SET YOUR MIND!

Effects of an intervention on mindset, self-efficacy, and intended STEM choice of students

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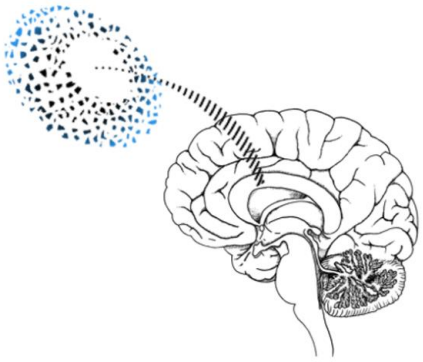

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Foreword

I am pleased to present to you my master thesis. This thesis is the result of a year filled with hard work and stretching myself further than I could have even imagined. Conducting scientific research and writing a thesis while working part time was a new experience for me. Over the course of the study I learned to move beyond my own fixed mindset and its corresponding insecureties toward a growth mindset which aloud me to maximize my own potential. When I started, I could not imagine delivering this thesis which I am very proud of. Writing a master thesis is an emotional process and I cannot believe it has almost ended.

During this journey I was supported in numerous ways. Therefore I would like to thank a number of people. To start with, I would like to thank all the participating schools and students. This study could not take place if they were not willing to participate.

In addition, I would like to thank my dear friend Kirste den Hollander as well. There were moments were I felt very unsecure about the process but she always knew how to support me. Whether it was by providing feedback or making me realize the strength of my own work. She was always there for me and I hope I can do the same for her when she is writing her master thesis.

Frthermore, I would like to thank Juliette Walma van der Molen for her extended knowledge and feedback on the subject matter. Her critical eye helped me to sharpen my ideas as well as my thesis. There were moments I did not notice pitfalls and she pointed them out for me making my thesis better. Thank you for your contribution.

Last but not least I want to thank the person who introduced mindset to me; Sandra van Aalderen – Smeets. No words can describe how she pulled me through this last year. Sandra inspired me to criticise my own work but also to have fun during the whole (writing) process. She learned me something I will be grateful for my whole life; never be ashamed for your mistakes, instead learn from them. Thank you for never condemn me. Without your expertise, I could not have written this thesis. I really hope we will be working together in the future again so I do not have to miss our laughs and talks.

After my graduation, I finished my master Educational Science and Technology. However, I am looking forward to develop myself in the future holding a growth mindset, thereby never stop learning. Failure has been transformed from an identity (I am a failure) to an action (I failed). I can honestly say that mindset changed my life.

Eline Meijerink

Enschede, August 2016

Abstract

There is a shortage of technical skilled personnel in the Netherlans. This shortage could partly be reduced by increasing the inflow of students choosing for a STEM study (science, technology, engineering and mathematics). It is expected that mindset of students has an indirect influence on their STEM choice and that self-efficacy is an important variable in this relationship. Students holding a fixed mindset believe that intelligence is something that they cannot change, while a growth mindset involves the believe that intelligence can be developed through effort. Additionally, the distinction between general and STEM mindset has not been made in previous studies. In order to stimulate students to choose a STEM study, the present study tried to shift the mindset of students from a fixed to a growth mindset. For this purpose, an experimental pre-post control group design was conducted among students from pre-university education (vwo5). After a total of 173 students of six schools filled out the questionnaire, students holding a fixed mindset were invited to participate in the intervention. From the 57 students who were invited to participate, 28 were part of the experimental group and 25 ended up in the control group. The gathered data was analyzed using GLM repeated measures MANOVA and (paired) t-tests. As expected, general and STEM mindsets of students were shifted and self-efficacy did increase. However, no significant change in STEM choice was found between the experimental and control group. Further research needs to be conducted to learn more about other variables that influence STEM choic. This study should also involve teachers and parents as well as since their mindset also influences STEM choice of students.

Keywords: general mindset, STEM mindset, intended STEM-choice, self-efficacy, students in pre-university education

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Introduction

To remain internationally competitive and exploit market opportunities, the Dutch government wants to decrease the shortage of high skilled technical personnel. The lack of qualified personnel is alarming since technicians are sorely needed in important areas of the Dutch economy (Berkhout, Bisschop, Volkerink, 2013). The necessity of qualified technical personnel is demonstrated by the fact that 55% of the employers experience difficulties in finding technicians (ROA, 2015). A consequence of the shortage for organistions is underproduction which causes a loss of revenue (de Wit, 2013).

Between 2015 and 2020 it is expected that the demand for technicians will increase by 1,2% on a yearly basis. Looking at this expansion and the expected replacement of retiring employees, the required increase of high skilled technicians reaches 47.400 (ROA, 2015). However, current forecasts show that in the same period of time, 25.300 students will enter the labor market (ROA, 2015), leaving an expected discrepancy of 22.100 vacancies. Although the inflow of technical skilled staff on the labor market will increase in the coming years this increase is expected to be insufficient to close the gap between accretion and demand of technical staff (ROA, 2015).

In the current situation organisations have explored various avenues to close the gap yet are unable to reduce the lack of qualified technical personnel by means of increasing benefits and compensation, postponing retirement or attracting foreign employees (de Wit, 2013). These options substantially increase the costs and efforts made by companies in need of such personnel.

An important part of increasing the availability of highly educated technicians is increasing the amount of students in technical studies. These technical studies revolve around the subjects of science, technology, engineering and mathematics; the so called STEM studies. Especially females are underrepresented in these STEM studies (Miller, Eagly & Linn, 2015; Hill, Corbett, & St Rose, 2010). Van Tuijl & Walma van der Molen (2016) emphasized several factors that could contribute to the inflow of high school students in STEM studies, such as knowledge, affective value and ability beliefs and self-efficacy building. In addition, they found that a lack of interest and self-knowlegde inhibit students from signing up for STEM studies. However, these students do have the intellectual capabilities (Van Tuijl & Walma van der Molen, 2016).

Previous government initiatives to increase student inflow mainly focused on increasing interest of high school students for technical studies (Berkhout, Bisschop, & Volkerink, 2013). Nevertheless, in order to increase inflow focusing solely on interest seems

to be inadequate. The focus on explicit beliefs (e.g. interest) of prospective students has not culminated into sufficient interest in STEM studies. To illustrate, explicit beliefs are conscious, while implicit belief are subconscious. Additionally, research shows that explicit beliefs seem to be influenced by implicit beliefs (Blackwell, Trzesniewski, & Dweck, 2007; van Aalderen-Smeets & Walma van der Molen, 2016; Nix, Perez-Felkner, & Thomas, 2015). One of these implicit beliefs is the theory of intelligence, also called mindset.

Mindset is the extent to which people believe that their intelligence is fixed or malleable (Dweck, 2008). According to Dweck (2008), there are two types of mindset: the fixed and growth mindset. Students holding a fixed mindset believe that their intelligence is something that they cannot change, while students holding a growth mindset believe that their intelligence is malleable. Nix et al. (2015) suggest that mindset has an indirect influence on completing advanced science coursework, remaining in intended STEM major fields, and selecting mathematics-intensive science majors. In addition, Nix et al. (2015) found that a growth mindset among students will increase their probability of majoring in physics, engineering, mathematics, or computer science. Additionally, van Aalderen-Smeets & Walma van der Molen (2016) propose that mindset influences STEM choice indirectly and this relationship is mediated through self-efficacy. These studies suggest that implicit beliefs (e.g. mindset) could play an important role in increasing the number of students choosing a STEM study (Nix et al., 2015; van Aalderen- Smeets & Walma van der Molen, 2016).

This implies that if mindset could shift self-efficacy and intended STEM choice could increase as a result of the shift in mindset. The relationship between mindset and STEM choice has not been empirically investigated yet. The goal of the present study is to investigate the effects of a shift in mindset on self-efficacy and intended STEM choice of students.

Mindset, self-efficacy, and intended STEM- choice

There are two categories of mindset: the *fixed and growth mindset*. Students holding a fixed mindset believe that their intelligence is fixed and there is nothing they can do to change their abilities. In contrast, students holding a growth mindset believe that their intelligence is malleable and can be developed through training, feedback, and effort (Dweck, 2008). An overview of which consequences mindset can have on people is provided in table 1.

