**UNIVERSITY OF TWENTE**

Bachelor thesis

# The Influence of Mindsets and Perceived Self-Efficacy on STEM-Related Study Intention of High School Students in Secondary Education

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June 22, 2016

Enschede

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**Abstract**

The decrease of interest in a career in the domain of technology, engineering and mathematics, the so called STEM-field, still seems to be a continuing problem among high school students. To gain more insights in the choice of a study in the STEM-field, attention is directed to the role of psychological factors that might play a role in the decision-making process in reference to career and study choices. This study aimed to illuminate the influence of mindset and perceived self-efficacy on the intention of Dutch students in preparatory secondary vocational education to follow a study in STEM-field. It was hypothesized that the relation between student's mindsets about the malleability and determination of their abilities regarding the STEM-field and their intention to follow a STEM-related study is mediated by their perceived self-efficacy. To test this relation, a questionnaire is composed and evaluated, compromising four subscales. It was demonstrated that the compromised questionnaire had poor psychometric qualities. On that account, an adjustment of the subscales was performed by a rearrangement of the items. The results of the statistical analyses of the adjusted subscales suggested that positive mindset, which encompasses high perceived self-efficacy and a growth mindset, and positive effort beliefs both are correlated with the intention to follow a STEM-related study. Study and career choice making is a highly complex process, but having a positive mindset and positive effort beliefs are two factors which do have an influence on it. These findings might not only be relevant for further research intending the identification and understanding of the role of psychological variables in career choice, but might also provide a good starting point for practical interventions in the education system.

**Keywords:** implicit theories of intelligence; mindset; STEM; perceived self-efficacy; effort beliefs; study and career choice

Number of words: 11070

**Samenvatting**

De afname van interesse in een loopbaan in het domein van technologie, techniek en mathematiek, het zogenaamde STEM-gebied, blijkt nog steeds een aanhoudend probleem te zijn onder studenten op de middelbare school. Om meer inzicht de krijgen in de keuze voor een loopbaan in het STEM-gebied, wordt veel aandacht besteed aan de rol van psychologische factoren in de loopbaankeuze. In deze studie werd onderzocht in hoeverre mindsets en zelfwerkzaamheid invloed hebben op de intentie van vmbo studenten om een mbo-studie in de richting van het STEM-gebied te volgen. Het werd verondersteld dat de relatie tussen de overtuiging dat de eigen vaardigheden óf vooraf bepaald óf vervormbaar zijn én de beoogde studiekeuze beïnvloed wordt door de waargenomen zelfwerkzaamheid van de studenten. Om deze relatie te testen werd een vragenlijst ontworpen bestaande uit vier subschalen. Echter bleek dat de vragenlijst een lage psychometrische kwaliteit bezat. Om deze reden werden drie van de vier subschalen aangepast door een herschikking van de items. Desondanks suggereren de resultaten dat een positieve mindset, bestaande uit hoge waargenomen zelfwerkzaamheid en een groei mindset, en positieve effort beliefs gecorreleerd zijn aan de intentie om een STEM-gerelateerde studie te volgen. Concluderend kan worden gezegd dat de keuze voor een bepaalde loopbaan een complex proces is. Maar een positieve mindset en positieve effort beliefs zijn blijkbaar twee factoren die invloed hebben op het keuzeproces. Deze bevindingen zijn niet alleen belangrijk voor verder onderzoek, dat gericht is op de identificatie en verhouding van psychologische factoren die betrokken zijn bij keuzeprocessen. Ook bieden de resultaten een goed aanknopingspunt voor mogelijke praktische implementatie en interventie in het onderwijssysteem.

**Sleutelwoorden:** impliciete theorieën; mindset; STEM; zelfwerkzaamheid; effort beliefs; loopbaan en studiekeuze

Aantal woorden: 11070

**The Influence of Mindsets and Perceived Self-Efficacy on STEM-Related Study Intention of High School Students in Secondary Education**

The underrepresentation of employees in the domain of science, technology, engineering and mathematics, the so called STEM-field, seems to be a continuing problem, as demonstrated by different studies (CPST, 2007; Beggs et al., 2009; Kuechler et al., 2009). There is growing evidence that especially the proportion of women in scientific and technical career fields is low. In the Netherlands, in the technical sector the amount of women in 2011 was only 22 percent (VHTO, 2016). In comparison to lower educated women, highly educated women seem to employ their talent the best: 21% of highly educated technicians are women. But still, also in technical labor market sectors there is an underrepresentation of women. In the construction industry there are only 9% female workers, in the industry sector 21% and in the ICT-sector the amount of women is 21%. Moreover, only a few women with a technical or ICT profession get a higher function. Only 11% of the managers in the construction and industry sector are women and in the ICT sector is low as 8% of the managers are female. Following Atria and VHTO (2015), in the population of the Netherlands, partly there is still the believe that natural sciences, technology and ICT field are related to men. Adolescents, but teachers and parents as well, still see limited possibilities for women to work in one of these fields. In addition, regarding a career in the STEM-field, girls still seem to be unsure about their talents and experience a lack of support to choose an accurate learning path (Atria & VHTO, 2015).

Presently, high school students appear to have small interest in choosing a STEM-related study. Especially girls choose less often an education and profession related to technical fields than boys. Admittedly, in the last decades the amount of female students in secondary education choosing a science- or technical-related pathway increased. However, this fact mainly refers to female students in higher levels of secondary education. In the scholastic year 2014-2015 in the school of higher general secondary education in the Netherlands, approximately one third of female students (38%) and about the half (58%) of female students in pre-university education had chosen to follow a science-profile (Platform Bèta Techniek, 2014). However, in the lower levels of education fewer girls choose technology as a main emphasis. Only 10% of all students in preparatory secondary vocational education who chose a technology-related pathway is female. Furthermore, not all students who choose science or technology in secondary education take a technical or scientific follow-up. This brings up the question if there is an unused technical and scientific talent, and which psychological mechanisms and self-variables might have an influence on the career-

choice of high school students (Atria & VHTO, 2015). The identification of these factors enhances the contingency to intervene and increase the interest of female and male students in a STEM-related career.

Across disciplines, there is a host of research on different kinds of variables which might have a role on students' career-related choices. To gain more insight in the choice of a career or study in STEM-related fields, more and more researchers directed attention to not only contextual factors, but also to different psychological variables, for example to self-variables such as self-control (e.g., Job, Dweck & Walton, 2010; Mukhopadhyay & Yeung, 2010).

The aim of the current study is to examine the influence of two variables on the STEM-related study choice of students. This study focuses on the perceived self-efficacy and the possession of different mindsets in the student population, because of the empirical evidence of the great influence on adolescents and the effect they might have on the intended study choice. Additionally, the influence of these variables might offer an explanation of the differences in the proportion of women and men in scientific and technical career fields and the different amount of interest of girls and boys in a STEM-related study. However, only dissimilarities in perceived self-efficacy were previously demonstrated and mindsets appear to be not considered so far. For the present, this study mainly focuses on the general influence of perceived self-efficacy and mindsets on study choice on both sexes. The definition and the influence of mindsets and perceived self-efficacy will be discussed in more detail in the following sections.

