# How students choose their subjects:

A SELF-DETERMINATION PERSPECTIVE ON SUBJECT CLUSTER CHOICE.

Friso Zandwijk, 3868826

Supervised by R. F. G. Meulenbroeks

## Abstract

A shortage of highly skilled workers in STEM-fields has been predicted across Europe. One possible reason for this is a relatively low enrolment rate in tertiary STEM education. This is a subject on which descriptive research exists, but no studies have been found regarding its mechanisms. The present study investigates the Subject Cluster Choices of Dutch 9th grade students, a key decision that is expected to provide a first step in elucidating the enrolment problem. Student motivational drives are the subject of this investigation. A case-study, mixed methods approach is adopted, using questionnaires, classroom observation and semi-structured focus group interviews. Four classes from the same medium-sized school were studied, leading to a sample of 121 students aged 14-15. Students were shown to be predominantly autonomously motivated. Controlled motivators were shown to be important as tiebreakers when motivation was equal. Further study should be focused on expanding the reported results as well as longitudinally investigating motivational profiles of students.

## Introduction

Since the turn of the 21st century, there has been a call for policymakers to invest in the stimulation of human resources for science and technology (e.g. EU, 2004). Too few students enter tertiary STEM education and many of them drop back out or switch to a different subject. This leads to a shortage in human capital entering the field as researchers, engineers, and scientists. A shortage like this is expected to hamper scientific, economic and societal progress (Campanella, 2015; EU, 2004; Osborne & Dillon, 2008). Action should be undertaken in order to ensure that more professionals will enter the workforce in due time, meaning that studies in STEM subjects will need higher enrolment. Three reasons have been identified for the current shortage of human capital in science and engineering: high drop-out, competing career choices and relatively low STEM enrolment (EU, 2004).

The first major issue in tertiary STEM education is a relatively high drop-out rate (EU, 2015; Heublein, 2014; OECD, 2018). Drop-out is a subject that garners much attention in the literature (e.g. De Witte *et al*., 2013; Lee & Choi, 2011; Lyche, 2010) but is still considered poorly understood due to competing models and inconsistent use of definitions in these models (Bogaard, 2012; EU, 2015). Many possible

reasons exist for a student to drop out and individual students are usually considered not to have a singular reason to drop out. However, throughout many different models, the most stable predictor of student success appears to be student ability (Bogaard, 2012). Even so, there are many other variables, some more prominent than others, that could explain the high drop-out rates in tertiary STEM education.

The second issue is that STEM graduates do not always end up in the STEM workforce (EU, 2004; Smith & White, 2017, 2019). This means that a proportion of graduates does not contribute to remedying the shortage of human capital. This problem is difficult to address, as no effective policies have as of yet been identified (Smith & White, 2017, 2019). Furthermore, there appear to be mismatches between the expectations of new graduates and industry employers (Alrifai & Raju, 2019). According to Cannady, Greenwald & Harris (2014), the 'STEM pipeline' metaphor which is widely used to inform policy is an ineffective model. This causes mismatches between policy and the issues at hand (Cannady et al., 2014)

The third issue is a relatively low enrolment rate. In 2017, on average across the OECD-countries 27.1% of first-year students in tertiary education were enrolled in STEM-studies. In the Netherlands, this number is even lower at 20.8%. These numbers have been shown to be stable throughout the last decade (OECD, 2013, 2018). It seems that students are either unmotivated to study science and technology or less motivated to study it compared to other subjects. It is also worth noting that there is quite a gender disparity in higher education. Whereas more than half of all graduates is female (approx. 57%), only about 40% of degrees in science and 23% of degrees in engineering, manufacturing and construction are awarded to females (OECD, 2016).

There is a relative scarcity of research on this topic and most of the existing research is descriptive (e.g. OECD indicators). Thus, underlying mechanisms need to be investigated to provide better insight into this problem. Knowing how and why students decide to enrol (or not) in STEM studies could inform policies aimed at attracting more human capital to STEM.

As a starting point for this exploration we should start earlier in a student's career. Since the introduction of the Ba-Ma structure in 2002, education in the Netherlands is set up in such a way that students are preparing for their eventual choice of subject early on. Primary education lasts eight years, after which secondary education lasts 4-6 years, depending on the student's educational pathway. Students in senior general education and pre-university education choose a subject cluster at the end of 9$^{th}$ grade (3$^{rd}$ grade in Dutch secondary education) and starting the 10$^{th}$ grade, will follow a curriculum based on their subject cluster. Four different subject clusters are available, all having similar basic structures but differing in mandatory and optional subjects. An overview of the four subject clusters is presented in table 1. Besides these specific subjects, the subject clusters also contain a general component that is compulsory for all students as well as room for one or two electives.

**Table 1: a short overview of subjects in the four different subject clusters.**

| *Subject cluster name* | *Mandatory subjects* | *Optional subjects* |
|---|---|---|
| *Nature & Health* | Mathematics, Biology, Chemistry | Physics, Geography, Research & Design, NLT (Nature, Life, Technology) |
| *Nature & Technology* | Mathematics, Physics, Chemistry | Computer science, Biology, NLT, Mathematics 'D', Research & Design |
| *Culture & Society* | Mathematics (pre-uni only), Modern foreign language, History | Chemistry, Social sciences, Economics, Modern foreign language, Philosophy, Art subjects |
| *Economics & Society* | Mathematics, Economics, History | Modern foreign language, Geography, Social sciences, Management & Organisation. |

This subject cluster choice (referred to as SCC) is a key moment in Dutch students' educational career, as the choice of cluster determines to a large extent entry into specific tertiary studies. For example, those that wish to study biology in tertiary education will need to choose a subject cluster that includes biology.