Table 1

Overview aspects of mindsets. Adopted from Dweck (2008)

Fixed mindset	*Growth mindset*
Avoid challenges	See challenges as a learning opportunity
Doubt themselves easily	Do not doubt own capabilities but effort
Sees challenges as confirmation for failing and gives up easily	Push through when facing challenges
Sees effort as useless	Sees that effort is needed to learn
Notices only failing, not feedback	Notices feedback, not emotions
Feels threatened by success of others	Sees success of others as inspiration
Very sensitive for stereo-type thinking	Less sensitive for stereo-type thinking

The two mindsets play an important role in school situations. Research shows that even when students have equal intellectual capabilities, their mindset shapes their response to challenges as well as setbacks (Blackwell et al., 2007). Consequently, having a fixed mindset could affect students enormously since it can make students feel that they are not capable of succeeding in difficult tasks and that that practice does not have any effect on their capabilities when this is not necessarily true. These beliefs could be a reason that students holding a fixed mindset are less likely to sign up for STEM-studies.

Dorsen, Carlson and Goodyear (2006) distinguish several factors that could contribute to the pursuit of STEM career paths by students. One of those factors is self-efficacy. *Self-efficacy* is defined as the confidence a person has about their ability to reach a certain goal, especially when situations contain difficult aspects (Bandura, 1977). Perceived self-efficacy is a precursor of behavior and behavioral change (Bandura, 1977). Students with higher levels of self-efficacy about learning or performing a task, participate more readily, work harder, persist longer when encountering difficulties, and achieve at a higher level (Schunk & Pajares, 2002). According to Clewell and Campbell (2002), sufficient self-efficacy is necessary to leave high school academically prepared.

Although mindset and self-efficacy show similar aspects at first sight, there is a large difference between these variables. Students holding a fixed mindset attribute bad performance due to lack of talent, thereby decreasing their self-efficacy, while students holding a growth mindset attribute bad performance due to lack of effort and retain their self-efficacy (Erdley, Loomis, Cain, Dumas-Hines & Dweck, 1997; Hong, Chiu, Dweck, Lin & Wan, 1999; Dweck, 2006).

The relationship between self-efficacy and STEM-choice was mainly studied in

mathematics. O'Brien, Martinez-Pons, & Kopala (1999) found that career interest in science is predicted by science- mathematics self-efficacy. Likewise, Hackett and Betz (1982) showed that mathematics related self-efficacy correlates with the extent to which students choose science- based college majors and does not depend on actual math performance. These results show that a higher level of self-efficacy leads to a greater intention to choose a STEM-study.

According to van Aalderen-Smeets & Walma van der Molen (2016), shifting the mindset of students, could improve their STEM related self-efficacy beliefs and consequently influence STEM study choices. For example, students who do not sign up for a STEM study because they are holding a fixed mindset but do have interest and capabilities needed to succeed in STEM studies. If such students would be holding a growth mindset, it is expected that the inflow into STEM studies would increase. However, until now there have not been any empirical studies that have tested this relation. The present study aims to shift the fixed mindset that students hold towards a growth mindset. Previous research shows that shifting mindset is possible (Aronson, Fried & Good, 2002; Good, Aronson & Inzlicht, 2003; Mueller & Dweck, 1998). For example, Blackwell, Trzesniewski & Dweck (2007) showed that this shift had an effect on mathematics performance. Though shifting mindsets through participation during an intervention is possible, the inference to self-efficacy and STEM choice has not been made yet. Therefore, this study will also investigate whether an intervention aiming to shift mindset has a positive effect on self-efficacy regarding STEM related subjects and on the intention to choose for a STEM related study. Additionally, previous studies focused on, and measured only mindset in general. Whether or not people hold the believe that general intelligence can change. The present study is conducted within a STEM context, therefore this study will focus on the mindset of students towards STEM context. Maybe a more focused STEM mindset has a more distinct influence on STEM intention. The present study is partly a replication of a study of Blackwell et al. (2007) but the distinction between general mindset and STEM mindset and the inference to self-efficacy regarding STEM and intended STEM choice has been added. STEM mindset is added because it is expected that STEM mindset predicts STEM-choice better than general mindset. STEM mindset refers to students' belief about the malleability of their aptitude and abilities for STEM. For example: "I believe that there is nothing I can do to change my abilities at STEM subjects". In order to test the contribution of STEM mindset, both measures were included in the present study.

The following research question leaded the study; "*What are the effects of an intervention, which is designed to influence mindset, on general mindset, STEM mindset, self-efficacy, and*

intended STEM choice of students in pre-university education?" Five sub questions were formulated, and a complete overview of these sub questions and the corresponding hypotheses are presented in table 2.

Table 2.

Research questions and hypotheses of the present study

Research question	Hypothesis
Can a general fixed mindset be shifted to a general growth mindset in students in pre-university education by means of an intervention which is designed to influence mindset?	A general fixed mindset can be shifted to a general growth mindset in students in pre-university education through an intervention which is designed to influence mindset.
Can a STEM fixed mindset be shifted to a STEM growth mindset in students by means of an intervention which is designed to influence mindset?	A STEM fixed mindset can be shifted to a STEM growth mindset in students by means of an intervention which is designed to influence mindset.
Does an intervention have an effect on the perceived self-efficacy of students in pre-university education regarding STEM related subjects?	An intervention has a positive effect on the perceived self-efficacy of students in pre-university education regarding STEM. In other words, self-efficacy of students will increase after participation in the intervention.
Does an intervention have an effect on the intention of students in pre-university education to choose a STEM-study?	An intervention has a positive effect on intended STEM-choice of students in pre-university education. More students are inclined to choose a STEM- study after participation in the intervention.

In order to answer the research questions, an intervention was designed and given to high school students to shift their fixed mindset to a growth mindset. Before and after this intervention, students were asked to fill out a questionnaire measuring four variables, namely general mindset, STEM mindset, self-efficacy and the intention of students to choose a STEM-study. The study was done by using an experimental pre-post control group design in which the effects of the intervention were observed.

Method

Design and participants

The aim of this study was to investigate if mindset of students who hold a fixed

mindset could be shifted towards a growth mindset by means of an intervention and whether this same intervention has a positive effect on self-efficacy of students regarding STEM related subjects as well as their intention to choose for a STEM related study. For the purpose of this study an experimental pre-post control group design was applied as this offers the opportunity to examine the differences between the experimental and the control group based on their scores on the pre- and posttest. The variables used are general mindset, STEM mindset, intended STEM choice, and self-efficacy.

The participants of this study were students of six secondary schools spread across the eastern part of the Netherlands. These students were in the fifth year of the 'vwo' (pre-university education) and have chosen the N-profiles including subjects like chemistry and physics ('Natuur en Gezondheid (N&G)= Science and Health' and 'Natuur en Techniek (N&T) = Science and Technology' or a combination of both). In N&G, biology, chemistry, and mathematics are required subjects. While this profile prepares students for medical and biological studies, students can still sign up for technical and natural studies. Biology, chemistry, and mathematics are required subjects. In addition, N&T prepares students for technical studies and includes mathematics, physics and chemistry as required subjects. Students of vwo 5 were chosen to participate in the study since they have familiar with science subjects and are still complying the requirements for STEM studies in university, e.g. compulsory subjects.

In total, 173 students of six different schools filled out the pretest. Based on the score on the scale general mindset score on this pretest, it was deterimented whethers students hold a fixed or a growth mindset All students holding a fixed mindset were included in the present study. Hence, 57 students holding a fixed mindset were invited to participate in the intervention of which 28 students actually agreed to participate in the intervention. These 28 students were assigned to the experimental group and 25 students were assigned to the control group. Students in the the experimental group participated in the intervention, while the control group only filled out the pre- and posttest. The four remaining students who did not filled out the posttest and were left out of the present study. No interventions were arranged on two schools, therefore, the students of these schools were automatically assigned to the control group. As a result, the control group contained 12 participants from schools in which no intervention was arranged. A distribution per school can be found in table 2.