**Implicit Theories and Mindsets**

One factor which insinuates a great influence on the performance development of adolescents is the implicit theory of intelligence. In the recent years, implicit theories gained more and more attention. With implicit theories it is meant that individuals seem to attribute meaning to circumstances through their beliefs about the continuity of the own characteristics and capabilities, such as knowledge. Particularly, individuals value the potential and limitations of their own capacities through either one of two frameworks (Dweck, 1986; Nicholls, 1984). The first framework is known as the incremental theory or a growth mindset, which contains the belief that effort and control can promote the development of traits and attributes. This means that individuals with a growth mindset believe that the nature of ability is malleable and improvable (Bandura & Dweck, 1985; Dweck, Chiu, & Hong, 1995; Dweck & Leggett, 1988; Dweck & Molden, 2005). Contrarily, individuals who have the belief that

the nature of ability is determined are called entity theorists or having a fixed mindset. As such, individuals with a fixed mindset believe that even with much effort, the potential of capabilities and characters is not changeable because of predetermination (*cf.*, Dweck, 2006).

This mindset theory has become more and more a topic of research in the self-theory literature. Mostly, the theory is applied in the context of the concept of intelligence. Regarding the dissemination of the mindsets in the student population, it was found that approximately 40% of the general student population hold a growth mindset and another 40% is compromised by fixed mindset. Round 20% of the students could not clearly be categorized to one of the two mindset frameworks (Dweck, 2008).

Mindsets appear to have great influence on the young population. Blackwell, Trzesniewski and Dweck (2007), for example, found that adolescents who are viewed as having a growth mindset appear to "hold more positive beliefs about effort, and make fewer ability-based, "helpless" attributions, with the result that they choose positive, effort-based strategies in response to failure, boosting mathematics achievement" (p.258). In comparison, having a fixed mindset seems to indorse less positive beliefs about the own capacities and endorse less effort and achievement.

In conclusion, mindsets seem to have great influence on students' beliefs about their own abilities and capacities, and on the strategies and achievement in school, by which also the view of their future and intended career choice might be influenced. However, it seems that there is still missing research on the influence of mindset on study-related choices.

**Perceived Self-Efficacy**

One variable which is often linked to mindsets and is empirical proven to have an effect on students' career-choice is the perceived self-efficacy. There seems to be a growing number of theory and research about the linkage between self-referent thoughts and psychological functioning (Bandura, 1981). Self-referent thoughts include the view of the own efficacy, which is often called perceived self-efficacy and defined in various ways. Bandura (1991) determined perceived self-efficacy as the individual's perception of the own ability to perform in an adequate way in a certain situation. Research either refers to perceived self-efficacy in a specific field or to generalized self-efficacy, as a global idea of performance ability (Caraway, 2013). As Caraway (2013) pointed out, perceived self-efficacy influences "how people behave, think, feel, and self-motivate" (p.419).

By developing the social-cognitive theory, Bandura (1991) recognized that the perceived self-efficacy has great impact on the individual, including on goal-setting, decision-

making and the extent of effort putting in certain tasks. Research confirms this theory by indicating that the perception of the own functioning and potentials indeed determine the amount of effort and perseverance people will employ to deal with life tasks (Bandura, 1982). Whereas distrusting the own self-efficacy will lead to less efforts, high perceived self-efficacy will lead to more effort in dealing with, and facing difficulties and challenges and will lead to greater achievement (Bandura & Schunk, 1981; Brown & Inouye, 1978; Schunk, 1981; Weinberg, Gould, & Jackson, 1979). As Bandura (1982) formulated: "High perseverance usually produces high performance attainments" (p.123).

Based on these assumptions, it seems obvious that people's perception of their own efficacy can have a great influence on their career. Because of the growing underrepresentation of women and men in the STEM-field, a lot of researchers have focused on the link between perceived self-efficacy and career choice. For example, Betz and Hackett (1981) studied the usefulness of self-efficacy theory in understanding career choice. Their results support the idea that perceived self-efficacy do have an influence on the career choices.

However, the linkage between perceived self-efficacy and career-choice is not only studied in the working population, but also in students regarding their future career choice. Bandura (1994) evinced that career-choice and development is one example for the strong effect of perceived self-efficacy on choice-related processes. A higher level of perceived self-efficacy simultaneously implicates a larger range of considered career choices, more interest in different career choices, and a better scholastically preparation for the pursuance of the potential career paths. The results of different research are in line with the findings in working population. It was demonstrated that female college students report a weaker math- and science self-efficacy than male college students, whereas higher math self-efficacy is directly linked to the choice of a math- and science related college major (Betz & Hackett, 1983; Hackett, 1985; Hackett & Betz, 1989). Perceived efficacy in relation to mathematics and science seems to be one immediate and strong predictor of students' choice of math- and science college majors (Hackett, 1985). Research also suggests that in predicting career-related choices, perceived self-efficacy is of greater importance than the actual ability or past experience (Hackett & Betz, 1989). Students, who are confident of their abilities and academic achievement, are more likely to persist in demanding college majors and achieve higher levels of academic accomplishment than students with weaker perceived self-efficacy (Hackett, 1985). In addition, research has shown the level of perceived self-efficacy influences student's choice to settle on a STEM-related career (Blackwell et al., 2007; Dweck

2006; Dweck, 2008).

These findings emphasize the great influence of perceived self-efficacy on student's study and career choices. However, perceived self-efficacy also is capable of being influenced, as the basis and framework of perceived self-efficacy changes through the course of the lifetime and there is an empirical evidence that self-efficacy can be improved and developed (Bandura, 1989, 1994). Thus, enhancing student's perceived self-efficacy with the aid of intervention and training can increase the belief in their own ability and performance and have an influence on STEM-related choices.

As described above, both mindsets about intelligence and perceived self-efficacy appear to have an impact on students' life, especially on their academic performance and success (Bandura, 1991; Blackwell et al., 2007). Furthermore, perceived self-efficacy even seems to influence the career choice of students (Hackett, 1985). However, perceived self-efficacy and mindsets not only have influence on students separately, but research indicates that there is a linkage between perceived self-efficacy and the mindset people hold. The results of the study from Bell and Kozlowski (2002) reveal that students with a high level of perceived self-efficacy tend to have a growth mindset, whereas students with low perceived self-efficacy are more likely to hold a fixed mindset. Because both mindsets and perceived self-efficacy are proven to be changeable and improvable, these variables provide a good occasion to intervene in order to motivate students to consider a STEM-related educational and career pathway and to restrict the lack of workers of male and especially female workers in the STEM field. However, it is not clear yet in how far mindsets and perceived self-efficacy together have an influence on STEM-related study choice. In addition, most findings about career and study choices are based on adults or students in higher education and apparently there is a lack of literature about students in lower level of secondary education.

By means of the assumptions about mindsets and perceived self-efficacy examined above, it is hypothesized that student's mindset is related to their intention to follow a STEM-related study, and that this relation is mediated by the perceived self-efficacy. This is based on the supposition of Van Aalderen-Smeets & Walma van der Molen (in preparation), which had proposed a similar model.