Many factors have been hypothesized to influence a student's SCC (ITS, 2009). SCC has, however, been the subject of few studies, many of them descriptive in nature (van Aalderen-Smeets & Walma van der Molen, 2018). No research was found that was aimed at the mechanisms underlying SCC. It is therefore not known based on which motivators students make their choice. There appears to be a disparity between the number of pupils studying STEM in secondary education and the number of entrants into tertiary STEM education. As previously mentioned, in 2017, 20.8% of entrants in tertiary education in the Netherlands choose a STEM subject. However, in 2014-2015 (the year these entrants would have been making their SCC) no less than 50.5% of students in Dutch secondary education choose a STEM subject cluster. This indicates that approximately 60% of these students did not eventually end up studying in a STEM-field in tertiary education. These students have opted for other fields of study, either during secondary education or upon entering tertiary education. It must be mentioned that the two STEM subject clusters also provide entry into tertiary programs which lie outside the OECD's definition of STEM, such as the field of Health and welfare or Veterinary medicine. Therefore, the true number will probably be lower than 60%.

For a 13-15 year old, SCC is considered to be a big, sometimes daunting decision, that may be influenced by many different factors (ITS, 2009). These factors may be divided into intrinsic and extrinsic factors. This allows SCC to be seen from a motivational standpoint: what motivates students to opt for a specific subject cluster? Motivation is usually seen as pertaining to a single action (Hidi & Renninger, 2006; Ryan & Deci, 2000). However, by using motivation as a guiding principle, specific motivators that can be either intrinsic or extrinsic in nature may be identified and studied.

*RQ "What are the motivational drives of Dutch 9$^{th}$ grade students during the process of making their subject cluster choice?"*

Note that this is a different approach to studying motivation for and attitude towards secondary school science in general, subjects that have been studied extensively (e.g. Becker & Park, 2011; Dignath & Büttner, 2008; Osborne, Simon, & Collins, 2003; Potvin & Hasni, 2014 for reviews). The present study intends to investigate the motivation behind opting into a subject (or not). This approach may bridge the gap between enjoying classroom science and pursuing a career in science.

There are two sub questions, that are designed to allow for triangulation of data from different sources as well as provide a better-founded understanding of the findings regarding the main questions. Sub questions are as follows:

*SQ1 "What specific motivators can be identified as influencing subject cluster choice?"*
*SQ2 "To what extent are counselling sessions supportive of intrinsic motivational profiles?"*

# Theoretical Framework

One leading motivational theory is Self-Determination Theory (SDT). One sub theory of SDT assumes that every person has certain universal basic needs, which need to be met in order for them to feel motivated towards doing something (Deci & Ryan, 1995; Ryan & Deci, 2000, 2017). These universal needs are competence, autonomy, and relatedness. Competence can be explained as a sense of joy or accomplishment in being able to do something or improving at it. A subject's perception of their competence is a prerequisite for the development of intrinsic motivation, meaning for example that a person who is unconvinced of their own competence is unlikely to be intrinsically motivated for that specific activity. Autonomy is the control one has over their decisions in the completion of a task or activity. Freedom of choice as well as having a choice at all can support the need for autonomy. Rewards however are known to adversely affect a person's sense of autonomy and thereby limit the development of intrinsic motivation (Deci, Ryan, & Koestner, 1999; Ryan & Deci, 2000). The satisfaction of the need for autonomy may also rely on learning climate, where autonomy may be supported or not (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). A study by Vansteenkiste et al. (2004) showed that the need for autonomy may be satisfied based on the wording used in written instructions (e.g. pp. 252). For example, an autonomy supportive sentence used was "you might decide to try to learn more about communication styles" (pp. 252) whereas the controlling wording of the same sentence was "you should learn more about communication styles" (pp. 252). The third and final need is the need for relatedness. This entails the propensity of people to seek out meaningful relations with others. When a relation involved in a task is considered to be distant, this may dampen intrinsic motivation. A warmer or more personal approach on the other hand, can foster intrinsic motivation.

Behaviour is motivated by a tendency to avoid situations in which the three basic needs are not sufficiently met and seeking out those situations in which they are being met. The resulting behaviour can be scored on a continuum ranging from amotivated (no intention to act) to intrinsically motivated. This continuum can be roughly divided into six types of motivation or regulatory styles, see figure 1. The six different types of motivation correspond to very different conditions. As an example, external regulation can be found in a situation where a subject is made to be compliant with an external source of control (Ryan & Deci, 2000). Any rewards or punishments are external as well as the perceived locus of causality. This leads to the basic needs of autonomy and relatedness being undermined. The subject then becomes less likely to perform a certain action than a subject who perceives their basic psychological needs as being met.

It is important to note that making a complex decision is difficult to define as a single action or activity. The final choice is preceded by counselling sessions, discussion with teachers, peers or parents and 'soul-searching'. Therefore, a slightly simplified model of SDT will be used as a guiding frame for this study. This simplification was previously used by Vansteenkiste *et al*. (2009) in order to develop a questionnaire. The SDT-model is simplified to four motivational profiles, namely Extrinsic, Controlled, Autonomous and Intrinsic motivation. These four profiles are at the basis of this study. The Extrinsic profile corresponds to external regulation in figure 1, the Controlled profile to introjected regulation. These two profiles are considered to be the controlled types of motivation, as the perceived locus of causality is external. The Autonomous profile corresponds to identified regulation and the Intrinsic profile corresponds to intrinsic regulation. These together are autonomous types of motivation, as the perceived locus of causality is the subject's self (Vansteenkiste et al., 2009).