Table 2
Participating students per school

School	Number of participating students			Percentage
	Invited	Experimental	Control	
Bonhoeffer College, van der Waalslaan	11	3	4	13.2
Bonhoeffer College, Bruggertstraat	9	0	9	17.0
Erasmus College	7	7	0	13.2
CSG het Noordik	14	12	2	26.4
Greijdanus College	16	6	7	24.5
Reggesteyn	0	0	3	5.7
Total	57	28	25	100

Of the total group, 32 students were female (60,4%) and 21 students were male (39,6%). Their average age was *M*= 16.11, *SD=0*.61, ranging from 14 to 17 years old. When looking at the distribution in the profiles of the participants, 22.6% of the students have chosen the profile Science and Health, 18.9% students have chosen the profile Science and Technology, and 58.5% of the students have chosen a combination of both profiles.

Procedure

Several schools in the region of University Twente were approached to participate in the study. When they responded with interest, a letter containing information about the study was distrubuted among all parents and students who have chosen an N-profile. Both parents and students gave passive consent to fill out the pretest questionnaire. Before participation in the intervention, parents and students gave active written consent. The pre-test was administed per school during six months. All participants of the school the filled out the questionnaire at the same time. The questionnaire was administered online or on paper, depended on the possibilities of each school.

After the data of the pretest was analyzed, some students were invited to participate in

the intervention. Students of Reggesteyn were not inviteed because this number of students was too low to arrange an intervention on this school. Before participation in the intervention students and parents gave active written consent. Students in the experimental group were not informed on which basis they were selected to participate in the intervention. Since, this could (have) influence(d) the attitude of students during the intervention and their answers on the posttest questionnaire.

After completion of the intervention, students in the experimental group were asked to fill out the posttest questionnaire. Students in the control group continued their "business as usual" and filled out the posttest questionnaire between eight and ten weeks after filling out the pretest, so the time between pre- and posttest was comparable. Books were raffled among the students who filled out both the pre- and posttest to encourage students to fill out the questionnaires.

Questionnaires

All data was collected using a questionnaire. As this study is part of a larger study the questionnaire consisted of different parts and variables but the present study was limited to the variables general mindset, STEM mindset, intended STEM choice, and self-efficacy. The questionnaire consisted of four subscales, containing 28 items total, which were rated on a forced choice Likert scale from 1 (totally disagree) to 4 (totally agree).

The general mindset subscale consisted of nine items and the STEM mindset subscale consisted of eight items. All items were adapted from De Castella, Goldin, Jazaieri, Ziv, Dweck, & Gross (2013) and STEM items were adjusted for purposes of this study. An example of an item about general mindset was; "I don't think I personally can do much to increase my intelligence". An example of a STEM mindset question was; "I believe I can always change how well I do in STEM subjects." For students to be labelled with a fixed mindset and to be invited to participate in this study, their mean score on general fixed mindset items, lied between 2.50 and 4.00 (a score of 2.50 was not included), because this implied agreement with fixed mindset items.

The self-efficacy scale consisted of five items which were adapted from the Patterns of Adaptive Learning Scale (PALS) and adjusted for purposes of this study. The PALS was developed to examine a relation between the learning environment and motivation, affect and behavior of a student (Midgley et al., 2000). Examples of self-efficacy items regarding STEM were; "I'm certain I can master the skills taught in STEM classes this year" and "Even if the work is hard in STEM classes, I can learn it". Since it is expected that STEM-choice is

predicted by STEM mindset, it is expected that self-efficacy about STEM subjects predicts STEM choice best as well. The questions measuring self-efficacy are therefore focused on STEM subjects.

The final subscale, the intended STEM choice scale, consisted of six items and these were formulated in conjunction with collaborating researchers since questionnaires about this topic did not yet exist. An example of an item regarding the intended STEM study choice was; “If I would go to university, I plan to choose a study where physics and / or chemistry is required”.

To receive background information about the participants, questions about demographic features (e.g. gender and age) and background characteristics were added to the questionnaire. Moreover, all items were formulated in Dutch since only Dutch students were participating in the present study. Most questionnaires were filled out on the computer. In order to compare the pre- and posttest questionnaires, personal information of students was used to create personal codes. After these personal codes were created, data was processed anonymously.

In order to make sure the pretest was well developed, the pre-test was piloted among five students of 5vwo. These students were asked to fill out the questionnaire on paper and share their thoughts and opinions about the questionnaire aloud. Small changes were made based on their feedback. Most feedback was about spelling and grammar that could cause confusion for participants. An example of the pretest questionnaire can be found in Appendix A.

The posttest questionnaire was almost similar to the pretest questionnaire. Evaluative questions about the intervention itself were added to the posttest questionnaire to improve the lessons The questions were needed to by answered by students in the experimental group on a forced point Likert scale from 1 (totally disagree) to 4 (totally agree) . Examples of multiple choice questions to evaluate the intervention were; “I became more aware of my reaction after a setback” and “I would recommend the lessons to a friend.”. The questionnaire ended with an open question about what researchers could do to improve the lessons. These questions can be found in Appendix B.

Factor analysis and analysis of internal consistency

In order to gain insight into the validity of the questionnaire, an explorative factor analysis was conducted using a Principal Component Analysis (PCA) with oblimin rotation with Kaiser Normalization. Initially, the factor analysis with 28 questions (N=173), yielded

with an extraction of five factors with Eigenvalue greater than 1. After this extraction, fourfixed factors were extracted and values below .4 were suppressed. In addition, the Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .87 and the Bartlett's test of sphericity $X2$ (496) = 3241.15, $p < .00$, indicated that correlations between items were sufficiently large for conducting PCA. Subsequently, the matrix of the performed factor analysis was interpreted and items that cross- loaded on more than one factor were removed from the factor. Three items were removed from the dataset because their factor loading was too low. After these items were deleted, the factor analysis was performed once more to reavaluate the structure of the matrix. All factor loadings can be found in Appendix C.

Based on the identified factors, items that loaded together on the same factor were assessed on reliability using an analysis of internal consistency (Cronbach's alpha). Prior to the analysis, the items of fixed mindset items and negative STEM intention were recoded to allow comparison. One item of the STEM construct was removed from the dataset because Cronbach's Alpha of the STEM construct increased when this item was deleted. After factor analysis and analysis of internal consistency, 24 items were used for further analyses. Table 3 provides an overview of Cronbach's Alpha, the number of items in each construct and their descriptive statistics.

Table 3

Cronbach's Alpha, Mean, and Standard Deviation of Continuous Variables after Factor analysis and analysis of internal consistency was performed on the pretest (N = 173)

	Cronbach's Alpha	Number of items	Mean	Standard Deviation
General mindset	.90	8	2.26*	.33
STEM mindset	.84	6	2.62*	.47
Self-efficacy	.80	4	2.39*	.61
Intention	.87	6	2.67*	.70

*Mean scores ranged from 1 (totally disagree) to 4 (totally agree).

Intervention

The intervention consisted of three lessons of one hour, focused on creating awareness among students about (their) mindset, their reaction to setbacks, and the influence on study choice. The lessons contained a combination of knowledge transfer, assignments, and interactive aspects to discuss assignments. Students were asked to do homework which was

discussed at the beginning of the next lesson.

During the first lesson, students learned the importance of persistence after a setback and to interpret situations as challenging instead of failing experiences. This notion was addressed as van Aalderen & Walma van der Molen (2016) suggested that mindset has less influence as long as there is no setback which activates the mindset, we wanted to show the relevance of setbacks. This is the reason why lesson one started with a setback. Moreover, it is assumed that when students become aware of how they are currently responding to setbacks, they can connect what is learned to their daily life. In addition, the ABC- scheme (in Dutch; "het G-schema") was introduced. This scheme suggests that behavior is influenced by feelings and beliefs but in advance, these are influenced by a person's thoughts and interpretation of the situation, see figure 1. To make sure students understand were the aforementioned beliefs come from, the ABC scheme was followed by the introduction of mindset in which the fixed and growth mindset were fully explained. Followed by a small test for students to find out what mindset they hold in different areas (e.g. school, music and sports). Whereafter, students practiced with controlling their thoughts to influence their feelings and beliefs during the lesson. For example; students practiced with asking a teacher for help when receiving a bad grade instead of feeling worse and not put effort in learning a next time. All assignments were done individually or in small groups during the lesson. At the end of the lessons, students were asked to write down situations when they react holding a fixed or a growth mindset as homework.

