate and describe their experiences from the first year in their chosen STEM study?
- What characterises the first-year experiences of students who rated their overall experience of their study situation as better than expected?
- What characterises the first-year experiences of students who rated their overall experience of their study situation as worse than expected?

Methods

The IRIS Project

The present article utilises questionnaire data that was collected in 2010 as part of the IRIS project (Henriksen, Dillon, & Ryder, 2015). The project applied a range of qualitative methods as well as a questionnaire distributed among first year STEM students (cf. Ryder, Ulriksen, and Bøe (2015) for the array of methods employed). A questionnaire offers a straightforward way to get standardised data concerning attitudes, values and experiences of a relatively large number of people (Robson, 2002). However, such a design limits the degree of complexity and nuances that can be obtained compared to applying qualitative methodologies (Creswell, 2013). On this background the purpose of the present study is to study how a larger group of first-year students experience the transition into first year higher education STEM. The aim has thus been to identify patterns of experiences rather than the complexity of their narratives.

In this article, we have analysed Norwegian and Danish STEM university students' responses to 19 closed, Likert-scale items and one open-ended question related to the students' first-year experiences. The closed responses provided quantitative information about different aspects of the study

situation, while the open-ended responses provided richer descriptions of the experiences and helped us to identify aspects of the study situation that appear to support or to hinder academic integration and motivation to continue. By combining the closed and the open-ended questions we seek to achieve a more nuanced understanding of the experiences of the students than can be obtained from the closed items alone.

Target Population, Data Collection and Respondents

Norway and Denmark have no tuition fees in higher education. Students receive government support in the form of a grant and the opportunity to take a loan to cover their basic living expenses while studying. The participation rate for students below the age of 30 in higher education programmes was 33 % in Norway and 39 % in Denmark in 2009, while the OECD average was 32 % (OECD, 2011, p. 68). Of the tertiary level students, 17 % in Norway and 19 % in Denmark entered a programme within engineering, manufacturing, construction, or science in 2009 (OECD, 2011, p. 83). The OECD average was 24 %.

The target population in the IRIS study (See Appendix in Henriksen et al. (2015)) was first-year higher education students enrolled in 3-year bachelor programmes and 5-year integrated master programmes within eight STEM disciplines defined following the International Standard Classification of Education (ISCED) system: biology and biotechnology, physics, chemistry, mathematics, computer science, mechanical engineering, electronic engineering and chemical and process engineering. These disciplines were selected to obtain a variety of different STEM subjects across science, technology, engineering and mathematics. The entire target population was invited to respond to the questionnaire. (Data was not collected for mechanical engineering students in Denmark.) Deans of science and technology faculties in target institutions approved of the study, and administrative staff processed the electronic invitations to the students. Questionnaire data was collected through an electronic solution during the period March-June 2010 (the students' second semester of their first year). Table 1 shows the target population and respondents. Overall response rate in the sample presented here is 24 %, which is relatively low, but comparable to response rates in similar projects (see e.g. Purcell et al., 2008).

Table 1. Number of first-year higher education students who answered the IRIS questionnaire in Norway and Denmark, total target population in both countries (in parentheses), and response rates.

	Norway respondents (total population)	Denmark respondents (total population)	Total Norway + Denmark respondents (total population)
	1314 (5663)	874 (3416)	2188 (9079)
Response rate (%)	23	26	24

Questionnaire Design and Data Analysis

The questionnaire

The questionnaire was constructed to investigate the background of the educational choices of first-year STEM students as well as their experiences during their first year of higher education (See Appendix in Henriksen et al., 2015). Questionnaire items were suggested and discussed in several rounds by IRIS research consortium members, and a preliminary version was piloted in early 2010. Reference persons representing stakeholders in education, government and industry were consulted during instrument development. The final questionnaire comprised a total of 65 items, of which 19 closed items and one open-ended question are used in the present analysis. For the closed ques-

tions, response categories were five-point Likert scales ranging from "Strongly disagree" to "Strongly agree", or three-point scales labelled "Worse than expected", "As expected" or "Better than expected".