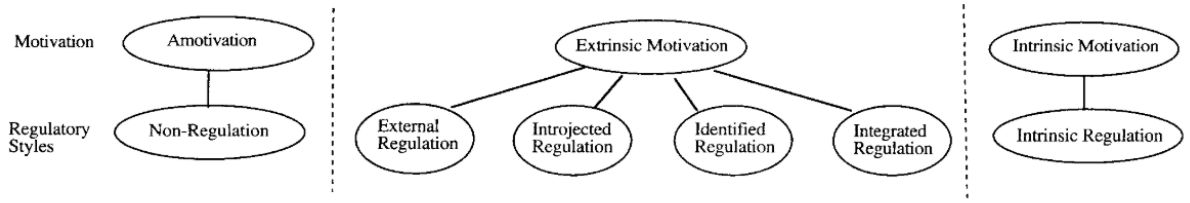


**Figure 1: The Self-Determination continuum. Depending on whether the perceived locus of causality lies more or less external and whether their regulation is more or less autonomous, extrinsic motivation can be categorized into one of four types. Less autonomous and more external perceptions of cause lie to the left towards amotivation (Ryan & Deci, 2000).**

Motivation usually applies to a concrete action or behaviour. This concerns split-second decisions rather than complex, pre-meditated choices. Motivation therefore seems to be an ill-suited model for the proposed investigation. However, students are already studying most, if not all, the subjects included in their future subject cluster. This means they are already motivated to some degree to do their class work or pay attention in class regarding each specific subject. The students may be said to be motivated 'for' a subject, meaning it is possible to explicate this motivation.

Furthermore, various factors have been identified (ITS, 2009) and can additionally be thought of that may be important to a student in their choice. For example, a student might be advised by their parents to pursue a certain career and therefore, a specific subject cluster. Another example is that students have been reported to select those subject clusters containing subjects they report to be talented in (ITS, 2009). These are examples of an extrinsic motivator and an intrinsic motivator, respectively. Motivational theory can then be used to shed light on the different types of motivators that students use. This provides insight in the degree of autonomy the students experience in making their SCC.

# Methods

## Sample

To answer the research question, a case-study approach is adopted. The research is conducted at a medium-sized secondary school. This school is known as an 'excellente school', which is a predicate awarded to schools by the Dutch educational inspectorate for extraordinary qualities or excellent results (Inspectie van het Onderwijs, 2018). The school is further characterised by its protestant-Christian grounding and a relatively large societal involvement, both as a school being involved with the outside world and as a school that intends to teach life lessons and skills to its students.

This last characteristic is exemplified by the relatively large amount of time that is spent on counselling students making their SCC. This makes the school an ideal candidate for this study. The students at this school are mostly local children. The school offers education to any student, regardless of (religious) background. It may be expected however, that many students will come from a protestant-Christian background. This is not expected to influence results, as this study is mostly exploratory in nature. The students researched will be 14-15-year-old, grade nine students that are enrolled in the third year of either senior general secondary or pre-university education. Two classes from each educational level will be under study, as they will all have their counselling sessions on the same weekday. This will provide a sample of approximately 110 students.

# Data collection

Firstly, the students' motivations for the different subjects are examined early in the school year, using a questionnaire adapted from Vansteenkiste *et al.* (2009). The original questionnaire asked applicants to report why they were motivated for the activity of studying. An adaptation was made to the premise of the questionnaire, in order to create the example sentence "I will choose a certain subject cluster, because…" Students were then asked to complete items asking how important 16 different motivators were to them. An example of a controlled motivator is "I will choose a certain subject cluster, because I want others to think I am sensible". An example of an intrinsic motivator is "I will choose a certain subject cluster, because the subjects in this cluster are interesting to me". The corresponding questions from the unabridged questionnaire are as follows; "I'm studying because I want others to think I am smart" and "I'm studying because I am highly interested in doing this", respectively. The full questionnaire can be found in appendix A. The questionnaire will be administered a second time after the last counselling session. Cronbach's α was used to check the internal consistency. This resulted in a score of $\alpha=0.721$ for the pre-test and a score of $\alpha=0.736$ for the post-test, which was deemed sufficient. Motivational profile scores were then compared pre- to post-test using a Wilcoxon matched-pairs test, repeated once for every Motivational profile.

Secondly, as the year progresses, the counselling sessions will be observed. There will be a total of ten sessions, five of which will serve to inform a bottom-up approach to constructing a coding scheme. A preliminary coding scheme was used, based on literature as well as preparatory meetings with the school's dean. Coding will proceed in five-minute intervals, where a code will be applied when a motivator is discussed at any time during the five-minute bracket. Motivators that are not yet contained in the coding scheme will be added in a bottom-up approach. After the first five sessions, the coding scheme is used to code the second group of five sessions, which will subsequently be analysed. Due to the nature of the counselling sessions, no second coding will be applied.

Finally, a focus group of students will be formed for a semi-structured interview. Students will be asked to volunteer for the interview by filling out a consent form. When the number of responses is too high to interview all volunteers, a selection will be made on the premises of 'first come, first served'. The interview data will be analysed using the coding scheme developed during the observation phase. A total of 17 fragments were extracted from the transcript yielding a total of 18 specific motivators being coded. Second coding was applied to this data, reaching an agreement of $\kappa=0.813$. Two fragments were deemed not to correspond to any of the previously identified motivators and were instead reason to develop an additional code. This specific motivator was termed 'workload' and was deemed to be a controlled motivator. A total of 7 autonomous motivators and 9 controlled motivators were identified, 'dissemination of neutral information' having been coded twice. Aside from specific motivators being coded, the students' answers will also be used to interpret quantitative data and gain a more in-depth insight into student motivation. This interview will focus on open-ended questions, wherein students will be asked to explain their reasoning and discuss what motivators have played a role in making their decision. Prepared questions can be found in appendix B.

# Data analysis

The questionnaire data will be analysed using a one-way repeated measures ANOVA or its non-parametric equivalent, post-hoc tested using paired t-tests or their non-parametric equivalent, in order to examine longitudinal differences between the four tested motivational profiles. In order to quantify differences in scores for the different motivational profiles, they will be compared using paired t-tests or their non-parametric equivalent. The comparison between the different motivational profiles will use

only data from the second questionnaire, as this questionnaire will be completed very close to the deadline for SCC. This will therefor provide the best insight into how the students are motivated for their SCC just before actually committing to it.