**The Study**

Due to the lack of research and the low interest in a STEM-related career in the lower levels of education, this study focuses on high school students in the lowest level of secondary education. The Dutch education system offers three branches of secondary education. The

lowest branch, the preparatory secondary vocational education provides the combination vocational training and theoretical education in languages, mathematic, history, arts and sciences. Students have the possibility to choose one of four different levels, each providing a different proportion of practical and theoretical training (UNESCO-UNEVOC, 2012). Also, there is the possibility to choose a specialization in a particular learning path relating to the technical, agriculture, economics or care or welfare sector. The different specializations include the opportunity to choose a learning path in the technical sector, which offers a good occasion to indicate in how far student intent to choose a study related to the STEM-field or one of the other sectors (iamsterdam, 2016). Nevertheless, even if the students already had chosen a certain learning path, there is still the possibility to choose another learning path or study, so only the intention to follow a STEM-related study can be investigated.

The purpose of this study is to explore in how far mindsets exist in Dutch high school students in lower secondary education and to what extent mindsets and perceived self-efficacy have an influence on the intention to follow a STEM-related study. Since in the literature both variables appeared to be linked to each other and to study-choice as well, this study brings the following research question into focus: *To what extent does perceived self-efficacy has an influence on the relation between mindset and STEM-related study intention of high school students of preparatory secondary vocational education?* Because it seems that there is no (Dutch) questionnaire which is evolved to measure all of the three variables, namely mindset, perceived self-efficacy and STEM-related study intention for respondents in secondary education, a questionnaire will be elaborated. On that account, a second aim of this study is the design of a compromised questionnaire which is adjusted for the target group and the evaluation of the psychometric qualities of it. Due to cooperation, the questionnaire is also designed to explore the presence of effort beliefs in the student population.

## Method

### Design

For this study a questionnaire survey design was employed. As variables, mindset of intelligence with two levels (fixed or growth) is used as independent variable and STEM-related study intention of the respondents with two levels (technical or not technical) as dependent variable. Additionally, perceived self-efficacy was used as a mediator.

### Respondents

By convenience sampling, one high school of secondary preparatory vocational education in the Netherlands volunteered to take part in this study with four different classes,

all in the fourth grade. In total, there were 103 respondents. Of this, 49 respondents were male and 54 respondents were female. The mean age of all respondents was 15.89 with a standard deviation of 0.63. The oldest respondent was 17 years old, while the youngest was 15 years old. In support of variation of the population, the respondents were following different learning paths at the time of the participation in the study. In total 19 respondents were following a technical learning path. A care & welfare learning path were following 19 respondents and 35 respondents were following an economical learning path. However, it has to be emphasized again that the respondents still had the possibility to choose another learning path, profession or a study which is not related to the current chosen learning path.

Because the respondents were not of full age, the students received an informed consent from the class teacher which had to be presented to the parents two weeks in advance. Without complaint issued by the parents, the permission that the respondent was allowed to take part in the study was automatically accepted.

**Materials**

The questionnaire used in this study consisted of four subscales. Except for open questions, all items were of a 4-point Likert-type ranging from ‘strongly disagree’ to ‘strongly agree’. It was tried to use as few items as possible making the questionnaire as short as possible, to ensure the probability for every respondent complete the survey with full concentration entirely. The items were based on the items by Van Aalderen-Smeets and Walma van der Molen (in preparation), De Castella and Byrne (2015), Blackwell et al. (2007) and the MSLQ (Pintrich, Smith, Garcia and McKeachie (1993). It was assured that all items were formulated comprehensible for every respondent. Therefore, in some cases a reformulation of the items in a simpler way than the original items where they were based on was executed.

The first subscale was used to measure the respondent’s intention to follow a STEM-related study. The scale consisted of three items, based on an earlier used questionnaire for Dutch students of preparatory scholarly education, investigating the likelihood of the respondents to follow a STEM-related university study (Van Aalderen-Smeets & Walma van der Molen, in preparation). In the current study, these items were exerted to establish the intention of the respondents to follow a STEM-related study after secondary preparatory vocational high school. An example of an item from this subscale is: ‘After my graduation, I am planning to follow a technical intermediate vocational education’.

The second subscale, consisting of six items, explored the construct mindset. The scale

was compromised by three items concerning a fixed mindset and three items regarding a growth mindset (for example, ‘My intelligence is something which I am not able to change very much’). Based on the items formulated by De Castella and Byrne (2015), the items were reformulated into a first person statement about the attitude of malleability of intelligence. For the reason that study took place in a Dutch high school, the items were semantically translated. The items concerning a fixed mindset were reversed coded and the final measure of the respondent’s mindset arose from the average score across the six items.

The third subscale of the questionnaire compromised five items with reference to the construct of effort beliefs. The items based on the items originally formulated by Blackwell, Trzesniewski and Dweck (2007). A reformulation and translation for the usage in preparatory scholarly education was done (Van Aalderen-Smeets & Walma van der Molen, in preparation). The items were supposed to measure positive effort beliefs (seeking), covered by two items and negative effort beliefs (avoidance), covered by three items. As an example, one item looked like this: ‘It doesn’t matter how hard you work, if you are not good at it (subject), you will never be’. The negative items were reversed coded and the average of the scores of the items provided a measure of the respondents’ effort beliefs. Due to collaboration, this part was used for another research, but was not supposed to be further necessary for this study.

The fourth subscale of the questionnaire envisioned measuring the variable perceived self-efficacy. The scale was comprised of three items which are based on a subscale from the ‘Motivated Strategies for Learning Questionnaire’ (MSLQ) by Pintrich, Smith, Garcia and McKeachie (1993), which was supposed to measure the general perceived self-efficacy. The MSLQ is a self-report instrument originally created to establish student’s motivational orientation and learning strategies. The chosen items were translated from English to Dutch. One example of the items is: ‘Even if the subject matter is difficult, I am able to learn it’. The average score of the three items provided an evaluation of the respondents’ perceived self-efficacy. The reliability of validity of the original MSLQ was rated as relatively good and the subscales showed a promising predictive validity (Pintrich et al., 1993). `

Lastly, the questionnaire contained open questions which were used to inquire date of birth, sex, current learning path, parent’s employment and intended future profession. This information was needed as background variables.

**Procedure**

The presentation of the questionnaire to each of the four classes ensued separately. Initially, a short explanation about the aim of the study, the procedure, the length of the study, the anonymity, and intimacy of the data was given. The survey was divided into two sections. The first section, which was handed over to the students as a paper-and-pen version, involved the first subscale regarding student's intended future career or study choice and open questions concerning the background information.

After the accomplishment of the paper-and-pen questionnaire, the second section of the survey proceeded, involving the remaining three scales of the survey. These were completed with the aid of an online classroom response system, which is called 'kahoot.it', making the study as interesting as possible for the respondents (March, 2015). With the handed paper-and-pen version every student received a number providing the nickname for logging onto the system with a mobile phone or tablet. It was clarified beforehand, that the students were familiar with the practice of the used system.