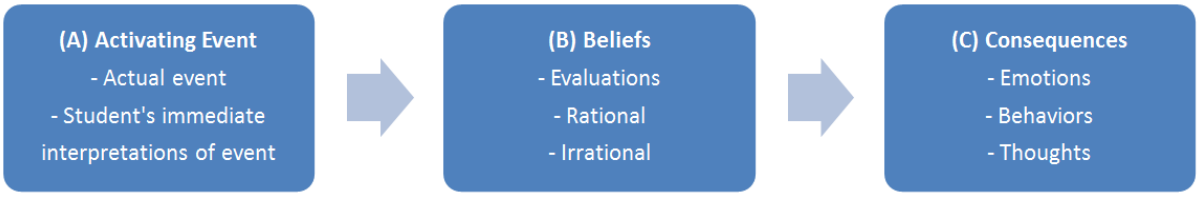

Figure 1. The ABC-scheme

At the start of the second lesson, students practiced with bending their thoughts in a positive manner. For example: "Will you teach me?" instead of "I do not know what to do". In addition, the malleability of the brain (neuroplasticity) was discussed. It was explained that connections become faster and stronger during learning. Neuroplasticity was included into the intervention since Blackwell et al. (2007) found that knowledge about neuroplasticity has an influence on mindset. For practice, students did a role-play where one student played a teacher and another student played a student holding a fixed or growth mindset to experience the difference and to see reactions of teachers and students. At last, students were asked to keep a diary about feedback they received from teachers and to write down if this feedback

stimulated a fixed or growth mindset during the week.

During the third lesson the unconscious and indirect relationship between mindset and study choice was discussed, including the factors that influence this relationship. For practice, students wrote an advice through e-mail to a younger pen pal. This assignment was based on an assignment used by Aronson et al. (2002) in which were students were asked to include mindset into the e-mail. As they found that students who explained mindset to somebody else in an e-mail showed better understaining of mindset. Next, students were asked what they want to study after graduating and which factors influenced their decision. Lastly, students received guidelines to keep in mind when choosing a study. These guidelines included skills and interests. For example; choose something in which you are good at. It was discussed that students take into account their grades to decide whether or not they believe they were doing well at a subject. When they would ask their friends or parents to name things they were good at, things that are not measured by grades, like creativity or kindness, could came up. These could be important to include when making studies choices.

Each students received a binder to collect all material and assignments, so they have the possibility to go over the material at home. Between lessons one and two, and two and three, students received an e-mail consisting of a summary of the previous lesson and to remind them of their homework. All lessons were facilitated by the researche on the schools of the participants with approximately one or two weeks in between.

Data analysis

In order to answer the research questions, several steps were taken to explore and analyze the data. First, the effects of the intervention were analyzed using General Linear Model (GLM) repeated measures MANOVA's, including post-hoc univariate analyses. These tests were performed on mean scores of each construct. We were mainly interested in interaction effects that could show that the mean scores of mindset and intended STEM choice of the experimental group improved to a greater extent than the scores of the control group. To gain further insight into the (non)-effects of the intervention, additional analyses within the experimental and control group separately using (paired) *t*-tests were performed. In addition, to investigate whether the fixed mindset of students in the control group were significantly shifted in compairison to the control group a frequencies analysis was preformed. Finally, feedback of participants on the intervention was analyzed in order to improve the intervention for future applications.

Results

The purpose of the present study was to measure the effects of an intervention on general mindset, STEM mindset, self-efficacy, and intended STEM choice. In this section the findings of the study are presented by means of inferential statistics. These findings build the foundation in answering the research questions. A summary of mean scores and standard deviations of all participants for both conditions can be found in table 3 and table 4.

Table 4

Mean scores and standard deviations on all variables for both groups in both conditions (N=53)

	Experimental group (N=28)				Control group (N=25)						
	Pretest		Posttest		Pretest		Posttest		Time x group		
	M	SD	M	SD	M	SD	M	SD	F	*p*	η_p^2
General mindset	2.33	.37	2.99*	.56	2.18	.27	2.49*	.56	5.31	**.03**	.09
STEM mindset	2.58	.50	3.06*	.51	2.67	.45	2.62	.43	14.25	**.00**	.22
Self-efficacy	2.15	.56	2.61*	.55	2.66	.55	2.52*	.56	15.26	**.00**	.23
Intended STEM choice	2.56	.72	2.74	.67	2.79	.67	2.79	.82	1.42	.24	.03

Mean scores could range between 1 (totally disagree) and 4 (totally agree).
p-values in bold indicate a significant interaction effect ($p < .05$) between time and condition.
* Significant difference (α=.05) between pre- and posttest analyzed with paired *t*-tests.

To investigate the general effects of the lessons, a GLM repeated measures MANOVA was conducted with condition (experimental and control group) as between-subjects factor, time (pre- and posttest) as a within-subjects factor, and the four variables as dependent variables. Preliminary assumption testing was conducted to check normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no violations noted (Box M sig. value $p = .33$).

A statistically significant difference was found between pre- and posttest on the combined dependent variables: $F(4, 48)= 6.65$, $p < .000$, $V= .36$, $\eta_p^2 = .36$. According to Field (2009) and Pallant (2005) Pillai's trace is the safest and most robust test to use. This shows that the change in the experimental group was greater in comparison to the control group.

To gain further insight into the origins of this interaction effect, the univariate test of

each dependent variable was investigated. A statistically significant univariate interaction effect of time and condition was found for the variable *general* mindset $F(1)= 5.31$, $p = .03$, $\eta_p^2 = .09$. Students who participated in the intervention shifted more from a general fixed to a growth mindset in comparison to the control group. Additional paired *t*-tests showed a significant increase in both the experimental group $t(27) = -6.33$, $p< .00$ and the control group $t(24) = -.2.94$, $p= .01$. This means that both the experimental and the control group showed significant improvements when we look at general mindset. These results can be found in figure 2.

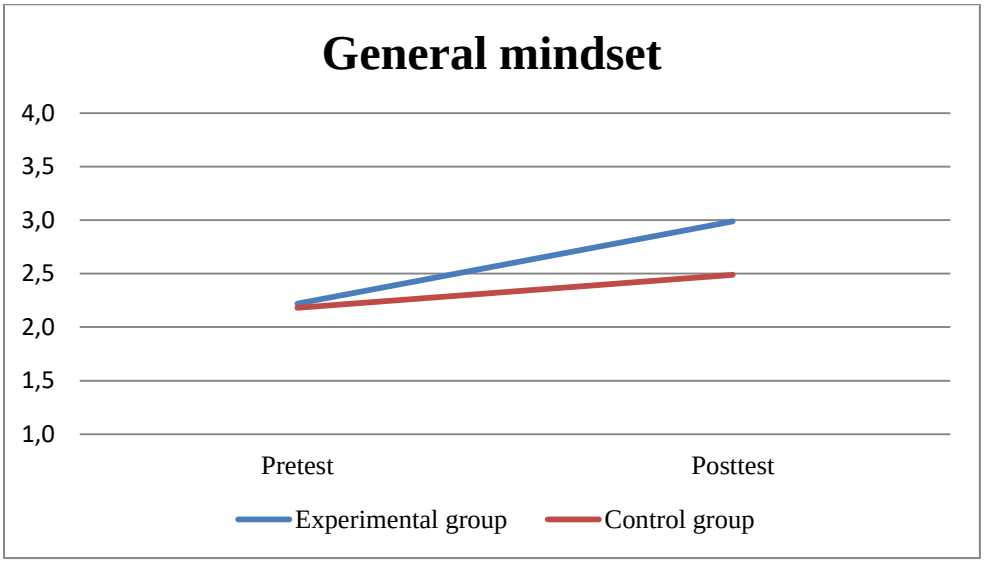

Figure 2. Mean general mindset scores before and after the lessons of the experimental and the control group.

In addition, the difference in general mindset scores between the experimental and control group at the time of the pretest was non-significant $t(51)= 1.69$, $p = .10$, $r= 0.23$, while the difference at the time of the posttest was significant $t(51)= 3.24$, $p< .00$, $r= 41$. This indicates that both groups did not differ at the time of the pretest, both felt the same about their general mindset.