The qualitative interview data will be used to provide some insight into student reasoning concerning their SCC as well as the counselling sessions. This is an important data source especially for answering sub question two. Answers will also be analysed to elucidate which (type of) motivators carry most weight with the students.

# Results

In this section an overview of the results of this study will be provided. These results will be divided by means of collection of the data, e.g. each section will be dedicated to the analysis of all data from one source.

## Observations of classroom activities

An overview of specific motivators related to SCC that were observed during classroom observations can be found in figure 2. Those motivators that were mentioned, on average, once per session, were deemed to be of significance. Figure 2 is limited to those motivators that were coded at least four times. A slight majority of motivators (56.7%) was of an autonomous nature.
An example of a controlled motivator being coded was when the dean explicitly asked the students who had asked their parents for advice. Neutral information was mostly coded in relation to the procedure involved in SCC as well as the structure of and options for students in the Dutch educational system. The specific motivators described below are the following, from left to right: The prospect of a 'good' salary, pressure from parents, pressure from peers, grades or performance, dissemination of neutral information, students' interests, (adjusting to) student personalities and having or wanting to unfurl certain talents. The full coding rubric can be found in appendix C.

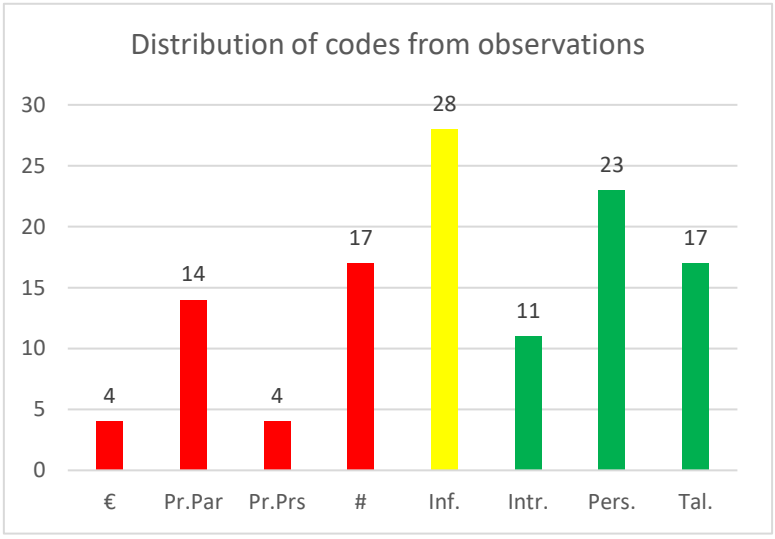


**Figure 2: Distribution of motivators coded during classroom observations. Red bars describe Controlled motivators and green bars describe Autonomous motivators. The yellow bar represents neutral information.**

Additionally, data was collected regarding the classroom climate. This data was coded to be either thwarting or supportive of the three basic needs in Basic Need Satisfaction theory. An example of a competence-thwarting exchange that was observed, was the dean requiring the students to do an assignment that they considered unchallenging and unnecessary. An example of an autonomy-supportive exchange was when the dean discussed examples provided by the students themselves. This showed the students that they were partially responsible for the content of the sessions and that their dean takes their input into account.

Distribution of classroom-climate related codes are presented in figure 3. Approximately two-thirds (66,9%) of instances was supportive in nature, as opposed to one-third having been coded as thwarting. These are data compiled across all classes and all four sessions.

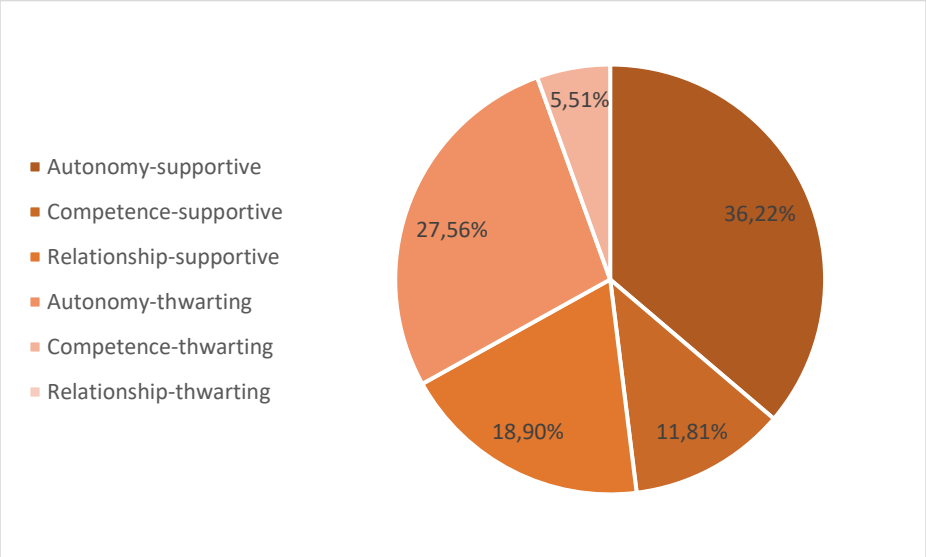


**Figure 3: Distribution of classroom-climate codes**

# Questionnaires

A total of 121 students returned questionnaires, with 44 of them completing just one of two questionnaires. Omission of these 44 students left a sample size of 77. These students were omitted for this analysis since they had not completed two questionnaires to be compared. Because four different motivational profiles were measured, each with four items on the questionnaire, scores were computed as the mean of the four items for each motivational profile. Results of this analysis can be found in table 1. Scores did not differ significantly pre- to post-test for any of the motivational profiles.