Comparing two respondent groups based on their expressed overall experience

For the present analysis of the closed items, respondents were split into two groups based on their response to the item "The overall experience of being a student on this course" under the question "Have the following aspects of your everyday life as a student been as expected, better than expected or worse than expected?" One group consists of the 748 students who answered "Better than expected" (hereafter labelled "the satisfied group"), the other of the 256 students who answered "Worse than expected" (hereafter labelled "the dissatisfied group"). The item had three response categories, and the last group, comprised of the 1179 students who answered "As expected", were not included in this comparison (but their responses are included in the mean scores for all students).

Thematic analysis of the open-ended question

The open-ended question "If someone you know was thinking about enrolling in your course and asked you about it, what would you say to her or him?" prompts responses concerning students' experiences during their first months as STEM undergraduates. The written responses from students who had ticked off "worse than expected" or "better than expected" on the item "your overall experience of the course" were included in this analysis in order to identify positive experiences that contribute to overall satisfaction, and negative experiences reducing satisfaction and thereby increasing the risk of non-completion. Of the 256 students who answered that the overall experience of being a student was *worse than expected* (the dissatisfied group), 216 replied to the open-ended question. In total 748 students answered that the overall experience of being a student was *better than expected* (the satisfied group). Using the random number function in Excel, we aimed at drawing a similar-sized group of satisfied respondents to match the dissatisfied group size, and ended up with 190 responses. The selection was done both in order to limit the data material and because the themes present in the students' responses were expected to be identifiable within a smaller number of responses than the full data set. Thus, a total of 406 responses were analysed.

A thematic analysis (Braun & Clarke, 2006) was performed using the NVivo 9 software to code quotations and identify repeated patterns of meaning. Responses were reviewed in several cycles. First, all authors through discussion constructed a preliminary code set based on a subset of the responses. This code set was tried out and further refined by two of the authors, resulting in a final set of 16 codes (Table 4). Codes were created inductively, based on the respondents' actual expressions; however, labelling of codes and interpretation of predominant themes was guided by the theoretical frameworks. Two authors performed independent coding of all the 406 responses. Comparison revealed that four out of the 16 codes were used differently by the two coders. Disagreements were resolved in a joint recoding (by both researchers) of the responses in question. Several codes were assigned to the same passage where appropriate. In the Results section we indicate the frequencies of the different codes assigned (Onwuegbuzie & Daniel, 2003); however, frequencies in themselves cannot be interpreted as directly indicative of the relative importance of various values or considerations for respondents. Quotes have been translated into English by the authors.

Results

This section is divided into two parts. The first part presents the results found in the closed questions concerning the first year students' general first year experiences and differences between the satisfied and the dissatisfied group. The second part presents the results from the open-ended question.

Students' Evaluation of Their First-Year Experiences

Table 2 lists the items where respondents were asked to rate aspects of their study situation in relation to what they expected before entering the STEM higher education programme. First, we note that respondents overall express relatively high satisfaction with their experiences as compared to their expectations; the means for all students lie at or on the positive side of the neutral midpoint for all items except "The effort you have to spend on studying". When comparing the satisfied respondents with their dissatisfied peers, it should be noted that because the dissatisfied group is much smaller than the satisfied group, the mean scores for the satisfied group are closer to the mean scores of "all students". We see that not surprisingly, the dissatisfied students rate most aspects lower, with large differences for the items concerning social relationship to fellow students, interest in course content and quality of teaching. Strikingly, however, the difference between the two groups is small on the item concerning effort on studying: this is experienced as greater than expected by both respondent groups.

Table 2. Danish and Norwegian students' ratings of aspects of their study situation in relation to what they expected before entering a STEM higher education programme. The table shows mean and standard deviation on a scale from "Worse than expected" (1) via "As expected" (2) to "Better than expected (3). Cohen's d between the satisfied and the dissatisfied group is also shown.

	All students	Dissatisfied group	Satisfied group	
	Mean	Mean	Mean	*d*
Your social relationship with your fellow students	2.2	1.7	2.6	1.5
The overall experience of being a student on this course	2.2	n/a	n/a	n/a
How interesting you find the content of the course	2.1	1.5	2.3	1.3
The overall quality of the teaching	2.0	1.6	2.2	0.9
The effort you have to spend on studying ("worse" means "greater effort")	1.8	1.7	1.8	0.3

Some more results concerning how the students experienced their study situation are presented in Table 3. These items are related to the students' experiences of the study so far, and respondents were asked to rate statements on a five-point scale from "strongly disagree" (1) to "strongly agree" (5). Here, too, means are given for the entire respondent group and for the satisfied and the dissatisfied group, respectively.