Subsequently, in the second section, the statements were shown to the respondents on a big screen in class and on their facilities sequentially. Under every statement, four different colored buttons were shown. Choosing one of the colors concurrently implied the degree of agreement with the statement. For reasons of simplicity, on the mobile phone or tablet only the colors appeared, not the matching name of the option. After the election of an answer of all respondents, an overview of the spreading of the answers in form of a diagram was displayed. It was aimed to open the next statement as fast as possible to restrict potential influence on the respondents through the diagram. Another researcher was reading every statement aloud to the group. The demonstration of the items occurred randomized.

**Data-Analysis**

Firstly, performing an exploratory factor analysis led to the exploration of the underlying structure of the items, an examination of the dimensionality and ultimately the determination of the validity of the scales. The selection of four factors to be extracted was made on the basis of the supposition that there are four variables that were investigated with the subscales of the survey. The factor analysis was utilized with an oblique rotation (direct oblimin), based on the theoretical assumption that the four factors were correlated.

Secondly, the performance of a reliability analysis of the psychometric instrument proceeded by measuring the internal consistency of the subscales calculating the Cronbach's alpha coefficient.

Thirdly, utilization of the average of the scores descriptive statistics was made to get an overview of the variation of answers of the respondents and to give a representation of the entire sample.

Fourthly, a correlation analysis was transformed to measure the degree of associations between the variables. Frequencies and histograms suggested a non-parametric distribution, because multiple humps and a skewness were demonstrated by the histogram. Thus, the implementation of a bivariate non-parametric population correlation analysis was chosen, to be precise the Spearman rank correlation.

Lastly, the inferential statistics followed to reach further conclusions and explanations from the data about the relationship between the three different variables. Therefore, based on the results of the correlation analysis a causal model was proposed and tested by the utilization of a mediation analysis, dependent on the assumed relationship of the variables. This analysis was done with the aid of multiple regression analysis.

## Results

The data of all 103 respondents was used in the data analysis, which did not seem to be aberrant and there was no indication of outliners. Hence, no transformation of the data was performed in any way.

Initially, the factorability of the 18 items was examined. An exploratory factor analysis with the extraction of four factors and an oblique rotation was transformed to explore the underlying structure of the correlation of the items. The results of an oblique rotation of the solution are shown in Table 1. The results suggested that there were four factors with an eigenvalue greater than 1, although the scree plot supposed only two factors. Based on the eigenvalues and the extraction of the factors, it was assumed that the analysis yielded a four-factor solution.

Principal components analysis was used because the primary purpose was to identify composite scores for the factors underlying the compromised questionnaire. Initial eigenvalues indicated that the first factor explained 20.08% and the second factor explained 11.08% of the variance. Furthermore, the third and fourth factor explained 10% and 8.5% of the variance respectively. Together they were capable of explaining approximately 49.66% of all the items variances.

Based on the factor loadings, suggestions for adjustment of the composition of the subscales were made. Formerly, it was expected that the first six items were measuring the factor mindset and the items 7 till 10 were measuring the factor effort beliefs. Perceived self-

efficacy was supposed to be measured by the items 13, 14 and 15 and STEM-related intention was expected to be measured by the items 16, 17 and 18. The factor loadings suggest that the items 1, 2 and 3 were indeed loading on one factor. Nevertheless, the items 4, 5 and 6 were loaded on the second factor separately, together with the items 7, 13, 15 & 16. The items 8 till 12 were loaded on the third factor respectively. On the fourth factor, the items 16, 17 and 18 were loaded (see Table 1).

Obviously, these results of the factor analysis were not in line with the expectations. On the basis of the factor loadings, the subscales were adjusted by rearranging the items. The rearrangement of the items and adjustment of the subscales implicated the formation of partly different variables. As we can see above, the first three mindset-items did measure one factor. Regarding the content of the items, these items were concerning a negative attitude upon the malleability of intelligence. Therefore, the first three items were rearranged into one factor concerning a fixed mindset. The remaining three items from the mindset subscale were loading on one factor together with the three items which were supposed to measure perceived self-efficacy and one item for measuring effort beliefs. The content of the items proposed a positive attitude upon the malleability of intelligence and confidence in the own abilities. Accordingly, these items were adjusted together to a factor called ‘positive mindset’. The items 8 till 12 were presumed to measure effort beliefs and were loaded on the third factor. Consequently, the third factor was still measuring effort beliefs, but with less items as proposed for this questionnaire. Lastly, the items 16, 17 and 18 were loading on one factor. This result was consistent with the purpose of the three items, namely the measurement of one factor, the STEM-related study intention.

The unexpected adjustment of the subscales had the consequence that self-efficacy could no longer be measured separately and that no measurement of general mindset as whole was possible. On that account, the following analyses were based on the factors fixed mindset, positive mindset and STEM-intention. Also, the factor effort beliefs was taken into account, as one effort belief item did load on the factor positive mindset, indicating a possible linkage between this variable and the other variables.

Table 1

*Four-factor Solution and Item Factor Loadings for All Items of the Compromised Questionnaire*

| | | Factors and Factor Loadings | | | |
|---|---|---|---|---|---|
| | Items* | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| Fixed Mindset | 1. I think that I am not able change my intelligence very much | -.52 | .35 | | |
| | 2. My intelligence is something which I am not able to change very much | .84 | | | |
| | 3. To be honest, I do not think that I can change how intelligent I am | .75 | | | |
| Positive Mindset | 4.I think that with enough time and effort I can improve my intelligence properly | | .74 | | |
| | 5. I believe that I can always improve my intelligence properly | | .56 | | |
| | 6. It does not matter what my intelligence is now, I think I can always change it | -.36 | .38 | | |
| | 7. If you are good in a subject, through hard working you can always better understand it | | .48 | | |
| Effort Beliefs | 8. If an assignment is really difficult, I can learn much from it | .37 | | -.52 | |
| | 9. If the subject matter is getting more difficult, I am going to work even more at it, not less | | | -.56 | |
| | 10. It does not matter how hard you work, if you are not good (subject) you will never be | | | .59 | |
| | 11. I think that is has no use to give my best for a subject which I am not good at | .37 | | .62 | |
| | 12. If I have to work much for a subject, I feel like I am not good at it | | | .61 | |
| | 13. I know surely that I am able to solve the difficult assignments from the textbook | | .61 | | |
| | 14. Even if the subject matter is difficult, I am able to learn it | | .47 | | |
| | 15. If I am doing my best, I can solve the difficult assignments in school | | .49 | | |
| STEM-Related Study Intention | 16. I am planning to follow a technical intermediate vocational education | | | | .84 |
| | 17. I am planning to choose an intermediate vocational education where you do not need no mathematics or physics | | | | .52 |
| | 18. I am planning to choose an intermediate vocational education which has nothing to do with technology. | | | | .89 |

**Note. The items are translated freely in the interest of clarity.*

After the adjustment of the subscales, a reliability analysis was performed by measuring the internal consistency of the adjusted subscales. The Cronbach's alpha for the subscale measuring fixed mindset was 0.66, representing a questionable reliability following George & Mallery (2003). The subscale measuring positive mindset provided a Cronbach's alpha of 0.7, expressing an acceptable internal reliability (George & Mallery, 2003). Another questionable internal consistency was given by the subscale measuring effort beliefs, with a Cronbach's alpha of 0.59. Lastly, the STEM-related intention subscale demonstrated a Cronbach's alpha of 0.71, thus an acceptable reliability (see Table 2).