*Table 2: test results for pre- to post-test comparison using Wilcoxon matched-pairs tests*

| *motivational profile* | *Z-score* | *P-value* |
|---|---|---|
| *Intrinsic motivation* | -0.660 | 0.509 |
| *Autonomous motivation* | -1.231 | 0.218 |
| *Controlled motivation* | -0.627 | 0.530 |
| *Extrinsic motivation* | -0.835 | 0.404 |

Furthermore, differences in score between motivational profiles were analysed using Friedman's ANOVA. There was a statistically significant difference between the motivational profiles, $\chi^2(3)=204.206$, $p<0.000$. Post hoc analysis using Wilcoxon matched-pairs tests was performed with a Bonferroni correction,

resulting in a critical p-value of 0.0083. Mean (SD) scores for intrinsic motivation, autonomous motivation, controlled motivation, and extrinsic motivation were 3.79 (0.57), 3.37 (0.83), 1.48 (0.74) and 1.33 (0.65), respectively. No significant differences were found when comparing Controlled and Extrinsic motivation (Z=-2.323, p=0.02). Significant differences were found between Autonomous and Intrinsic motivation (Z=-4.394, p<0.000), favouring intrinsic motivation, Controlled and Intrinsic motivation (Z=-8.363, p<0.000), favouring intrinsic motivation, Extrinsic and Intrinsic motivation (Z=-8.417, p<0.000), favouring intrinsic motivation, Controlled and Autonomous motivation (Z=-8.109, p<0.000), favouring autonomous motivation, and Extrinsic and Autonomous Motivation (Z=-8.026, p<0.000), favouring autonomous motivation. See figure 4 for the distribution of scores.

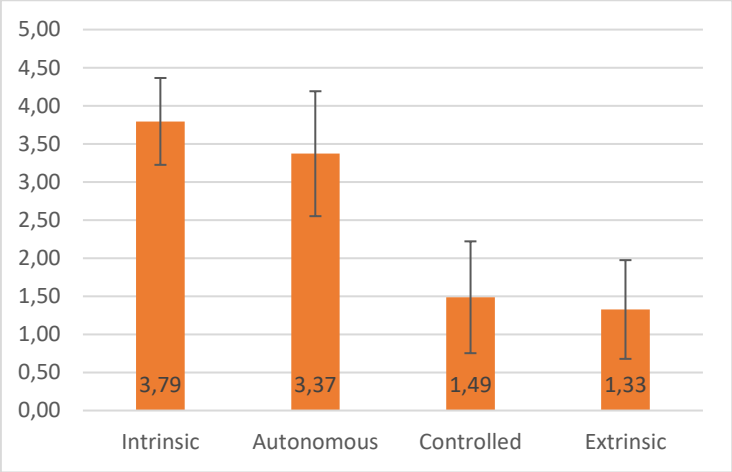


**Figure 4: Distribution of mean score per motivational profiles on post-test.**

## Semi-structured interview

The interviewees, when asked about their reasoning through open-ended questions, first described motivators fitting autonomous motivation (e.g. enjoyment, personal interest). One word that was often repeated was 'leuk' (Dutch; fun, nice, enjoyable). Only upon further questioning did they mention controlled motivators, such as workload or external pressures. Furthermore, all interviewees mentioned their appreciation for having been informed about the possibilities and opportunities in choosing a cluster over the course of the counselling sessions. The distribution of codes from the interview can be found in figure 5.

When asked about the how the counselling sessions contributed to the student's SCC, one student remarked: "I liked the assignments during the lessons, because they showed you what you found interesting and what you didn't [find interesting]." The same student, when specifically asked to explicate their reasoning, said: "I think I mostly looked at the subjects that I found easier and that I liked as well. Then I checked which subject cluster had those subjects." The student mentioned a controlled motivator (a subject being easier) only upon further questioning. Furthermore, this was not the main consideration, but a way for the student to limit the choice somewhat.

Another student mentioned early on that they had already known what subject cluster they would choose before the first counselling session. This student said the following about the counselling sessions: "(…) I had already wanted to choose Nature & Health, but now I know what exactly is so nice about this cluster and why I want to choose that one." When questioned further, the student explained that "[even though I already choose a subject cluster] I didn't know for sure which subjects I was going to choose." Upon questioning what considerations were important in their choice, the student explained "I wanted to take mathematics 'A' because I thought mathematics 'B' was too much. And I asked my math and physics

teachers, and they said that I could." This student, even though they were primarily autonomously motivated, actively sought out advice from their teachers. This shows a thorough examination of different motivators and reasons involved in their SCC.

Interestingly, the interviewees seemed to have very different strategies for making their SCC. One interviewee, for example, used a method akin to a process of elimination. Subjects were eliminated, based mostly on (lack of) autonomous motivators, in order to cull the number of possibilities and select the cluster for which they were most autonomously motivated (that they enjoyed the subjects of the most). Another interviewee used an almost opposite strategy, considering many different motivators across a wide range of different options in a pros and cons approach.