Table 3. Danish and Norwegian students' ratings of statements concerning their study situation on a scale from "strongly disagree" (1) to "strongly agree" (5), with 3 as a neutral midpoint. The table shows mean for all respondents and for the satisfied and the dissatisfied group. Cohen's d between the satisfied and the dissatisfied group is also shown.

	All students	Dissatisfied group	Satisfied group	
	Mean	Mean	Mean	*d*
I enjoy the company of the other students on my course	4.2	3.4	4.6	1.5
I feel that my course suits the kind of person that I am	3.9	2.9	4.3	1.6
I have become more interested in the subject since I started	3.9	2.8	4.3	1.6
I feel I fit in socially	3.9	3.0	4.3	1.4
I can see the relevance of what I learn	3.9	3.1	4.1	1.2
The university/college offers good working conditions (equipment, library, common areas, cafés, technical support)	3.7	3.3	4.0	0.7
I am very motivated to study this course	3.6	2.6	4.0	1.4
I feel I can keep up with the pace of the teaching	3.6	3.0	3.8	0.9
I am confident that I am good enough at the subjects in this course	3.4	2.8	3.6	0.7
I will do better than average in this course	3.3	2.8	3.4	0.6
I feel my teachers care about whether students learn or not	3.3	2.5	3.5	1.0
I easily learn the subject matter in this course	3.1	2.7	3.2	0.5
I get personal feed-back from lecturers and teachers when I need it	2.9	2.3	3.2	0.8
I will probably decide to leave this course before I finish	1.6	2.7	1.4	-1.2

Table 3 again shows that respondents on average express relatively high satisfaction with most aspects of the study situation, including social integration and aspects of academic integration such as subject interest and relevance. The teaching and learning situation and respondents' expressed expectation of success are more moderate, but also on the average or the positive side of the neutral midpoint (3).

There are considerable differences between the dissatisfied respondent group and their satisfied peers on many aspects, notably the ones concerning social and academic integration. There are somewhat smaller, although still large differences between the groups on several aspects relating to self-efficacy. Not surprisingly, the dissatisfied group is more likely to consider leaving before finishing their course.

Thus, we may note that academic and social integration, and a feeling that the course suits one's identity, appear to be closely related to an overall positive experience with the study ("better than expected"), the same is true for the respondents' expectation of success, although the differences between the two groups are not as large for these items compared to the items related to academic and social integration.

Students' Evaluation of Their First-Year Experience in an Open-Ended Question

In this section we present responses from the students whose overall experience was worse than

expected (the dissatisfied group) and from students whose experience was better than expected (the satisfied group) to the open-ended question "If someone you know was thinking about enrolling on your course and asked you about it, what would you say to her or him?".

From the thematic analysis, a total of 16 codes that make up 7 main themes were constructed (Table 4). The themes that students' responses were categorized within, including the variation within each of them, will be presented in the following sections.

General experience

Overall, similar themes appeared in both the responses from the dissatisfied group and the satisfied group, and the characters of the responses were to a large extent alike in both groups. For instance, the students who described their study as interesting, worthwhile, or of good quality were found in large numbers in both the dissatisfied group and satisfied group (see "positive general experience with the programme" in Table 4). On the other hand, most of the respondents who wrote that the study programme was of poor quality, boring or not worthwhile ("negative general experience…" in Table 4), belonged to the dissatisfied group.

Table 4. List of codes and numbers of responses from the dissatisfied and satisfied group that were assigned to each code.

Code	***No. of responses dissatisfied group***	***No. of responses satisfied group***
General experience with the programme		
Positive	56	76
Negative	17	4
Cost		
Work load	55	43
Demands strong interest and motivation	23	23
Demands pre-knowledge	13	4
Mathematics	18	6
Teaching and organisation		
The study programme's organisation	27	21
Teaching	42	27
Relevance	13	8
Advice about the choice		
Advice about a personal and/or informed choice	20	14
Recommendation	12	44
Recommendation, if	12	41
Advice against	32	0
(Job) opportunities	11	12
Student social environment	23	40
Study site	35	11

The cost of the study programme

One of the most frequent categories was cost. Students described their study programme as requiring much time as well as mental effort. This appears to be a challenge for a considerable proportion of students in both groups.