**Exploratory Analysis of the Variables**

After the evaluation of the psychometric qualities of the compromised questionnaire and the adjustment of the subscales, the former research question and hypotheses could not be answered anymore, since through the adjustment perceived self-efficacy and general mindset could no longer be measured separately. Therefore, a new research question and hypotheses were established. The research question following the adjustment was: *What are the relations between fixed mindset, positive mindset and effort beliefs with STEM-related study intention?* The earlier treated literature demonstrated a relation between mindsets and perceived self-efficacy with study choice respectively. Based on this, it was hypothesized that fixed mindset and positive mindset (which includes growth mindset and perceived self-efficacy) does have an influence on STEM-related study intention (Blackwell et al., 2007; Dweck 2006; Dweck, 2008). Furthermore, literature revealed that mindsets and perceived self-efficacy both are related to effort beliefs (Bandura, 1991; Dweck, 2006, 2008). So it was hypothesized that effort beliefs have an influence on the relation between both mindsets and STEM-related study intention. The new formed research question and hypotheses were tested with the aid of an exploratory analysis of the variables to examine the interrelationships between the factors based on the adjusted subscales based on the factor analysis.

For an overview of the answers of the sample a calculation of the descriptives and frequencies was completed for the four subscales measuring the variables (see Table 2). Regarding the average scores, it seemed that the respondents were scoring higher on the subscale for a positive mindset than on the subscale for a fixed mindset. It appeared that 18.4% of the respondents scored higher than 2.5 on fixed mindset, whereas on positive mindset 89.3% of the respondents had a higher score than 2.5. For the adjusted subscale measuring effort beliefs the mean score was 2.76 with a standard deviation of 0.46, whereas for the STEM-related study intention the average score was 2.18 with a standard deviation of 0.88. Comparing the scores of females and males, it seemed that women scored higher on a

fixed mindset than men, whereas men scored higher on positive mindset than women. Female students were scoring higher on effort beliefs than male students, but male students were scoring higher on STEM-related study intention than female students.

Table 2

*Overview of the Scores of the Sample on the Four Subscales*

| | Female | | Male | | Total | | α |
|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | |
| Fixed Mindset | 2.13 | 0.57 | 1.93 | 0.55 | 2.03 | 0.57 | 0.66 |
| Positive Mindset | 2.91 | 0.36 | 3.06 | 0.36 | 2.98 | 0.36 | 0.70 |
| Effort Beliefs | 2.81 | 0.47 | 2.71 | 0.44 | 2.76 | 0.46 | 0.59 |
| STEM-Related Study Intention | 1.82 | 0.73 | 2.58 | 0.86 | 2.18 | 0.88 | 0.71 |

A bivariate non-parametric correlation analysis was applied by calculating the Spearman rank correlation to concern in how far the factors were correlated respectively (see Table 3). The results suggested that there was a significant negative correlation between positive mindset and fixed mindset. The spearman rank correlation suggested that higher positive mindset scores were correlated with lower fixed mindset scores. This correlation was categorized as moderate (Field, 2013). Effort beliefs appeared to be significant negative correlated with fixed mindset and positive correlated with positive mindset, but both correlations were weak as well (Field, 2013). Higher effort beliefs were associated with lower fixed mindset scores and higher positive mindset scores. Furthermore, positive mindset and intended study choice were significant correlated. This correlation was positive, thus, higher positive mindset scores were associated with higher scores for the intention of STEM-related study choice. However, referring to the spearman's rho the correlation was classified as weak (Field, 2013). Fixed mindset and positive mindset were not significant correlated with STEM-related intention, thus positive mindset was the only variable with a significant correlation with STEM-related study intention.

Table 3

*Bivariate Correlations Coefficients Values (Spearman's rho) Between the Four Variables*

| Measure | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Fixed Mindset | - | | | |
| 2. Positive Mindset | -.42** | - | | |
| 3. Effort Beliefs | -.21* | .25** | - | |
| 4. STEM-Related Study Intention | -.16 | .29* | .03 | - |

*p < *0.05; ** p < 0.01*

**Exploring Relations**

For the inferential statistics, based on the significant correlations found in the correlation analyses and conclusions of earlier treated literature, the different relationships between the variables were further examined. As we can see above, positive mindset and STEM-related study intention were significant correlated. The earlier treated literature supported this findings, as it was found that mindsets, and perceived self-efficacy have an influence on the study choice (Blackwell et al., 2007; Dweck 2006; Dweck, 2008). Since positive mindset combined a growth mindset and perceived self-efficacy in one variable, it could be assumed that positive mindset also had an influence on study choice. So it was expected that positive mindset has an influence on STEM-related study intention and functions as a predictor. In addition, effort beliefs seemed to be significant correlated with positive mindset as well. This could be supported with the findings of other studies which revealed that mindsets and perceived self-efficacy both are related to effort beliefs (Bandura, 1991; Dweck, 2006, 2008). On the basis of a similar proposed model in which effort beliefs functions as a moderator on the relationship between mindsets and study choice, it was assumed that the relationship between positive mindset and STEM-related study intention could be modified by effort beliefs (Van Aalderen-Smeets & Walma van der Molen, in preparation). So, the proposed model also encompassed positive mindset as independent variable, STEM-related intention as dependent variable and effort beliefs as a moderator.

This model was tested with the aid of a multiple regression analysis. At first a regression analysis with positive mindset as independent variable and STEM-related study intention was deliberated to test in how far positive mindset has an influence on the STEM-related study intention and functions as predictor. If this regression would be significant, it would be tested if effort beliefs did have an influence on that relation and functioned as a

moderator. These results were expected to give further insight in the relations of the variables of the proposed model.

The moderator analysis revealed that the correlation of a positive mindset and STEM-intention was not moderated by effort beliefs. The first regression analysis showed a not significant relation between mindset and STEM-intention [$b_{positivemindset}$=0.54, t (3.009) =2.05, p>0.05]. Thus, positive mindset was not a significant predictor of STEM-intention. So, our model was not confirmed as positive mindset did not have a significant influence on STEM-related study intention. Hence, there is no relationship between positive mindset and STEM-related study intention which could be modified by the variable effort beliefs.

To summarize, the results of this study showed that the items of the subscales of the compromised questionnaire did not completely load on the four proposed factors mindset, perceived self-efficacy, effort beliefs and STEM-related study intention. Several items corresponding to the four scales loaded on a different factor. On that account, a rearrangement of the items and adjustment of the subscales occurred. The factor loadings and content of the items suggested the factors 'fixed mindset', 'positive mindset' and 'effort beliefs', and the subscale 'study choice' remained the same. The results suggested that the respondents were more likely to hold a positive mindset than a fixed mindset and positive effort beliefs. Comparing the scores of women and men, women scored higher on fixed mindset and effort beliefs than men, whereas men were scoring higher on growth mindset and STEM-related study intention. Between the factors, fixed mindset was negatively correlated with positive mindset and positively with effort beliefs. Effort beliefs was also positively correlated with positive mindset, and positive mindset was correlated with STEM-related study intention as well. Based on these results and different literature, a model was proposed and tested with the aid of a moderator analysis. The model consisted of positive mindset as independent variable and STEM-related study intention as dependent variable. Effort beliefs was used as moderator. The results of these analyses did not confirm the model as it seemed that positive mindset was no predictor for STEM-related study intention.