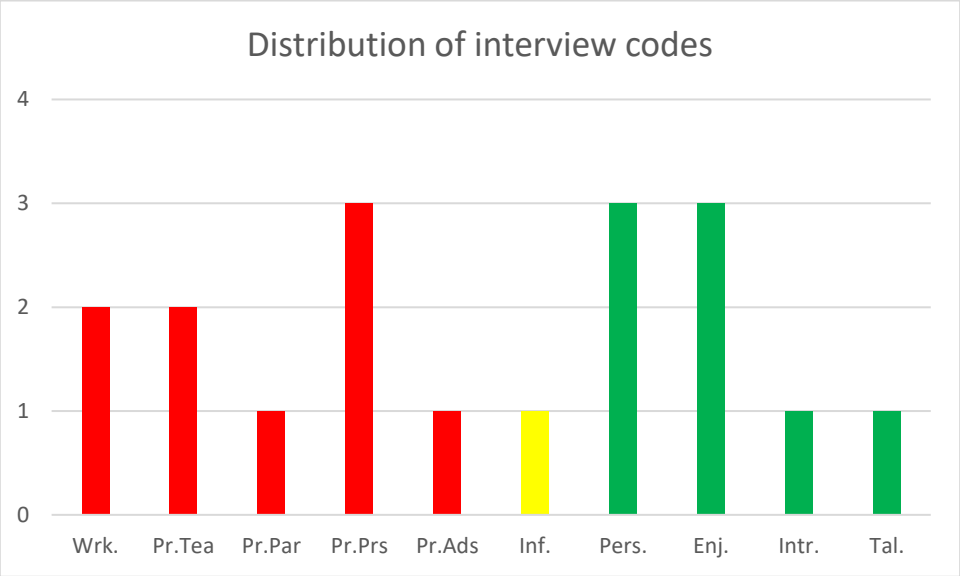


**Figure 5: Distribution of codes lifted from the semi-structured interview. Red bars show Controlled motivators, green bars show Autonomous motivators. The yellow bar represents the dissemination of neutral information.**

# Conclusion

The research question used in this study was "*What are the motivational drives of Dutch 9th grade students during the process of making their subject cluster choice*." sub questions were as follows; *"What specific motivators can be identified as influencing subject cluster choice?"* and *"To what extent are counselling sessions supportive of intrinsic motivational profiles?"*

Many specific motivators have been identified, both controlled and autonomous. A few motivators were mentioned only once or twice, where others have been mentioned multiple times during each counselling session. Three out of the five motivators most coded were autonomous motivators. One motivator was elucidated from the interview data (workload) and had not been mentioned during the counselling sessions. A full list of motivators can be found in the coding rubric in appendix C.

Concerning the role of counselling sessions, it is important to note that the self-reported motivational profile of the students had not changed significantly following the completion of the sessions. It can therefore be concluded that the counselling sessions were not supportive of intrinsic motivational profiles. One other important aspect of the sessions that became apparent, is providing the students with the information they might need to decide for a certain cluster. This became clear from both observations and the semi-structured interview. The role of the counselling sessions might therefore be

said to be the empowerment of students in making their SCC, by informing them of different options and possibilities. Their function does not appear to be to motivate students to make a certain choice, but to motivate them to make *any* choice. The class climate during the sessions was supportive of autonomy, competence, and relation. It may therefore be said that the sessions were at least not detrimental to intrinsic motivation.

Students were shown to base their SCC mostly on autonomous motivators and intrinsic reasoning. Questionnaire scores for both of the autonomous motivational profiles, Intrinsic motivation and Autonomous motivation, were significantly higher than those for the controlled motivational profiles. Interview data shows that students reported intrinsic reasoning first and foremost, resorting to controlled motivators only when questioned further. They were more outspoken and explicit in their description of autonomous motivators, as opposed to briefly touching upon controlled motivators. This does not mean that controlled motivators are unimportant, but they play a role mostly in tipping the scale when it is equally balanced.

# Discussion

This study must be seen for what it is – a case study. More large-scale investigations will have to be carried out to show whether this approach can truly merit the problems outlined. One might conceive a study focused on longitudinal effects and changes, mapping changes in subject cluster (which is possible, albeit difficult) and exploring what happens to students' motivational profiles as they progress through upper secondary education. Follow-up studies might also explore the connection between subject clusters in upper secondary and field of study in tertiary education. It is apparent that Dutch pupils do not necessarily choose a field of study connected to their subject cluster, as is apparent from the decrease in the fraction of students studying STEM between 9$^{th}$ grade and first year of tertiary education (from approx. 50% to 20.8% in the Netherlands).

Some further limitations, apart from the case study approach, that should be mentioned are as follows; firstly, counselling sessions were rescheduled a few times due to unforeseen circumstances, one of them being ultimately cancelled. This left nine sessions in total and made the workload slightly higher for the remaining sessions. It is unclear how this may have influenced results. Secondly, no more than three students were interviewed, because they were the only ones that had consented to being interviewed. Out of over 120 students, it is easy to see that some bias may be present in this selection. The small size of the focus group may also have influenced the students into providing what they felt were socially desirable answers.

Students have been shown to lean towards Autonomous motivation in making their SCC. Because this is their first step towards a possible career in a STEM-field, it is important to analyse what this means for entry into tertiary education. Where approximately half of students choose a STEM-oriented subject cluster, in 2017 only 20,8% of entrants into tertiary education opted for STEM-fields in the Netherlands (OECD, 2019). The present study did not investigate motivational profiles of first-year students towards their (STEM-) subject. However, it does address the general motivational drives reported by students at the first key moment in choosing a significant direction in their educational career. The relative 60% decrease in students studying STEM between upper secondary and early tertiary education may play a part in the projected shortage of human capital in STEM-fields (Campanella, 2015; EU, 2004; J Osborne & Dillon, 2008).

Another thing that became clear through this study, is that students appreciated the information their dean provided because it helped them to make their decision. By showing the students what is required of them, what they might expect from certain subjects and what possibilities there are, they were more confident in their choice. Perhaps the choice for a tertiary educational programme could benefit from the same type of counselling. This could conceivably have the dual function of lowering drop-out while increasing entry into tertiary STEM education.