> *Be aware that the subject matter is much tougher than in upper secondary school (Satisfied, NO)*

> *It is a good study programme, but it demands time. Lots of time. (Dissatisfied, DK)*

A proportion of students in both groups, but particularly in the dissatisfied group, mentioned specifically mathematics to be hard and time consuming. In particular, some found it hard to see how the mathematics they were presented with, related to their general study programme.

> *It takes much work, especially demanding within mathematics (Dissatisfied, NO)*

Within the "cost" category, many students reported that the study programme demanded a high interest in the field or subject and a lot of motivation.

> *... it is a great study if you love chemistry (...) But you need to have a strong interest in it (Satisfied, DK)*

> *A good study programme if you are really motivated and have a GREAT interest in ICT (Dissatisfied, NO)*

Responses from students in both groups were equally represented in the code "Demands strong interest and motivation". Several students, particularly in the dissatisfied group, wrote that they recommended having skills in the subject before applying. Skills in mathematics were particularly mentioned as important. Computer science students recommended having programming experience before entering a study programme in this field. This is particularly interesting in the Danish and Norwegian context as programming experience is not mandatory for enrolment.

> *The pace of learning is very high and prior knowledge in mathematics and physics must be in place in order to keep up (Dissatisfied, NO)*

> *It is hard to keep up if you haven't programmed and worked a lot with computers beforehand (Dissatisfied, DK)*

Teaching and organisation

One category concerned the structure of the programme and the quality of teaching. Many of the descriptions were about how individual courses or the whole study programme was organised.

> *The structure of this study programme is messy. Very variable levels of engagement among lecturers, poor organisation and poor communication (Dissatisfied, NO)*

The responses also related to the lecturers specifically. They were usually described with few words, and received a range of descriptions from doing a poor to doing a great job.

Other responses were specifically related to the organization and content of the study programme that set the scene for how to study.

> *It takes self-discipline, since there is a large degree of responsibility for your own learning (Dissatisfied, DK)*

… there is more chemistry than what is told at the introductory course (Satisfied, DK).

Several respondents wrote about how they perceived the relevance of the study. In particular, they highlighted how they were surprised by the fact that they were introduced to general courses during the first year, and that the courses they perceived as most relevant for their field of interest were placed later in the programme.

Be prepared that what you would like to do, and what interests you, you cannot pursue until after a few years (Dissatisfied, NO)

… like many university studies, it is very theoretical, and it can therefore be difficult to see the relevance of some of what you're learning (Dissatisfied, DK)

The number of responses assigned to the categories concerning teaching, programme structure and relevance were relatively equally distributed in the two student groups.

Advice about the choice

Several responses contained specific advice about the educational choice. A quite common response was to give general advice for a well informed and thought-through choice.

Think carefully. What is it you want? Will you be able to endure it and to keep motivation up when it is very hard to see practical uses for what you are learning…? (Dissatisfied, NO)

Not surprisingly, more respondents in the satisfied group recommended the study programme. A number of dissatisfied students advised against choosing the course.

Do it, by all means! (Satisfied, DK)

DON'T! (Dissatisfied, DK)

A number of students advised to opt for the study, but with some reservations, typically related to interest, motivation and pre-knowledge.

If you are interested in the subject, there is no reason for doubt (Satisfied, NO)

I absolutely recommend it, if the person is clever in science (Satisfied, NO)

Job opportunities

The expected career opportunities were also described by some students. Typically, these responses included in general terms how they expected it to be easy to get a job, and that the education would open up a range of different opportunities.

… interesting study programme, with good job opportunities (Dissatisfied, NO)

Some students struggled with seeing a career at all and suggested that the information they received before choosing their education was misleading.

And some of the things they promise [in the introduction/information from the institution] that you can become, you cannot (Satisfied, DK)

Student social environment and study site

Concerning student social environment, many, particularly satisfied respondents, stated that the social environment was great. Only some dissatisfied students reported that it was bad. Some related their view of the student life, positive or negative, to gender distribution, size of student groups, field work, events, student organizations, peers' enthusiasm for the subject, and to what extent they felt the environment matched their own identity.

