

MOTIVES FOR CHOOSING A DOUBLE DEGREE PROGRAMME. A CASE STUDY IN ENGINEERING AND EDUCATION

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Abstract

In Sweden, as in many other western countries, student interest and performance in STEM subjects (science, technology, engineering and mathematics) has been declining during the last decades. In Sweden, to make it worse, there is presently a severe shortage of teachers in these subjects in secondary and upper secondary school. In an effort to increase students' interest in becoming teachers, a double degree programme in engineering and education called *Master of Science in Engineering and in Education* was started at KTH Royal Institute of Technology in 2002. The programme is given in cooperation with Stockholm University and prepares for three roles: The pedagogical engineer, the upper secondary teacher with the engineering perspective, and the researcher in technology and learning.

The contribution of teachers to the upper secondary school from this double degree programme is significant. According to a study by the trade union "Lärarförbundet", half of those taking a degree in Sweden from a five years teacher programme in the spring 2014 in the subjects physics, chemistry, biology and technology, graduated from this programme. During the last four years there has been around 500 applicants to the programme. 60 students are admitted yearly. According to a yearly exit survey, sent out within 12 months from graduation, about 30% of the graduates indicate that they work as teachers in upper secondary school.

This study investigates what motives are expressed in the exit survey for having chosen this double degree programme in engineering and education. Data are available from 48 respondents. The material is analysed in an exploratory approach using content analysis, including manifest as well as latent content [1]. Codes were generated from the data.

The findings identify two major types of motives:

- Students chose this programme because they found the *combination* of STEM-subjects and pedagogics attractive (expressed 40 times). They express that the different parts reinforce each other and that this combination match their personal interests.
- Students also chose this programme because they were *uncertain* of career choices and identity, afraid of choosing other specific alternatives, or they had a desire for security (expressed 37 times).

Several minor types of motives are also identified. Some graduates express that status was a motive for choosing this programme (6 times), some had strategic motives (5 times), and some express that this programme was their second choice (3 times).

When these motives are compared with motives for choosing other engineering programmes at KTH Royal Institute of Technology, there are similarities as well as differences [2]. One conclusion is that the programme seems to have fulfilled the ambition to make more students interested in a degree in education.

Keywords: Double degree, Engineering, Education, Teacher, Motives.

1 INTRODUCTION

In Sweden, as in many other western countries, student interest and performance in STEM subjects (Science, Technology, Engineering and Mathematics) has been declining during the last decades. In Sweden, to make it worse, there is presently a severe shortage of teachers in these subjects in secondary and upper secondary school. Available data are difficult to interpret, but a report from the

Swedish Higher Education Authority (UKÄ) states that there is a shortage of graduating teachers in these subjects [3]. A more severe shortage is portrayed by the magazine Ny Teknik (New Technology), which concludes that there is a need of 1000 new Math teachers each year, and the need is about 500 each in Physics, Chemistry and Technology [4]. Most Swedish teacher education programmes have difficulties attracting students and there is a fear that Swedish children will be even less interested in choosing a career in these subjects in the future.

In engineering education, on the other hand, the CDIO initiative is an effort to re-introduce a wide range of skills and abilities in engineering education, which disappeared when hands-on practice was replaced by a more scientific approach in the late 20th century. In order to be able to handle real-world engineering situations, engineers should not only master technical challenges. They must also have e.g. personal, interpersonal skills and system building skills [5]. A broadened engineering role is also demanded by SEFI, the European Society for Engineering Education, in which students develop novel competencies in the intersection between technical, social, educational and communicative skills [6]. "T-shaped Engineers" with a combination of wide and deep competence are welcomed, and engineers must learn how to learn.

In an effort to make more students interested in becoming teachers in a STEM-subject, a double degree programme in engineering and education called *Master of Science in Engineering and in Education* was started at KTH Royal Institute of Technology in 2002 [7]. This programme was designed to meet the need of more teachers, at the same time as training of a wider range of skills was introduced in engineering education. The programme is given in cooperation with Stockholm University and prepares for three roles: The pedagogical engineer, the upper secondary teacher with the engineering perspective, and the researcher in technology and learning. It is a five years study programme where students get two degrees, a Master of Science in Engineering as well as a Master of Science in Education. At the beginning, there were three optional specializations: Mathematics and Physics, Mathematics and Chemistry, and Mathematics and Computer Science, respectively. There was a major revision of the programme in 2011, and the specialization Mathematics and Computer Science was exchanged for two new specializations: Mathematics and Information and Communication Technology, and Mathematics and Energy and Environmental Technology.