For *STEM* mindset, a statistically significant univariate interaction effect was found $F(1) = 14.25$ $p <.00$, $\eta_p^2 = .29$. This means that students in the experimental group shifted more from a STEM fixed mindset to a growth mindset than the control group. Closer inspection of the changes in STEM mindset using paired *t*-tests, showed a significant increase in STEM mindset for the experimental group from pre- to post test, $t(27) = -5.73$, $p< .00$. No change in means was found in de control group , $t(24) = .46$, $p= .65$. A visualization of the results can be found in figure 3.

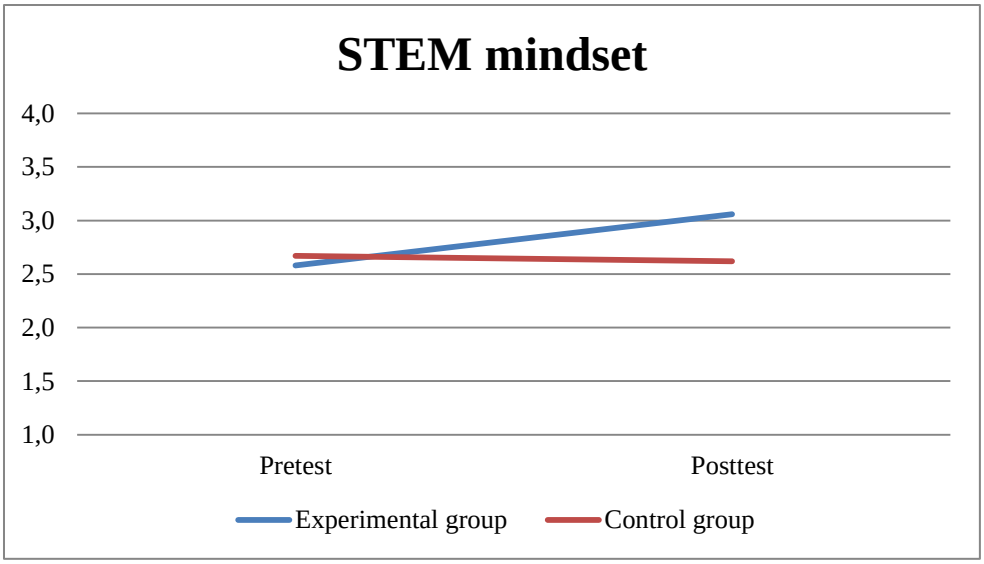

Figure 3. Mean STEM mindset scores before and after the lessons of the experimental and the control group.

In addition, the difference in STEM mindset scores between the experimental and control group at the time of the pretest was non-significant $t(51)= -.74$, $p = .46$, $r= 0.10$, while the difference at the time of the posttest was significant $t(51)= 3.35$, $p< .00$, $r= 42$. This indicates that STEM-mindset of students was equal at the time of the pretest.

Furthermore, a statistically significant interaction effect of time and condition was found for *self-efficacy* $F(1)= 15.26$ $p < .00$, $\eta_p^2 = .23$. This means that students who participated in the intervention showed a greater significant improvement in comparison to the control group. Additional paired *t*-tests showed a significant increase in the experimental group from pre- to posttest , $t(27) = -3.49$, $p< .00$. Surprisingly, an significant *decrease* in the control group from pre- to posttest was found, $t(24) = 2.06$, $p= .05$. Meaning the perceived self-efficacy of students in the control group declined over the course of the study. This indicates that these students felt less confident about their abilities at the time of the posttest in comparison to the pretest. These results can be found in figure 5. In addition, the difference in self-efficacy scores between the experimental and control group at the time of the pretest was significant $t(51)= -3.33$, $p < .00$, $r= 0.42$, while the difference at the time of the posttest was not significant $t(51)= .57$, $p= .57$, $r= .08$. This indicates that students in the experimental group felt less confident about their abilities compared to the control group during the pretest.

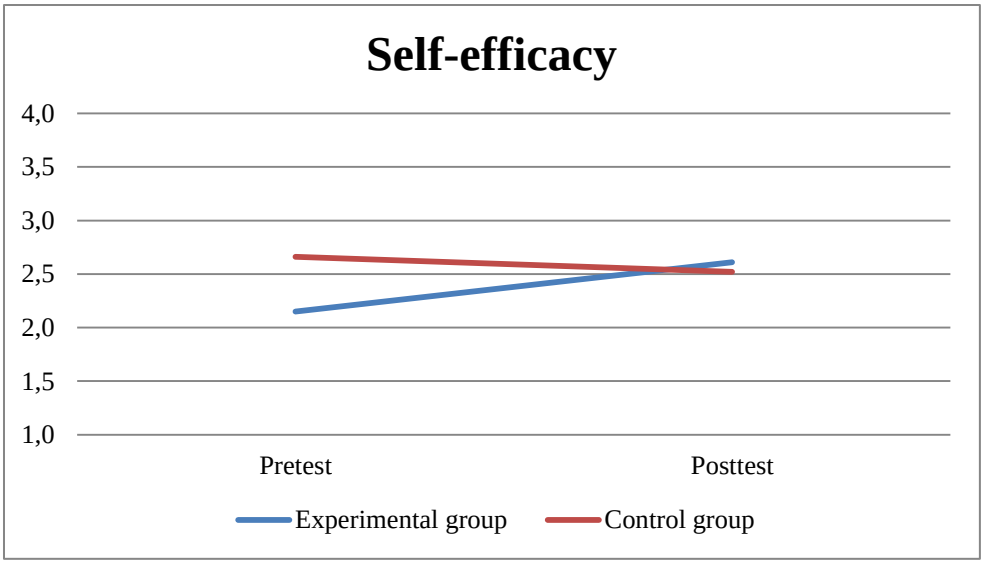

Figure 5. Mean self-efficacy scores before and after the lessons of the experimental and the control group.

Finally, the data did not show a statistically signification interaction effect for time and condition for the variable of *intended STEM choice* $F(1)= 1.42$ $p = .24$, $\eta_p^2 = .03$. Meaning that students who participated in the intervention did *not* show a significant greater intention to choose a STEM study. A visualization can be found in figure 4.

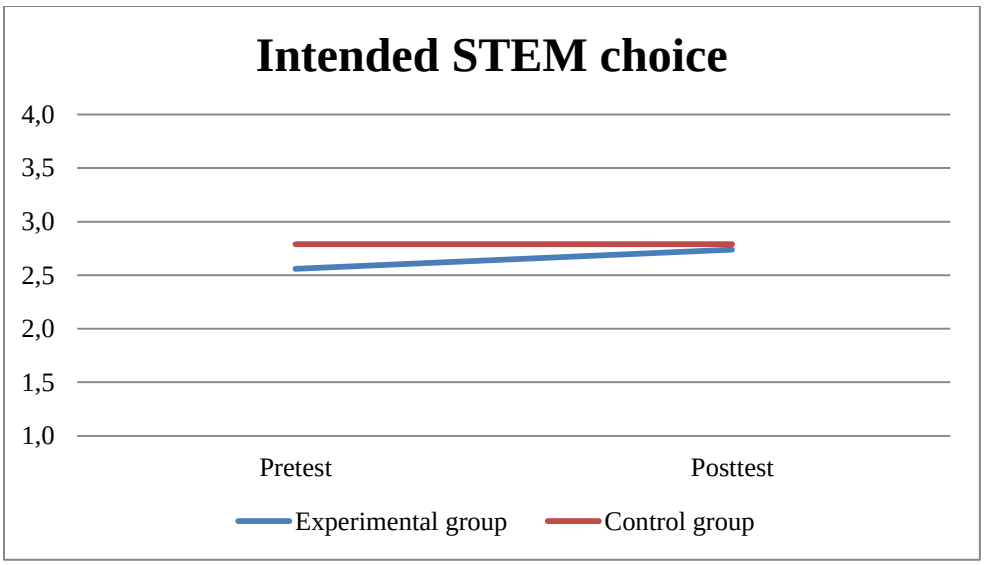

Figure 4. Mean intention scores before and after the lessons of the experimental and the control group.