> *Student social life is very good, there's good comradeship among students, also across years (Satisfied, DK)*

> *Fellow students are fantastic. People don't anymore see you as nerdy (Satisfied, DK)*

> *It is nice if you like computers and if you like to be in a class with only boys (Dissatisfied, DK)*

More students from the dissatisfied group than from the satisfied group commented on the study site. Most of these responses advised for or against choosing a specific study site, and several students commented on the quality of the institution's facilities, but did also relate their opinions of the study site to many of the other categories that emerged from the analysis, including teaching, organisation of the study programmes, student environment, work load etc.

> *Teaching and school facilities are incredibly bad in general (Dissatisfied, NO)*

> *Super place to study, exciting education (…) Positive and a far better place to study than when I went to [university] (Satisfied, DK)*

Above we have seen that responses from the dissatisfied group were more numerous in categories concerning cost, advice against the study, and the category where they rated the study as poor in general. However, it is just as noteworthy that the satisfied and dissatisfied groups had similar numbers of responses in many of the categories. A recurring message was that the study has a high cost, demands interest and motivation, but is worth it.

> *It takes dedication and hard work – but then again, it is a cool study programme (Satisfied, DK)*

Discussion, Implications and Conclusion

This study contributes to the existing research literature with three important findings. First, when comparing the satisfied respondents (those whose overall experience was better than expected) with their dissatisfied peers, we found large differences in how they described aspects of their study situation, both on most of the closed-ended questions and also on some of the themes from the open-ended question. Second, both groups felt that an unexpectedly great effort and dedication was required of them. Last, the dissatisfied group had mean scores that were neutral to slightly positive on several of the closed-ended questions related to their experiences with the study, indicating that even if the study situation did not match their expectations, they were still relatively positive about many aspects. Here we discuss each of these three findings, before ending with a more general discussion of how students need to balance cost and value in their first year of higher education.

Large differences, and some similarities, between the two student groups

Not surprisingly, the satisfied student group rated most aspects more positively than the dissatisfied group, and also reported being less likely to leave the study programme early. Thus, the results in this article to some extent differ from the work by Seymour and Hewitt, (1997) who found more similarities than differences between the students staying and the students leaving higher education. Ho-

wever, since the point made by Seymour and Hewitt related to students leaving compared to students staying at the programme, we cannot say if our findings eventually are different, because we cannot say which students might leave.

Further, our finding does not mean that there are not any similarities among the dissatisfied and satisfied student groups. Many students from both groups wrote in response to the open-ended question that they had generally positive experiences with the study programme. Furthermore they had similar responses related to job opportunities. Also, both groups advised that a choice of higher education should be personal and well-informed, and both groups stated that study demanded hard work and a strong motivation.

Both student groups were surprised by the effort and motivation needed

The most striking similarity between the satisfied and dissatisfied student groups on the closed items is that both groups were surprised by the effort they had to spend on studying. Responses to the open-ended question concerning this theme also showed strong similarities, and indicated that many Norwegian and Danish first-year students experienced STEM studies to require a strong dedication and interest. Similar results have been reported by Hazari, Sonnert, Sadler, and Shanahan (2010) and by Bøe and Henriksen (2013) for the case of physics. Concerning the substantial group of students who expressed that they needed to put more time and effort into studying than expected, it is not possible to state whether it was the students or the institutions that had unrealistic expectations of the effort to be invested by students. However, previous research has shown that upper-secondary school students generally perceive STEM studies (especially physics) as hard and demanding (Angell, Guttersrud, Henriksen, & Isnes, 2004; Carlone, 2003; Lyons & Quinn, 2010). In this perspective, it is noteworthy that so many of the students were surprised by the workload. This is one aspect of the "expectancy-experience gap" that many students encounter in their first year in higher education STEM programmes (Holmegaard et al., 2014).