Today, this programme is the five years teacher education programme in Science and Technology that attracts most students in Sweden. According to a study by the teachers' trade union "Lärarförbundet", half of those taking a degree in Sweden from a five years teacher education in the spring 2014 in the subjects Physics, Chemistry, Biology and Technology, graduated from *Master of Science in Engineering and in Education* [8]. During the last four years there has been around 500 applicants to the programme and 60 students are admitted yearly. According to a yearly exit survey, sent out within 12 months from graduation, about 30% of the graduates indicate that they work as teachers in upper secondary school.

However, most new teachers in Sweden graduate from 1.5 years teacher training programmes, "Kompletterande pedagogisk utbildning", where applicants have studied the teaching subjects in other contexts before being admitted.

There are some similar combined teacher and engineering programmes that also lead to double degrees, Master of Science in Engineering, and Master of Science in Education. In Sweden, Chalmers offer a programme called "Lärande och ledarskap" (Learning and Leadership), as a two years master programme. In Finland, Tampere University of Technology offers a five years programme, called "Matemaattisten aineiden DI-opettajankoulutus" (Mathematical Sciences Engineering-Teacher Training).

There are few studies on how those graduating from these combined programmes perceive their professional roles or how others, especially employers, perceive them. As combined teacher and engineering educations are rather novel phenomena and a significant proportion of the teachers who graduate today have this background, these are important questions. The perceptions may vary between programmes due to different e.g. marketing or educational profiles. Between different countries, the societal expectations also differ.

Each year since 2010, those graduating from *Master of Science in Engineering and in Education* have received an exit survey within one year after their graduation. Answers to this survey have provided a starting point for investigation of these questions. This study investigates what motives are expressed in the exit survey for having chosen this double degree programme in engineering and education.

2 METHODOLOGY

This study builds on exit surveys distributed every year from 2010 to 2015. Unfortunately, the records are incomplete and some data have been lost. It is evident that data have been collected, but raw data do not always seem to have been stored. Here, focus is on one specific question in the survey: "Why did you choose the study programme *Master of Science in Engineering and in Education*?". Answers are available from 48 respondents (18 women, 21 men, and 9 unknown gender). We do not know exactly who received the survey each year, but about 107 students graduated during the period, so the total dropout is about 55%. For the 107 students, some answers are available for 84 students, which indicate that the response rate probably was about 79%, even though we today have access to only 48 answers on the question that we are interested of.

The respondents' representation of the specializations of the programme is very even, as described in Table 1.

Table 1. Representation of specializations in the data

Specialization	Number of respondents
Mathematics and Physics	10
Mathematics and Chemistry	9
Mathematics and Computer Science	10
Not specified	9

The material is analysed using an exploratory approach with content analysis, including manifest as well as latent content [1]. The codes were generated from the data during the analysis. Every code was used at most one time for each respondent. Many codes are connected to feelings, and the feelings were used for categorization of the codes.

3 RESULTS

Table 2 gives an overview of the codes that were used in the analysis, and specifies how many times the different codes were used. The codes are labelled I – X for further references in the text below.

Table 2. The codes used in the analysis. The numbers in parentheses represent the number of respondents associated with each code.

	Negative feelings	Neutral feelings	Positive feelings
Interests	I. Uncertain about career choice (12) II. Fear of becoming shut in (7) III. Second choice (3)	VI. Status (6)	VIII. Cross-disciplinary span of interests (36)
Aim	IV. Either engineer or teacher (11)		IX. Alloy of competences (4)
Other	V. Possible plan B (1)	VII. Double value for the same study effort (5)	X. Security (6)

Motives for choosing this dual degree programme have been based on uncertainty or fear (codes I and II, together 19 respondents). Fear can relate to either profession: It can be fear of being trapped in teaching, or fear of being trapped in the lab. Both views are expressed in the data. The uncertainty can be about career choices, what to do, and identity. A graduate expressed: "I did not know who I would want to be".