In addition, the difference in intended STEM choice scores between the experimental and control group at the time of the pretest was non-significant $t(51)= -1.19$, $p = .24$, $r= 0.16$, and the difference at the time of the posttest was non- significant $t(51)= -.21$, $p= .84$, $r= 03$.

This indicates that students in one group did not show a greater intention to choose a STEM study at the time of the pretest compared to the other group.

Fixed mindset during posttest

In order to learn more about the mindset of participants at the time of the posttest, fixed mindset scores were calculated again. All 53 students were identified having a fixed mindset before participating in the intervention. In the experimental group, approximately 10% of the students were identified having a general fixed mindset *after* participation in the intervention. In contrast, in the control group approximately 40% of the students were identified having a general fixed mindset. This can be explained by participants in the control group filling out the questionnaire. Besides, 13 of 25 students in the control group could have discussed mindset with class mates who did participate in the intervention. For the remaining twelve students this was not possible since no intervention was arranged on their school.

Evaluating intervention

Students who participated in the intervention were asked for feedback about the lessons. Table 5 shows their reactions. To summarize the data in the table, 78% of the experimental group claims to became more aware of their response to a setback and 92% claims they became more aware of the mindset from which they are responding. Then, 71% claims to learn to react in a positive manner to a setbacks. Additionally, 60% said they enjoyed the lessons, 78% said the lessons were interesting and 17% of the students felt reluctant during the lessons.

Table 5.

Feedback from participants in the experimental group in percentages (N=28)

		Totally disagree	Disagree	Agree	Totally agree
1	Aware of response to setback	3.6	17.9	64.3	14.3
2	Aware of from which mindset is reacted	3.6	3.6	71.4	21.4
3	Learned to react positive on setbacks	3.6	25	64.3	7.1
4	Changed the image of own abilities at STEM- subjects	7.1	32.1	60.7	-
5	Helped to become more aware of study choice	17.9	50	32.1	-

6	I enjoyed the lessons	7.1	32.1	53.6	7.1
7	I felt reluctant during lessons	28.6	53.6	14.3	3.6
8	Lessons were useful for my future	7.1	28.6	50	14.3
9	Lessons were interesting	3.6	17.9	46.4	32.1
10	I would recommend lessons to a friend	14.3	53.6	32.1	-

Finally, students were asked to fill out an open question as well. Because the lessons will be distributed among participating schools to use, we want to improve the lessons and therefore asked students for input. Students said the relationship between mindset and STEM choice was not clear for them. Moreover, students said it was not clear at the start of the lessons what the lessons were about and that mindset could influence study-choice. According to students, the focus must lie on study-choice, not on mindset to make sure the students know what to expect of the lessons.

Discussion

This study aimed to increase the intended STEM choice of high school students by shifting their mindset from a fixed mindset towards a growth mindset. In order to do this, an intervention has been developed. The results of the study indicate that the intervention had a positive effect on mindset and self-efficacy. Students made a significant shift towards a growth mindset and their self-efficacy showed an increase after the intervention.

Conclusions

While previous research showed shifting mindset is possible, the distinction between general and STEM mindset has not been examined before. Therefore, the first purpose of the current study was to investigate if it is possible to shift a general fixed mindset to a general growth mindset through an intervention. Outcomes indicate that shifting mindset towards a general growth mindset is possible.

The second purpose of the current study was to investigate if STEM mindset could be shifted from a fixed to a growth mindset. Similar to general mindset, this shift is possible. This is consistent with what was expected since several studies found that shifting mindset is possible (Aronson, Fried & Good, 2002; Good, Aronson & Inzlicht, 2003; Mueller & Dweck, 1998; Blackwell et al, 2007). However, contrary to the general mindset, this shift did only occur in the experimental group. No change in STEM mindset was found in the control group. It can thus be assumed that an intervention helps shifting a STEM mindset from fixed to a

growth mindset.

The third purpose of this study was to increase self-efficacy of students. Outcomes indicated that levels of students' perceived self-efficacy increased after participation in the intervention. However, several findings were very surprising. First, the level of self-efficacy of the experimental group was significantly smaller at the time of the pretest compared to the control group. Second, the level of self-efficacy in the control group decreased. A possible explaination for these findings is the influence of peers. Since peers are very important at this age, peer influence could explain the decline in self-efficacy in the control group. Schunk & Pajares (2002) state that when children grow, peers become increasingly important. Peers influence self-efficacy in several ways; namely trough model similarity and peer networks (Schunk & Pajares, 2002). It is possible that students in the control group compared themselves with class mates. As a consequence, they could be more likely to believe that they lacked needed abilities. Especially students who are insecure about their abilities are likely to decline in self-efficacy.

A fourth purpose of this study was to examine if intended STEM choice could increase through the intervention. What did not reflect the hypothesis, is that intended STEM-choice of students did not significantly increase. Both the experimental and the control group were not likely to choose a STEM study after graduating then they were prior to the present study. There are several explanations why intended STEM-choice did not increase significantly, these are further elaborated upon in the limitation section below. Something to keep in mind is that it is possible that mindset had an effect on study choice. Students who participated in the intervention could have changed their study choice but because this study does only contain STEM studies, this was not measured.

It can be concluded that the intervention has a lot of positive effects. The intervention proved to have a positive effect on general mindset, STEM mindset, and self-efficacy. This is in line with Blackwell et al. (2007) and Aronson et al. (2002) who also found that certain aspects of an intervention proved to be effective.

The evaluation of the intervention revealed that students were very positive about the intervention; students became more aware of their response to a setback and which mindset they hold. Furthermore, most students enjoyed the lessons because they were interesting. Students claimed the information they got was a lot to take in, but worthwhile. According to the students, the intervention did not focus on study choice but on mindset. Furthermore, the students indicated that the relation between mindset and study choice should be stressed more clearly. It could be the case that the lack of effects on intended STEM choice is a result of the

absence of this relation. It makes sense that no effects were found since students were not aware of the goals of the intervention. This was done on purpose to keep all conditions the same for all students. It can be concluded that the focus should be shifted towards study choice instead of mindset in the future.

Limitations of the present study

This study presented valuable insights in the effects of an intervention on general mindset, STEM mindset and self-efficacy. Results showed that shifting general mindset is possible. However, this shift was not only present in the experimental group but also in the control group. An explanation for the shift in both groups could be that students in the experimental group could have told their classmates in the control group about the subject matter of the intervention. Meaning that students in the control group could have received information that was given during the intervention. As a consequence the distinction that was made between the experimental and control group was less strict than intended.

Furthermore, at the time of the pretest, the experimental and control group were equal regarding general and STEM mindset but differed with regard to the intended STEM choice as wel as their perceived self-efficacy. This means that both groups were not completely equal prior to the intervention which could have affected the comparability of both groups. Moreover, all studentsin the experimental group volunteered to participate in the intervention. This could have effected the result as the motives of participants play an important role in the motivation of students. One cause of these limitations could be the absence of a random distribution in this study. Randomiazation could have prevented the absence of significant results regarding intended STEM choice. To deal with this limitation in future research, it is recommended use random distribution of participants. Levels of all participants in the experimental and control group at the time of the should be equal (or equally unequal) due to randoisation. Randomasation could ensure more reliable and valid results as it rules out the external factors such as motives and allows for the compairability of groups.

With regard to the intervention students indicated that the relation between mindset and STEM choice was not explained clearly according to them, this could have caused the lack of effects on intended STEM choice. Because, for example, students were not able to connect mindset and study choice or students did not realize that the acquired knowledge about mindset could be applied on study choice as well. The lack of significant results regarding intended STEM choice could be explained because the goal of the intervention was not clear for students. For future research or future interventions, it is recommended to brief

students in advance about the intentions of the intervention. This way, students know what to expect of the intervention which could have a positive effect on finding significant results. In the present study, students expected study choice was the main subject of the intervention. It is recommended to make clear that mindset is the main subject for future research.