A central issue addressed in the open responses was whether the study content was interesting, motivating and relevant. One frequent coding category was "recommend if…". Responses in this category advised the potential STEM chooser to go forward with their choice, but only if he or she had the necessary level of interest and motivation. A strong message from the open questions was that a STEM study is something you choose only if you have high – perhaps extraordinary – interest and motivation. This is needed to balance the high costs that were expressed clearly by both respondent groups in the open as well as in the closed questions. All respondents agree that the study has a high cost, but only for some students (notably the satisfied group) is this high cost counterbalanced by a high value, for instance in terms of subject interest and social integration.

Students' feeling that the studies require greater effort than expected may be related not only to the actual workload, but also to students' challenges with establishing a sense of belonging to the study programme and figuring out what is required of them (Ulriksen, 2013). Robotham (2008) pointed out that the individual's experience of lack of control over time is a source of student stress. Furthermore there might be a conflict between on the one hand what is implied by the study programme in terms of the students' attitudes, interests and study practices (Ulriksen, 2009), and on the other hand the actual student population entering the study programme. An example is the fact that most students have part-time work (Hovdhaugen, 2015), whereas the courses they meet at the university may still be tailored to a full-time student and sometimes require more than a full week.

Neutral or positive experiences, but still worse than expected

The dissatisfied group had mean scores below the neutral midpoint on all closed-ended questions related to their expectations to the study programme (Table 2). This can be expected since they were sorted by their response that the overall experience was worse than expected. When it comes to rating

their actual experiences without comparing them to expectations (Table 3), they scored near and even above the neutral midpoint on many items. For the items related to social integration, relevance, working conditions and the pace of the teaching, the dissatisfied group responses were neutral to slightly positive. The most negative ratings were on the items related to the teaching and their motivation towards the course.

In response to the open-ended question, mainly dissatisfied students commented that the programme was of poor quality. Conversely, both satisfied and dissatisfied students commented on the programme as interesting and of good quality. Part of the explanation for this might be that Norwegian STEM students' expectations when embarking on a higher education STEM programme have been found to be very high (Schreiner, Henriksen, Sjaastad, Jensen, & Løken, 2010), so that the overall experience may be more than acceptable even if it is somewhat poorer than anticipated. This means that the dissatisfied group are not totally dissatisfied with all the aspects included in this questionnaire, but that they experienced a larger gap between their expectations and their experiences compared to the satisfied group. This calls for caution in the conclusions. What we find are indications of where there are large differences between what is expected and what is experienced. We can, however, not state anything about the quality of the programme offered.

Balancing cost and value: Summing up the discussion

Looking specifically at the respondent groups who rated the overall situation as better or worse than expected enabled us to identify some areas that were particularly associated with negative experiences and thereby with a risk of dropout. A poor match with students' interest, social integration, identity, motivation and perceived relevance of the study might increase students' risk of non-completion. When encountering the first year, students were surprised by the amount of work and how much time and effort were required. Our results suggest that the first-year students negotiate and balance on the one side their interest and motivation, and on the other side the cost associated with attending the study programme.

In the Eccles et al. expectancy-value model (2002), positive values such as interest, enjoyment and expectation of success have to be balanced against the cost attributed to an educational choice in question. Based on the responses in the present study we would argue that this act of balancing continues after entering university. This is in line with previous results (Holmegaard, 2012), based on a qualitative study of the transition from upper-secondary school to university, that the students' educational choice process continued after the students had entered university.

When the students experience that the content they meet appears irrelevant or that the teaching does not succeed in communicating the relevance or fascination of the content, their overall interest in the study programme decreases. If the students need to struggle too much to maintain their interest and motivation it both hampers their academic integration and it increases the risk that students will find it difficult to convince themselves that it is worth the effort to stay. If a strong interest is important to the students' first year experiences, we must consider what kinds of interests are supported within higher education STEM. Hence, to enable more students to get academically integrated in STEM departments we must consider how to support students with broader and more varied interests and motivations than the passionate interest which is expected in some institutional and student subcultures, notably physics (Bøe & Henriksen, 2013).

Implications for Educational Institutions

As presented above, students experience that a strong – maybe disproportionately strong – motivation is needed in order to balance the demands in a first-year STEM programme. How can higher education institutions support students in this balancing act and thus promote retention?