Some graduates expressed that they chose this programme even though they wished to study at another programme. This was their second choice when they were not admitted to e.g. Engineering Physics or Industrial Management (code III, 3 respondents).

Motives for choosing the programme were also based on a desire for greater security (codes IV, V and X, together 18 respondents). Some regarded it in a positive way, as an extra security. This could be expressed "A security factor in the ability to get a job" (code X). One graduate expressed a fear that his plan A might not work out (code V). A number of graduates expressed that they were open for working in either of the professions that the programme qualifies them for. They regarded the double degrees as a possibility for flexibility and a (partly cumbersome) security measure, "A tactical decision to increase my employability" (code IV).

Many graduates expressed motives based on a broad personal interest or on the view that the areas reinforce each other (codes VIII and IX, together 40 respondents). They were interested in both technology and pedagogy, or both engineering and teaching. Many expressed that they were interested in interdisciplinary or multidisciplinary contexts: "The width attracted". Many also expressed a view that the combination of components in the programme was particularly good: "I thought the combination of competencies has many synergies", or "The combination of subject knowledge and the ability to teach [was my motive to choose the programme.]"

Some graduates expressed pure strategic motives (code VII, 5 respondents), and that the programme provides great dividends. An example: "I was tempted by receiving two degrees for the same number of credits."

Some expressed that their motives were based on status (code VI, 6 respondents). They could be attracted by the status of the university or the engineering profession, or they could choose this programme because an alternative university had low status. It could also be a matter of personal status: "I wanted to be a teacher but my environment (read community) gave me the idea that it was not to bet high enough – not fine enough."

4 CONCLUSIONS

The findings support identification of two major types of motives for choosing the double degree programme *Master of Science in Engineering and in Education*:

1. Students chose this programme because they found the *combination* of STEM-subjects and pedagogics attractive (codes VIII and IX, expressed by 40 respondents). They express that the different components support each other and that this combination match their personal interests.
2. Students also chose this programme because they were *uncertain* of career choices and identity, afraid of choosing other specific alternatives, or they had a desire for security (codes I, II, IV, V and X, expressed by 37 respondents).

Both these types of motives are common and expressed by many respondents. They are also important for people who consider becoming teachers. The first type of motive provides a good basis for learning the subjects as well as teaching and learning in the subjects. A conclusion is that the programme seems to attract people with an appropriate and wide range of interests. The combination of degrees, disciplines or subjects in the programme appears to be well chosen. Many graduates express that it matches their personal combinations of interests, and that there are general synergies. This combination of interests is important regardless of in what context a person is working, in school or in a business company.

The second type of motives indicates that the programme offers more flexibility or more security than e.g. other programmes in education, or other engineering programmes. The reasons are not readily distinguishable. Probably status of the university has some part in it. Students may have considered other alternatives with less security or flexibility. Low security or flexibility may be a factor that restrains

people from becoming teachers. At least, this seems to be important for many of the respondents, and a conclusion is that flexibility and security are important for students.

Several minor types of motives are also identified. Some graduates express that status was a motive for choosing this programme, some had strategic motives, and some express that this programme was their second choice.

When the motives are compared with motives for choosing other engineering programmes at KTH Royal Institute of Technology, there are similarities as well as differences [2]. Similarities are:

- Students were attracted by the strong brand of KTH.
- Students have a personal interest for the subjects they are studying
- It is easy for graduates from KTH to find a job.

Some minor motives seem unique for choosing *Master of Science in Engineering and in Education*:

- The programme attracted students with a wide range of interests.
- Strategic considerations attract students, e.g. getting two degrees after five years of study,

According to our findings, uncertainty as described above is one of the major motives for choosing this programme. This type of motive has the opposite effect on other engineering programmes. In general, uncertainty may make students abandon their studies, but here it is a motive for choosing this programme. Thus, by opening up for further possibilities, the programme seems to have fulfilled the ambition to make more students interested in a degree in education.

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Conflict of interests: Cronhjort is the Programme Director of *Master of Science in Engineering and in Education* since 2014. Most of the respondents in the study graduated before he became involved in the programme.

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