Relating the questionnaire serveral limitations can be identified. First, the observation of students during the administration of the questionnaire revealed that not all students filled out the questionnaire in a serious manner, which could have affected the relability of the data. Moreover, we do not know whether mindset can be measured accurate by using a questionnaire which is filled out at one moment. Until now, mindset is measured often by ranking statements on a scale ranging from one to four. However, observations during the intervention indicate that students often have a mixed mindset. For example, they stated they had a growth mindset but something like creativity could not be learned. According to them, it is an ability that someone must have in order to develop. For future research, it is recommended to develop better instruments to measure mindset. Furthermore, not only a distinction between fixed and growth mindset could be made, but a distinction between different areas could be made as well. For example; academic skills, creativity, music, and sports.

Another aspect is the definition of intelligence, which was asked for frequently in the questionnaire, yet is a very subjective concept. Intelligence is not something tangible. Observations during the intervention showed that intelligence for students, is the same as academic skills or the level of their education (e.g. vmbo, havo, vwo). Therefore, it is recommended to explain the construct of intelligence before students fill out the questionnaire. A description of STEM subjects is already given at the start of the questionnaire so a definition of intelligence can easily be added to make sure students use the same definition of intelligence while filling out the questionnaire.

This study focused on ‘intention’ not actual choice. This means that when students answered they would choose a STEM study, this not necessary leads to more technical skilled staff. For future research, it is recommended to choose a longitudinal research design in order to learn more about what students choose after they said they would choose a STEM study and if they actual end up in a STEM work field. In addition, when using a longitudinal research design, it can be investigated if changes in mindset are permanent.

Finally, there are a lot of skills that are valuable in life but are unknown by students. A person’s character, (work) experience, connections, emotional intelligence, perseverance, and

the ability to understand the power of failure are aspects which are just as important to succeed in life as intelligence (Van Kesteren, 2016). These latter two show similarities to the growth mindset. It is recommended for future research, to focus less on academic intelligence in order to develop and succeed in life during the intervention but more on other variables that contribute to a successful life as well.

Taking these limitations into account it is clear that mindset, intelligence, and intended STEM choice are all aspects which have strong connections and are therefore difficult to measure in a vacuum. However, because this is the same for all participants, it is expected that these aspects had little influence on the results.

Practical implications

This study reveals that mindset of students can be shifted both on the general level as in relation to their attitudes towards STEM. This shift in their attitude could influence the inflow of students in STEM studies in the long run. This would be both benificical for the students as they grow to their potential as decreasing the shortage in the labor market. These results know practical benefits since schools can use this knowledge as well as this intervention to build the confidence of their students and as a consequence could become more open to STEM studies.

In order to distribute the lessons effectively among schools, more involvement needs to be created. Schools, teachers, student counselors and study counselors need sufficient background knowledge about mindset, self-efficacy and study-choice in order for them to teach the lessons. Therefore, the lessons need to be improved and a manual needs to be written for practical use. When this is done, the intervention gives an opportunity to the schools to shift the general mindset and STEM mindset of its students.

During the posttest, students were asked to write down what researchers could do to improve the lessons. After analyzing the received feedback from the experimental group, the homework should be re-examined. Students said the homework was boring and the printed materials that students could read at home, was too much. According to students, subjects were discussed too extensively and too few examples or personal experiences were used during the lessons. Besides, students would like to see more interaction instead of individual assignments. Finally, lesson two about neuroplasticity was perceived very interesting.

Future research

The results and limitations of the present study raise new questions and offer a steady base for future research. To start with, it was expected that mindset has an indirect influence

on STEM choice but it is likely that other variables (e.g. grades of students on STEM subjects) have a great contribution to STEM choice as well (Van Tuijl & Walma van der Molen, 2016; Wang & Degol, 2013; Wang, 2013; Eccles, 1994; Wigfield & Eccles, 2000; Eccles & Wang, 2016). For further research, it is recommended to add these variables to gain more in depth knowledge regarding the subject.

In the present study, items which measured fixed mindset and items measuring growth were taken together. It is recommended to separate these into different constructs for future research. Which means more constructs will be measured, namely general fixed mindset, general growth mindset, STEM fixed mindset, and STEM growth mindset. This can contribute to more valid and reliable results as the data is more precise. Since general mindset and STEM mindset showed different results, it is recommended to use this distinction in future research again.

Moreover, it is recommended to involve teachers in the study since students use cues from teachers to make attributions about effort and ability (Mayer, 2008). Furthermore, teacher judgements have an influence on educational achievement. The judgement of teachers about student intelligence may affect students' learning and consequently, shaping their educational careers (Fischbach, Baudson, Preckel, Martin, & Brunner, 2013) Not only teachers could be included, parents and peers could have a contribution to STEM choice as well.

Regarding participating students, instead of using fifth graders, younger participants could be investigated. For example before students have to choose a profile in secondary school. The effects of the intervention could have a greater effect on them because the participants in this study often already had chosen their study. Moreover, this study only consisted of a pre- and posttest meaning, that there are no long-term effects measured. Several studies show that mindset can be shifted (Aronson et al., 2002; Good, et al., 2003; Mueller & Dweck, 1998; Blackwell, et al., 2007) but we do not know if this shift is permanent. For future research it could be interesting to measure if the change in mindset is permanent and what studies were actually chosen after participation in the intervention. Finally, students said that the relation between mindset and study choice was not stressed out clearly during the lessons. If similar research will be conducted again, this relation should be clear so that students know what to expect of the lessons. Hopefully, the lessons will be more efficient when students know what to expect of them. Instead of not informing students at all at the start of the intervention, students should be told what they can expect of the lessons. If students know what to expect, more significant results could be expected. For these future

researches it is recommended to involve teachers, ensure random distribution, and creating less subjective measure instruments.

Reference list

Aronson, J., Fried, C.B., 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.

Bandura, A. (1977) Self-efficacy: Toward a Unifying Theory of Behavioral Change. *Psychological Review, Vol. 84,* (2) 191-215.

Bandura, A. (1997) *Self-efficacy: The Exercise of Control*. London: Worth Publishers.

Berkhout, E., Bisschop, P., & Volkerink, M. (2013). *Technici: mobiel en toch honkvast. Uitstroom van technici vergeleken met andere sectoren.* SEO Economisch Onderzoek, Universiteit Amsterdam.

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. Doi: 10.1111/j.1467-8624.2007.00995.x.

Centraal Bureau voor de Statistiek (CBS) (2010). Leerlingen in het vwo kiezen steeds vaker natuurprofiel. Retrieved on 01-10-2015 from http://www.cbs.nl/nl-NL/menu/themas/onderwijs/publicaties/artikelen/archief/2010/2010-3188-wm.htm.

Clewell, B. C. and P. B. Campbell (2002). "Taking Stock: Where we've been, where we are, where we're going." *Journal of Women and Minorities in Science and Engineering 8*: 255-284.

De Castella, K., Goldin, P., Jazaieri, H., Ziv, M., Dweck, C.S., & Gross, J.J. (2013). Beliefs About emotion: Links to emotion regulation, well-being, and psychological distress. *Basic and Applied Social Psychology, 35:6,* 497-505, Doi: 10.1080/01973533.2013.840632

De Wit, M. (2013). Tekort aan technici op arbeidsmarkt. Retrieved on 01-08-2015 from http://www.intermediair.nl/vakgebieden/techniek/tekort-aan-technici-op-arbeidsmarkt.

Dorsen, J., Carlson, B., Goodyear, L. (2006) *Connecting Informal STEM Experiences to Career Choices: Identifying the Pathway*. ITEST Learning Resource Center.

Dweck, C. S. (2006). Is math a gift? Beliefs that put females at risk. In S. J. Ceci & W. Williams (Eds.) (2006). Why aren't more women in science? Top researchers debate the evidence. American Psychological Association, Washington, DC.

Dweck, C.S (2008). *Mindset: The New Psychology Of Success*. New York, New York: The Random House Publishing Group.

Eccles, J.S. (1994). Understanding Women's Educational and Occupational Choices. *Psychology of Woman Quaterly, 18*, 585-609. Doi: 10.1111/j.1471-6402.1994.tb01049.x

Eccles, J.S., & Wang, M. (2016). What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development, 40*(2) 100–106. Doi: 10.1177/0165025415616201.

Emerencia, N., Boots, B., Van Vilsteren, G. (2012). Naar 4 op de 10. Meer technologietalent voor Nederland. Masterplan STEM en Technologie.