# References


Alrifai, A. A., & Raju, V. (2019). The Employability Skills of Higher Education Graduates: A Review of Literature. *Iarjset*, *6*(3), 83–88. https://doi.org/10.17148/iarjset.2019.6315

Becker, K., & Park, K. (2011). Integrative Approaches among Science, Technology, Engineering, and Mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. *Journal of STEM Education*, *12*(5), 23–38. Retrieved from http://eds.b.ebscohost.com.ezproxy.lib.usf.edu/ehost/pdfviewer/pdfviewer?sid=9804a02b-8893-42ea-9fa8-d9b40e9c1d75%40sessionmgr102&vid=4&hid=113

Bogaard, M. van den. (2012). Explaining student success in engineering education at Delft University of Technology: a literature synthesis. *European Journal of Engineering Education*, *37*(1), 59–82. https://doi.org/10.1080/03043797.2012.658507

Campanella, E. (2015). Reversing the elite brain drain: a first step to address Europe's skills shortage. *Journal of International Affairs*, *68*(2), 195–209.

Cannady, M. A., Greenwald, E., & Harris, K. N. (2014). Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce? *Science Education*, *98*(3), 443–460. https://doi.org/10.1002/sce.21108

De Witte, K., Cabus, S., Thyssen, G., Groot, W., & Maassen Van Den Brink, H. (2013). A critical review of the literature on school dropout. *Educational Research Review*, *10*, 13–28. https://doi.org/10.1016/j.edurev.2013.05.002

Deci, E. L., & Ryan, R. M. (1995). Human autonomy: The basis for true self-esteem. *Efficacy, Agency, and Self-Esteem. Plenum Series in Social/Clinical Psychology*, (July 2015), 31–49.

Deci, E. L., Ryan, R. M., & Koestner, R. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*(6), 627–668. https://doi.org/10.1037/0033-2909.125.6.627

Dignath, C., & Büttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning*, *3*, 231–264. https://doi.org/10.1007/s11409-008-9029-x

EU. (2004). *Report by the High Level Group on Increasing Human Resources for Science and Technology in Europe, 2004*. Luxembourg: Office for Official Publications of the European Communities.

EU. (2015). *Drop-out and completion in higher education in Europe - Main Report*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2766/826962

Heublein, U. (2014). Student Drop-out from German Higher Education Institutions. *European Journal of Education*, *49*(4), 497–513. https://doi.org/10.1111/ejed.12097

Hidi, S., & Renninger, K. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist*, *41*(2), 111–127. https://doi.org/10.1207/s15326985ep4102

Inspectie van het Onderwijs. (2018). *Juryrapport Excellente Scholen: Corlaer college havo & vwo*. Utrecht.

ITS. (2009). *Wat bepaalt de keuze voor een natuurprofiel? De invloed van de leerling, de school, de ouders en de peergroup*. (A. van Langen & H. Vierke, Eds.). Den Haag: Platform Bèta Techniek.

Lee, Y., & Choi, J. (2011). A review of online course dropout research: Implications for practice and future research. *Educational Technology Research and Development*, *59*(5), 593–618. https://doi.org/10.1007/s11423-010-9177-y

Lyche, C. S. (2010). Taking on the Completion Challenge: A Literature Review on Policies to Prevent Dropout and Early School Leaving. *OECD Education Working Papers*, *53*. https://doi.org/http://dx.doi.org/10.1787/5km4m2t59cmr-en

OECD. (2013). *Education at a Glance 2013: OECD Indicators*. OECD Publishing. Retrieved from http://www.oecd-ilibrary.org/docserver/download/4213201e.pdf?expires=1395222439&id=id&accname=guest&checksum=F9C6674E09CE56B8C66B5B09314145B0

OECD. (2016). *Education at a Glance 2016: OECD Indicators*. Paris: OECD Publishing. Retrieved from http://download.ei-ie.org/Docs/WebDepot/EaG2016_EN.pdf

OECD. (2018). *Education at a Glance 2018: OECD Indicators*. Paris: OECD Publishing. Retrieved from http://download.inep.gov.br/acoes_internacionais/estatisticas_educacionais/ocde/education_at_a_glance/Country_Note_traduzido.pdf

OECD. (2019). *Education at a Glance 2019: OECD indicators*. Paris: OECD Publishing.

Osborne, J, & Dillon, J. (2008). *Science education in Europe: Critical reflections*. *London: Nuffield Foundation*. Retrieved from http://www.fisica.unina.it/traces/attachments/article/149/Nuffield-Foundation-Osborne-Dillon-Science-Education-in-Europe.pdf%5Cnpapers2://publication/uuid/FA17ED57-71AF-429E-B7E5-D9E33DA4A538

Osborne, Jonathan, Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049–1079. https://doi.org/10.1080/0950069032000032199

Potvin, P., & Hasni, A. (2014). Interest, motivation and attitude towards science and technology at K-12 levels: a systematic review of 12 years of educational research. *Studies in Science Education*, *50*(1), 85–129. https://doi.org/10.1080/03057267.2014.881626

Ryan, R. M., & Deci, E. L. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., & Deci, E. L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development and Wellnass*. New York: The Guilford Press.

Smith, E., & White, P. (2017). A 'great way to get on'? The early career destinations of science, technology, engineering and mathematics graduates. *Research Papers in Education*, *32*(2), 231–253. https://doi.org/10.1080/02671522.2016.1167236

Smith, E., & White, P. (2019). Where Do All the STEM Graduates Go? Higher Education, the Labour Market and Career Trajectories in the UK. *Journal of Science Education and Technology*, *28*(1), 26–40. https://doi.org/10.1007/s10956-018-9741-5

van Aalderen-Smeets, S. I., & Walma van der Molen, J. H. (2018). Modeling the relation between students' implicit beliefs about their abilities and their educational STEM choices. *International Journal of Technology and Design Education*, *28*(1), 1–27. https://doi.org/10.1007/s10798-016-9387-7

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology*, *87*(2), 246–260. https://doi.org/10.1037/0022-3514.87.2.246

Vansteenkiste, M., Soenens, B., Sierens, E., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: the quality of motivation matters. *Journal of Educational Psychology*, *101*(3), 671–688. https://doi.org/10.1037/a0015083

# Appendix A: full questionnaire (Dutch)

## Vragenlijst motivatie bij profielkeuze

Beste leerling,

Voor je ligt een vragenlijst van 16 stellingen. Deze gaan over wat jij belangrijk vindt (of niet) bij het maken van jouw profielkeuze.