First of all, in order to minimise the "expectancy-experience gap" (Holmegaard et al., 2014), information material (web pages, brochures, education exposition stands, advertisements etc.) must give students a realistic impression of what will be expected of them in the educational programme in question: which background knowledge and skills are needed, which effort and degree of dedication, what degree of independence and time management, and so on. Also, such information must give varied and truthful information and examples of the opportunities for further study as well as professional careers that are open to candidates from the programme. This seems to be obvious from an educational point of view, however unfortunately it is not always the case (Ulriksen, Holmegaard, & Madsen, 2013).

Secondly, the structure of STEM study programmes should be examined. It is crucial for STEM students' first year experiences and retention to ensure leeway in the first semester for students to get integrated academically and to get acquainted with, and develop an identity related to their study programme. To achieve this it is crucial that the students meet topics that they experience as relevant and motivating during first year. For instance, students entering university with a great desire to understand black holes, may find it hard to endure several semesters of mathematics, programming and classical mechanics before getting even the smallest taste of the topics that made them choose physics. A sense of irrelevance makes it more difficult to endure the programme if it gets too difficult, too time-consuming, too costly. The students are in other words expected to postpone their meeting with what they applied for and endure 'deferred gratification' (Johannsen, 2012). As a consequence, STEM study programmes could gain from moving some of the introductory courses in for example mathematics that are often placed in the beginning of first year to later stages of the programme. An alternative approach to address this problem is to integrate the mathematics and programming more closely with the other components of the educational programme.

Thirdly, higher education must consider how students are supported in managing their time and study technique, as the results showed that the students needed to spend more time on their studies than expected. As this is not usually addressed explicitly within the curriculum, the students develop their own study strategies (Ulriksen, 2009). However, general courses in study technique might not solve the problem, as each course presupposes different strategies. Study strategies and frequent feedback on students' work need to be an integrated part of the teaching, since our results showed that a significant proportion of students did not experience sufficient feedback from their teachers when they needed it. To support first year students' study strategies it is therefore not enough to teach students the content, but also the way they are expected to learn it.

Limitations and Implications for Future Research

There are several limitations to the present study that should be noted. The response rate was limited, and only a few STEM higher education programmes were investigated, meaning that the analysed responses did not represent the full group of Danish and Norwegian higher education STEM students. The survey was administered in the second term, and it is likely that some of the students had already left their study programme. This might have resulted in a slightly more positive impression of students' experiences than if we had administered the same survey in the first term. Moreover, the responses to the questions where experiences were rated as better or worse than expected need to be interpreted with some caution, as these responses point to something relative and we did not measure their expectations prior to higher education. Thus, a student who reported worse than expected, might have had either low or high expectations beforehand.

Future studies can complement this study by applying longitudinal methodological approaches to gain insight into how the students construct their expectations over time as they gain new experiences. Also the experiences of students in a broader range of different STEM disciplines and in other national and cultural settings could extend our knowledge further. Finally, the closed-ended ques-

tions used in the present research comprised a limited number of items. More work could be done on further developing the questionnaire in order to capture the different aspects of students' first year experiences. Results from the open-ended question could provide useful information for instrument development.

Conclusion

The present analysis has shown that respondents attending first year STEM programmes at Danish and Norwegian universities on the average expressed a high degree of interest and enjoyment and a good social integration. The analysis found large differences between the respondents who experienced the study programme to be better than expected, and the ones who experienced it to be worse, particularly concerning social relationship to fellow students, interest in course content and quality of teaching.

On average, both groups felt that their studies cost more time and effort than anticipated and required an interest and motivation over and above the normal. In general, all students expressed moderate to high satisfaction with the teaching and learning situation, but a considerable proportion of students expressed that they did not get the feedback they needed.

The students who are at risk of opting out may be capable of completing their studies, but find the strain of a high workload and demanding subject matter not to be properly balanced by interesting, enjoyable and relevant content and work forms. To achieve academic integration, these students need a stimulating learning environment and a curriculum structure that appears coherent and that to a lesser extent presupposes students to endure 'deferred gratification' (Johannsen, 2012) and a sense of irrelevance.

The challenge for STEM education departments is to design and improve information material, programme structure, teaching and learning activities and support study strategies in ways that allow more students to strike a positive balance between the values and the costs involved in a STEM higher education.

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