## Discussion

The underrepresentation of employees in the STEM-field and the decrease of interest in a STEM-related study or career in the student population appears to be a continuing problem as it probably leads to an unused talent in relation to technology, engineering and mathematics, especially in high school students. To get further insight in the psychological factors and mechanisms that might play a role in student's choice, this study aimed to

illuminate the influence of two factors, perceived self-efficacy and mindsets on the STEM-related study intention. A second aim of this study was the generation and evaluation of a compromised questionnaire with four subscales which were supposed to measure perceived self-efficacy, mindset, effort beliefs and STEM-related study intention, and the investigation of background variables. The survey was applied to 103 students in preparatory secondary vocational education with the aid of an online platform called 'kahoot.it'.

In conclusion, the results of this study suggested that the compromised questionnaire did not seem to measure the variables mindset and perceived self-efficacy, but a fixed mindset and positive mindset. The latter described a mindset which includes a growth mindset and high perceived self-efficacy. However, effort beliefs and STEM-related study intention could be investigated by the questionnaire. After the rearrangement of the items and the adjustment of the subscales, the reliability and validity were more acceptable. Generally, the respondents seemed to have more a positive mindset than a fixed mindset and greater effort beliefs. But there was no great intention to follow a STEM-related study after graduation. The further results suggested that an individual who has the tendency to have a fixed mindset appeared to be more likely to not have the tendency for having a positive mindset, and the other way around. Moreover, a fixed mindset seemed to be associated with low effort beliefs. High effort beliefs appeared to be associated with having a positive mindset and a having positive mindset gave the impression to be associated with higher intention to follow a STEM-related study. In spite of these correlations, it was demonstrated that having a fixed mindset did not influence the relation between having a growth mindset and greater STEM-intention, so greater effort beliefs could not influence the relation between having a positive mindset and greater STEM-intention.

Because of the unexpected results, these were not completely compatible with the literature where this study was based on. Deriving from the low validity and reliability of the suggested subscales, the original research question could not be answered and the hypotheses that were established neither could be confirmed nor rejected. But the adjustment of the subscales promised a more acceptable validity and reliability and a new research question and hypothesis concerning the relation between the variables positive mindset, effort beliefs and STEM-related study intention were formed. The low usefulness of the initially compromised questionnaire was surprising, as the four subscales that were used were based on earlier invented subscales with good reliability and validity. The items that were used in this study to measure mindset were based on the items of the subscale measuring the general implicit theories of intelligence by De Castella and Byrne (2015). The original subscale demonstrated

good construct validity, good discriminate validity and good internal reliability. Furthermore, the items used to measure effort beliefs were based on a subscale which originally had a good test-retest reliability (Blackwell, Trzesniewski and Dweck, 2007). Equally the subscale of the MSLQ from Pintrich, Smith, Garica and McKeachie (1993) on which the items measuring perceived self-efficacy were based on, had a relatively good reliability and validity, and the subscales showed a promising predictive validity. Moreover, a similar compromised questionnaire was used in a kindred study, which had also investigated mindsets, perceived self-efficacy and effort beliefs, but with the aid of broader subscales and in reference to actual STEM-related study choice and not only the intention in another level of secondary education. The subscales of the questionnaire also showed better results for the reliability and validity (Van Aalderen-Smeets & Walma van der Molen, in preparation).

As the results of the evaluation of the questionnaire already suggested, there might be some confounding variables which had influenced the results and psychometric qualities of the questionnaire and explained the different results for the psychometric qualities in comparison to the equivalent study. Firstly, it seemed that the original scales on which the questionnaire was based on had good qualities, but in this study the qualities were questionable. This might be due to the translation of the subscales. Comparing to the study of Van Aalderen-Smeets & Walma van der Molen (in preparation) who only executed a translation of the items, in the current study also a reformulation to a simpler linguistic usage took place in order to make items more understandable. Another difference was the amount of items that were used for the subscales. The reformulation and the lower number of items might among other things explain the differences in the psychometric qualities between the mentioned and current study. Furthermore, during the data collection it seemed that some terms had to be explained to the respondents. Hence, it might be the case that the respondents of this study understood and interpreted terms and concepts of the items (e.g. ‘intelligence’) differently than, for example, the respondents of the comparable study by Van Aalderen and Walma van der Molen (in preparation), which had applied the survey to a different target group in a higher level of secondary education. Moreover, the results might be confounded by the fact that the most parts of the questionnaire were realized with the aid of a different method, namely on an online platform within the whole class, which is contradicted to the most common form using a paper-and-pen-version or online survey which is accomplished completely individual. It is often described that the medium used to collect data often can have a confounding effect on the data (Podsakoff et al., 2003). As we can see in the results, the scores were not very high or low, so the respondents might be influenced in the way that

there were chosen less extreme answers, so it was tried to answer averagely and conform to the classmates. Additionally, the respondents might not only be influenced by the presence of classmates, but the researchers and the teacher as well. The results of different studies underpin this presumption by showing that respondents under social influence showed a tendency to conformity and there is a propensity of obedience to authority (Baron et al., 1996; Milgram, 1978). Beyond, the results of all respondents showed up after every item in form of a diagram, which possibly strengthened the effect of social influence.

Despite the confounding effects, the results of the study of the adjusted subscales were still promising and to a certain degree corresponding with the outcomes of other studies. At first, the results indicated that a bit less than 20% of the respondents tended towards having a fixed mindset and about 90% headed positive mindset. This differs from the results of the study of Dweck (2008) who have found that about 40% of the students hold a fixed mindset and approximately 40% holds a growth mindset. However, this might come due the fact that in the current study we examined two mindsets that partly differ from the two mindsets that Dweck (2008) investigated. In this study a positive mindset was investigated instead of a growth mindset, although a positive mindset also covers a growth mindset. Additionally, in the current study the results suggested that women are more likely to have a fixed mindset, whereas men are more likely to have a growth mindset. Additionally, men were more likely to have the intention to follow a STEM-related study. As a growth mindset also includes high perceived self-efficacy, these results is in line with the findings of different studies, which had demonstrated higher perceived self-efficacy in men in relation to math and science and the higher interest of men and amount of male workers in the STEM-field (Atria & VHTO, 2015; Betz & Hackett, 1983; Hackett, 1985; Hackett & Betz, 1989; VHTO, 2016). Furthermore, it seemed that having a more fixed mindset was associated with a lower positive mindset, and the other way round. If assumed that a positive mindset can in one way or another be equated with growth mindset, this was not surprising since Dweck (1986) and Nicholls (1984) maintained that an individual understands his or her own abilities through either one of two frameworks. Thus, an individual with a fixed mindset is less likely to have a positive mindset, and the other way round. Additionally, the negative correlation between a fixed mindset and effort beliefs that was found suggested that a fixed mindset apparently led to more negative effort beliefs. This result was not surprising, because of the findings that an individual with a fixed mindset is more likely to see any effort as ineffective and students with a growth mindset are expected to be more likely to believe in the power of effort (Dweck 2006, 2008). Besides, higher positive effort beliefs seemed to be associated with a positive mindset.