Achter iedere stelling staan de cijfers 1 t/m 5. Een score van '1' betekent dat de stelling helemaal niet van toepassing is op jou, een score van '5' betekent dat deze stelling helemaal wel van toepassing is op jou. Omcirkel achter iedere stelling één cijfer. Als je twijfelt tussen twee cijfers, probeer dan toch voor een van de twee te kiezen.

Voordat je aan de stellingen begint, wil ik je vragen om jouw informatie hieronder in te vullen.

Ik ben een… □ Jongen □ Meisje

Laatste 4 cijfers telefoonnummer: _____

Klas:

**Hieronder beginnen de stellingen**

Ik kies voor een bepaald profiel omdat …

| | | | | | |
|---|---|---|---|---|---|
| 1. De vakken in dit profiel me erg interesseren. | 1 | 2 | 3 | 4 | 5 |
| 2. Ik de vakken in dit profiel leuk vind. | 1 | 2 | 3 | 4 | 5 |
| 3. Ik dit profiel boeiend vind. | 1 | 2 | 3 | 4 | 5 |
| 4. Ik het studeren voor de vakken in dit profiel een aangename bezigheid vind. | 1 | 2 | 3 | 4 | 5 |
| 5. Ik nieuwe dingen wil bijleren. | 1 | 2 | 3 | 4 | 5 |
| 6. Ik dit profiel persoonlijk zeer waardevol vind. | 1 | 2 | 3 | 4 | 5 |
| 7. Dit profiel uit vakken bestaat die voor mij persoonlijk waardevol zijn. | 1 | 2 | 3 | 4 | 5 |
| 8. De vakken in dit profiel me helpen met het bereiken van mijn levensdoel. | 1 | 2 | 3 | 4 | 5 |

Ik kies voor een bepaald profiel omdat …

| | | | | | |
|---|---|---|---|---|---|
| 9. Ik wil dat anderen denken dat ik verstandig ben. | 1 | 2 | 3 | 4 | 5 |
| 10. Ik me schuldig zou voelen als ik een ander profiel zou kiezen. | 1 | 2 | 3 | 4 | 5 |
| 11. Ik me zou schamen als ik een ander profiel zou kiezen. | 1 | 2 | 3 | 4 | 5 |
| 12. Ik anderen de indruk wil geven dat ik een goede leerling ben. | 1 | 2 | 3 | 4 | 5 |
| 13. Ik verondersteld word ervoor te kiezen. | 1 | 2 | 3 | 4 | 5 |
| 14. Anderen (ouders, vrienden, docenten, …) me dwingen om ervoor te kiezen. | 1 | 2 | 3 | 4 | 5 |
| 15. Anderen (ouders, vrienden, docenten, …) me verplichten om ervoor te kiezen. | 1 | 2 | 3 | 4 | 5 |
| 16. Anderen (ouders, vrienden, docenten, …) van me verwachten dat ik ervoor kies. | 1 | 2 | 3 | 4 | 5 |

# Appendix B: Interview questions

Basic interview scheme for semi-structured focus group interview.
Five open-ended questions will be used as a starting point, further questioning will be based on responses and achieving further explication of utterances.

1. You have attended nine [SCC] counselling sessions over the past half year. What did you think of these sessions?
   -What was an important thing you learned or found out?
   -What did you like about the sessions?

2. How have the counselling sessions contributed to your SCC?
   -When did you first make a decision?

3. Are you anxious about making your SCC final?
   -Why (not)?
   -What might have prevented you from feeling this way?

4. What were important considerations in making your SCC?
   -Why was/were this/these consideration(s) so important?
   -Are there other considerations that were not important to you?

5. Have the counselling sessions changed your considerations in any way?
   -How have your considerations changed?

# Appendix C: coding rubric

## **Content-related codes:**

Controlled motivators:

-Money: when earning (a lot of) money or becoming rich is mentioned (as a motivator), code as '€'.

-Status: when achieving a certain status/prestige is mentioned (as a motivator), code as '>'.

-Pressure: When an indirect influence on student behaviour, caused by explicit or implicit expectations held by others (pressure) is mentioned (as a motivator), code as

From parents, 'Pr.par'
From peers, 'Pr.prs'
From teachers, 'Pr.tea'
From adults not otherwise mentioned, 'Pr.ads'
From (social) media/news-outlets, 'Pr.med'
From guilt/shame (internal pressure), 'Pr.int'

-Grades: when grades, achieving high/low grades or the need to achieve a certain grade level (sufficient marks) is mentioned (as a motivator), code as '#'.

-Workload: when the desire (not) to work hard or something being (too) easy or difficult is mentioned, code as 'Wrk'.

Autonomous motivators:

-Interest: when students' personal interest is mentioned (as a motivator), code as 'Intr'.

-Enjoyment: when students' enjoyment in a certain subject or activity is mentioned (as a motivator), code as 'Enj'.

-Value: when the (intrinsic) value of an activity or certain knowledge (to the student) is mentioned (as a motivator), code as 'Val'.

-Learning: when learning or the opportunity for (much) learning is mentioned (as a motivator), code as 'Lrn'

-Personality: When students' personalities and especially adjusting or connecting to it is mentioned (as a motivator), code as 'Pers'.

-Talents: when having or wanting to unfurl or develop certain talents is mentioned (as a motivator), code as 'Tal'.

---

Dissemination of neutral information/facts: When information is provided or transmitted that does not clearly motivate any which way, coded as 'Inf'.