Because positive mindset in this case was a combination of growth mindset and perceived self-efficacy beliefs, this matched with the results of other studies. As we have seen in earlier studies, a growth mindset is related to higher positive effort beliefs and it seems that perceived self-efficacy and effort beliefs are linked as well (Dweck, 2008; Zimmermann, 2000). Moreover, it appears to be clear that perceived self-efficacy and mindsets have both great influence on younger people and their choices, so the combination of these two variables, namely a positive mindset, could be related to study choice as well (Blackwell et al., 2007; Dweck 2006; Dweck, 2008). However, it was not clear yet in how far perceived self-efficacy and mindset leads to a certain study choice. The results of this study suggested that in this case having positive effort beliefs and the combination of higher perceived self-efficacy and holding a growth mindset probably leads to a higher intention to follow a STEM-related study. But, all of these correlations seemed to be not very high. However, career decision making is a highly complex process which is influenced by many environmental and personal variables and many tasks that lead to a decision (Hossler & Gallagher, 1987). There is a range of theories about making career decisions. That means, among other things, understanding career development is about understanding how the development of the self and the context someone lives in influence decision-making (Brown, 2002). Hence, it could not be expected that effort beliefs and implicit theories have that great influence on study choices, because of the many factors that play a role in this process.

For further research, firstly it is suggested to adjust the formulation of the items to improve the psychometric qualities of the questionnaire, so it can be used for a similar target. Based on the literature, there is a good probability that perceived self-efficacy and mindsets have an influence on students' study choice. To find out to what extent this is the case, an appropriate questionnaire is needed for this target group. In the current study, through modification the psychometric qualities could already be improved, however, the reliability of the questionnaires is still partially questionable or just acceptable. Still, mindset and perceived self-efficacy could not be measured generally and separately. Nevertheless, the results suggest that there is a correlation between positive mindset and effort beliefs with STEM-related study intention. But it is presumed, that the actual STEM-related study choice process is even more complex. So, it is recommended to further examine self-variables that influence this process to get further insight in how students decide for a STEM-career. For example, outcome expectancies, stereotypical beliefs and motivational belief were found to be linked to study and career choice as well (e.g. Aronson et al., 2002; Eccles, 1994; Lent, Brown & Hackett, 1994). It is suggested to bring all the findings together and take as much

psychological factors and self-variables as possible into account, improving the understanding of the career choice process and making a movement towards a more unifying theory about STEM-related study choice. Lastly, literature and the results of the current study suggested that women are more likely to have a fixed mindset than men and lower perceived self-efficacy which might have an influence on the future career and study choices. On that account, for further research it is recommended to reconsider the differences between male and female students regarding psychological variables that are probably involved in the decision-making process.

To sum up, it could be said that this study attempted to make a further step towards the measure and understanding of which and how different psychological factors influence at least the intended study choice of students in preparatory secondary vocational education. In all levels of education and in the labor market sectors, there can be seen a decline of interest in a career in the STEM-field. Especially women are underrepresented in these sectors. To prevent further decrease of STEM-workers and increase of unused potential, a higher understanding of how to improve the prediction of choice, achievement and persistence in STEM-related fields is needed. Therefore, other contextual and self-variables like outcome expectations, and stereotypical and motivational beliefs, that probably do have an influence, should be considered and examined. If in other studies it will be examined that mindsets, effort beliefs and self-efficacy play a role in the STEM-related study choice, this offers the possibility for schools to implement interventions focused on the increase of interest for a study and career in the STEM-field. For example, a practical intervention could implicate different sessions to increase the confidence in the own possibilities and abilities and to make clear that these abilities are not completely predetermined and fixed. These practical implementations could also be specialized to increase especially the interest of women in a career in the STEM-field and the confidence in the own STEM-related abilities.

**Reference List**

Aalderen-Smeets, van, S.I. & Walma van der Molen, J.H. (submitted). The relevance of the implicit theory of intelligence perspective to STEM educational and career choices. *Science Education.*

Aronson, J., Fried, C., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology, 38,* 113-125.doi:10.1006/jesp.2001.1491

Atria & VHTO. (2015, September 24). *Factsheet Meisjes en vrouwen in bèta, techniek en ICT*. Retrieved 15 march, 2016 from: http://www.vhto.nl/cijfers onderzoek/cijfers/samenvatting/

Bandura, A. (1981). Self-referent thought: A developmental analysis of self-efficacy. *Social cognitive development: Frontiers and possible futures*, 200 239.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122–147.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175–1184.

Bandura, A. (1991). Social cognitive theory of self-regulation. Organizational Behavior and Human Decision Processes, 50, 248–287.

Bandura, A. (1994). *Self-efficacy*. John Wiley & Sons, Inc..

Bandura, M. & Dweck, C. S. (1985). The relationship of conceptions of intelligence and achievement goals to achievement-related cognition, affect, and behavior. Unpublished

Bandura, A., & Schunk, D. H. (1981) Cultivating competence, selfefficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41,* 586-598

Baron, R. S., Vandello, J. A., & Brunsman, B. (1996). The forgotten variable in conformity research: Impact of task importance on social influence. *Journal of Personality and Social Psychology*, *71*(5), 915.

Beggs, J. M., Bantham, J. H., & Taylor, S. (2008). Distinguishing the factors influencing college students' choice of a major. *College Student Journal*, 42, 381-394.

Bell, B. S., & Kozlowski, W. J. (2002). Goal orientation and ability: interactive effects on self-efficacy, performance, and knowledge. *Journal of Applied Psychology*, *87*(3), 497.

Betz, N. E., & Hackett, G. (1981). The relationship of career-related self-efficacy expectations to perceived career options in college women and men. *Journal of Counseling Psychology, 28,* 399-410.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23*,329-345.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child development*, *78*(1), 246-263

Brown, D. (Ed.). (2002). *Career choice and development*. John Wiley & Sons.

Caraway, K., Tucker, C. M., Reinke, W. M., & Hall, C. (2003). Self-efficacy, goal orientation, and fear of failure as predictors of school engagement in high school students. *Psychology in the Schools*, *40*(4), 417-427.

Commission on Professionals in Science and Technology -CPST (2007, Oct 9). *Is US science and technology adrift?* STEM Workforce Data Project: Report No. 8. Washington, DC: CPST.

De Castella, K., & Byrne, D. (2015). My intelligence may be more malleable than yours: the revised implicit theories of intelligence (self-theory) scale is a better predictor of achievement, motivation, and student disengagement. *European Journal of Psychology of Education*, *30*(3), 245-267.

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040-1048.

Dweck, C. S. (2000). Self-theories: Their role in motivation, personality, and development. Philadelphia: Psychology Press.

Dweck, C. S. (2006). *Mindset: The new psychology of success.* New York: Random House.

Dweck, C. S. (2008). Mindsets and math/science achievement. Paper prepared for the Carnegie- IAS Commission on Mathematics and Science Education. Available online: http://www.opportunityequation.org/resources/commissioned papers/dweck/.

Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6*, 267-285.

Dweck, C. S., & Legget, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256-273.

Dweck, C. S. & Molden, D. C. (2005). Self-theories: Their impact on competence motivation and acquisition. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 120-140). New York: Guilford Press.

Eccles, J. S. (1994). Understanding women's educational and occupational choices. Psychology of Women Quarterly, 18, 585-609. Doi: 10.1111/j.1471-6402. 1994.tb01049. x.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston: Allyn & Bacon.

Hackett, G. (1985). The role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling*

Hackett, G, & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/ mathematics performance correspondence. *Journal for Research in Mathematics Education, 20,*261-273. *Psychology, 32,*47-56.

Hong, Y., Chiu, C., Dweck, C. S., Lin, D., & Wan, W. (1999). Implicit theories, attributions, and coping: A meaning system approach. *Journal of Personality and Social Psychology, 77,* 588-599. doi:10.1037/0022-3514.77.3.588

Hossler, D., & Gallagher, K. S. (1987). Studying Student College Choice: A Three-Phase Model and the Implications for Policymakers. *College and university*, *62*(3), 207-21.

Job, V., Dweck, C. S., & Walton, G. M. (2010). Ego depletion—Is it all in your head? Implicit theories about willpower affect self-regulation. *Psychological Science,* 1-8. doi:10.1177/0956797610384745.

Iamsterdam. (2016). *The Dutch education system*. Retrieved 15 March, 2016, from http://www.iamsterdam.com/en/local/move/dutch-education-system

Kuechler, W. L., McLeod, A., & Simkin, M. G. (2009). Why don't more students major in IS? *Decision Sciences Journal of Innovative Education*, 7, 463-488.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of counseling psychology*, *47*(1), 36.

March, H. (2015). Webbasierte Classroom Response Systeme (CRS) im Physik-und Chemieunterricht.

Milgram, S. (1978). Obedience to authority.

Mukhopadhyay, A., & Yeung, C. W. M. (2010). Building character: Effects of lay theories of self-control on the selection of products for children. *Journal of Marketing Research, 47,* 240-250. doi:10.1509/jmkr.47.2.240

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91,* 328-346.

Pintrich, P. R., Smith, D. A., García, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and psychological measurement*, *53*(3), 801-813

Platform Bèta-Techniek. (2014). *Facts & Figures 2014*. Jaarlijks Rapport Platform Bèta Techniek, Den Haag: www.kennisbankbètatechniek.nl.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of applied psychology*, *88*(5), 879.

UNESCO-UNEVOC. (2012). *World TVET DatabaseCountry Profiles Netherlands*. Retrieved 15 March, 2016, from http://www.unevoc.unesco.org/go.php?q=World+TVET+Database&ct=NLD

VHTO. (2016). *Meisjes en vrouwen in het onderwijs en op de arbeidsmarkt*. Retrieved 15 March, 2016, from http://www.vhto.nl/cijfers onderzoek/cijfers

Weinberg, R. S., Gould, D., & Jackson, A. (1979). Expectations and performance: An empirical test of Bandura's self-efficacy theory. *Journal of Sport Psychology,* 1979, J, 320-331.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary educational psychology*, *25*(1), 82-91.

# Appendices

## Appendix A

Table 4

*Items of the Questionnaire Allocated to the Former Subscales*

| Mindset |
|---|
| Ik denk dat ik zelf niet veel aan mijn intelligentie kan veranderen |
| Mijn intelligentie is iets aan mij waar ik zelf niet veel aan kan veranderen |
| Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe intelligent ik ben |
| Ik denk dat ik met genoeg tijd en inspanning mijn intelligentie behoorlijk kan verbeteren |
| Ik geloof dat ik altijd mijn intelligentie behoorlijk kan verbeteren |
| Het maakt niet uit wat mijn intelligentie nu is, ik denk dat ik er altijd wel wat aan kan veranderen |
| Effort Beliefs |
| Als je goed bent in een vak zorgt hard werken ervoor dat je het steeds beter zal snappen |
| Als een opdracht heel moeilijk is, zal ik er waarschijnlijk veel van leren |
| Als de stof bij een vak moeilijker wordt, ga ik er juist harder aan werken, niet minder hard |
| Het maakt niet uit hoe hard je werkt, als je niet goed bent (vak) zal je het ook nooit worden |
| Ik denk dat het geen zin heeft hard mijn best te doen voor een vak dat ik toch niet goed kan |
| Als ik hard moet werken voor een vak geeft dit me het gevoel dat ik er niet goed in ben |
| Perceived Self-Efficacy |
| Ik weet zeker dat ik bij de moeilijke opdrachten uit het lesboek tot een goed antwoord kom |
| Ook al is de leerstof lastig, ik krijg het wel geleerd |
| Als ik mijn best doe kan ik de moeilijkere opdrachten op school maken |
| STEM-Related Study Intention |
| Ben ik plan om een technische mbo-opleiding te gaan volgen |
| Ben ik van plan een mbo-opleiding te kiezen waar je geen wiskunde of natuurkunde voor nodig hebt |
| Ben ik van plan om een mbo-opleiding te kiezen die niets te maken heeft met techniek |

## Appendix B

Table 5

*Items of the Questionnaire Allocated to the Adjusted Subscales*

| Fixed Mindset |
|---|
| Ik denk dat ik zelf niet veel aan mijn intelligentie kan veranderen |
| Mijn intelligentie is iets waar ik zelf niet veel aan kan veranderen |
| Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe intelligent ik ben |
| **Positive Mindset** |
| Ik denk dat ik met genoeg tijd en inspanning mijn intelligentie behoorlijk kan verbeteren |
| Ik geloof dat ik mijn intelligentie altijd kan verbeteren |
| Het maakt niet uit wat mijn intelligentie nu is ik denk dat ik er altijd wat aan kan veranderen |
| Als je goed bent in een vak zorgt hard werken ervoor dat je het steeds beter zal snappen |
| Ik weet zeker dat ik bij de moeilijke opdrachten uit het lesboek tot een goed antwoord kom |
| Ook al is de leerstof lastig, ik krijg het wel geleerd |
| Als ik mijn best doe kan ik de moeilijkere opdrachten op school maken |
| **Effort Beliefs** |
| Als een opdracht heel moeilijk is, zal ik er waarschijnlijk veel van leren |
| Als de stof bij een vak moeilijker wordt, ga ik er juist harder aan werken, niet minder hard |
| Het maakt niet uit hoe hard je werkt, als je niet goed bent (vak) zal je het ook nooit worden |
| Ik denk dat het geen zin heeft hard mijn best te doen voor een vak dat ik toch niet goed kan |
| Als ik hard moet werken voor een vak geeft dit me het gevoel dat ik er niet goed in ben |
| **STEM-Related Study Intention** |
| Ben ik plan om een technische mbo-opleiding te gaan volgen |
| Ben ik van plan een mbo-opleiding te kiezen waar je geen wiskunde of natuurkunde voor nodig hebt |
| Ben ik van plan om een mbo-opleiding te kiezen die niets te maken heeft met techniek |