Erdley, C. A., Cain, K.M., Loomis, C.C., Dumas-Hines, F., & Dweck, C.S. (1997). Relations Among Children's Social Goals, Implicit Personality Theories, and Responses to Social Failure. *Developmental Psychology, 33*(2), 263-272. Doi: 10.1037/0012-1649.33.2.263.

Field, A. (2009). *Discovering statistics using SPSS* (rev. ed.). London, England; SAGE Publications Ltd.

Fischbach, A., Baudson, T.G., Preckel, F., Martin, T., & Brunner, M. (2013). Do teacher judgments of student intelligence predict life outcomes? *Learning and Individual Differences* 27, 109–119. Doi:10.1016/j.lindif.2013.07.004

Good, C., Aronson, J., Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Applied Developmental Psychology, 24*, 645-662. Doi:10.1016/j.appdev.2003.09.002.

Hackett, G., & Betz, N. E. (1982). Mathematics Self-Efficacy Expectations, Math Performance, and the Consideration of Math- Related Majors. *American Educational Research Association*. Retrieved on July 7, 2016 from http://files.eric.ed.gov/fulltext/ED218089.pdf.

Hill, C., Corbett, C., & St Rose, A. (2010). Why so few? women in science, technology, engineering, and mathematics. Washington, D.C: AAUW.

Hoeffnagel, W. (2015, 27 march). Managers: 'Automatisering wordt heel waardevol voor het bedrijfsleven'. Retrieved from http://executive-people.nl/526265/managers-a-automatisering-wordt-heel-waardevol-voor-het-bedrijfslevena.html. On 02-11-2015.

Hong, Y. Y., Chiu, C. Y., Dweck, C.Sl, Lin, D., & Wan, W. (1999). Implicit theories, attribution, and coping: A meaning system approach. *Journal of Personality and Social Psychology, 77*(3), 588-599. Doi: 10.1037/0022-3514.77.3.588.

Hoskin, R. (2012). *The dangers of self-report*. Retrieved on 27-7-2016 from http://www.sciencebrainwaves.com/the-dangers-of-self-report/.

Mayer, R.E. (2008). *Learning and Instruction* (2nd ed.). Chicago, Illinois: R. R. Donnelley & Sons Company.

Midgley, C.; Maehr, M.L., Hruda, L.Z.; Anderman, E., Anderman, L., Freeman, K.E., Gheen, M., Kaplan, A., Kumar R., Middleton, M.J., Nelson, J., Roeser, R., Urdan, T. (2000). Manual for the Patterns of Adaptive Learning Scales. University of Michigan.

Miller, D.I., Eagly, A.H., Linn, M.C. (2015). Women's Representation in Science Predicts National Gender-Science Stereotypes: Evidence From 66 Nations. *Journal of Educational Psychology,107*(3), 631-644. Doi: 10.1037/edu0000005.

Nix, S., Perez-Felkner, L., Thomas, K. (2015). Perceived mathematical ability under challenge: a longitudinal perspective on sex segregation among STEM degree fields. Frontiers in Psychology, Vol. 6, article 530. Doi: 10.3389/fpsyg.2015.00530.

O'Brien, V., Martinez-Pons, M., & Kopala,. M, (1999). Mathematics Self-efficacy, Ethnic Identity, Gender, and Career Interests Related to Mathematics and Science. The Journal of Educational Research, 92(4), 231-235. Doi: 10.1080/00220679909597600.

Pallant, J. (2005). SPSS Survival Manual: a step by step guide to data analysis using SPSS. Crows Nest NSW, Australia; Allen & Unwin.

ROA. (2015). De arbeidsmarkt naar opleiding en beroep tot 2020. Maastricht: Researchcentrum voor Onderwijs en Arbeidsmarkt.

Schunk, D.H., Pajares, F. (2002). The Development of Academic Self-Efficacy. Academic Press in A. Wigfield & J. Eccles (Eds.), Development of achievement motivation.

Tillaart, H. van den, Elfering, S., Vermeulen, H., Van Rens, C., Warmerdam. J., De Wit, W., Doesborgh, J. & Sombekke, E. (2012). Trends en ontwikkelingen in de technische installatiebranche 2012. Nijmegen: ITS, Radboud Universiteit Nijmegen.

Van Aalderen-Smeets, S.I. & Walma van der Molen, J.H. (2016). STEM Educational and Career Choices: The Relevance of the Implicit Theory of Intelligence Perspective. *Science Education.*

Van Kesteren, L. (2016). *Waarom 'zesjes' studenten uiteindelijk het meest succesvol zijn in het leven.* Retrieved on 27-7-2016 from https://www.reptoir.nl/waarom-zesjes-studenten-uiteindelijk-het-meest-succesvol-zijn-in-het-leven/.

Van Tuijl, C., Walma van der Molen, J.H.W. (2016). Study choice and career development in STEM fields: an overview and integration of the research. *International Journal of Technology and Design Education. 26* (2), 159-183. Doi: 10.1007/s10798-015-9308-1.

Wang X. (2013). Why Students Choose STEM Majors: Motivation, High School Learning, and Postsecondary Context of Support. *American Educational Research Journal, 50*(5), 1081–1121. Doi: 10.3102/0002831213488622

Wang, M. & Degol, J. (2013). Motivational Pathways to STEM Career Choices: Using Expectancy-Value Perspective to Understand Individual and Gender Differences in STEM Fields. *Developmental Review 33*(4), 304-340. Doi: 10.1016/j.dr.2013.08.001

Wigfield, A., & Eccles, J. S. (2000). Expectancy- Value Theory of Achievement Motivation. *Contemporary Educational Psychology, 25,* 68-81. Doi: 10.1006/ceps.1999.1015

Appendices

Appendix A

STEM-mindset en studiekeuze

Research Center for Science Education and Talent Development
UNIVERSITY OF TWENTE.

Beste leerling,

Wij doen onderzoek naar de studiekeuze van VWO leerlingen. Deze vragenlijst is ontwikkeld om meer te weten te komen over hoe leerlingen hun studiekeuze maken en welke factoren hieraan bijdragen. We hebben jouw input nodig om een goed beeld te krijgen van hoe het studiekeuze proces werkt.

Er zijn bij het invullen geen goede of foute antwoorden, we willen alleen kijken hoe het in werkelijkheid zit. Het is daarom belangrijk dat je jouw eigen mening geeft zodat ons onderzoek een realistisch beeld oplevert.

Invullen. We willen je vragen de vragenlijst volledig in te vullen Een onvolledig ingevulde vragenlijst kunnen we niet meenemen in de analyses. Hoe vul je hem in? Denk niet te lang na bij elke vraag, maar ga af op je eerste gevoel. Bij elke vraag kun je aangeven in hoeverre je het eens bent met de stelling (variërend van “helemaal niet mee eens” tot “helemaal mee eens”). Het kan lijken dat sommige stellingen sterk op elkaar lijken. Dat klopt. Dit is nodig om de vragenlijst statistisch betrouwbaar te maken, vul daarom alle vragen in.

Anoniem. De resultaten van de vragenlijst zullen anoniem verwerkt worden en niet worden gekoppeld aan jou als persoon. Wel wordt er een code gemaakt op basis van je persoonsgegevens zodat de data uit deze lijst gekoppeld kunnen worden aan de vragenlijst die je op een later tijdstip invult.

STEM. De meeste vragen gaan over STEMvakken en STEM-vervolgopleidingen. Met STEMvakken bedoelen we de vakken wiskunde (A, B & D), natuurkunde, scheikunde, biologie, informatica, techniek, NLT, onderzoeken en ontwerpen, etc. Met STEM-vervolgopleidingen bedoelen we technische en/of natuurwetenschappelijke opleidingen, bijvoorbeeld waarvoor je een van de STEMvakken als ingangseis nodig hebt. Geneeskunde wordt in deze vragenlijst niet als STEM-vervolgopleiding gezien, technische geneeskunde wel. Met alfavakken bedoelen we de talige vakken zoals Engels, Nederlands, maar ook geschiedenis en maatschappijleer.

De vragenlijst bevat de volgende onderdelen:

Onderdeel 1 Studiekeuze en houding ten opzichte van STEM
Onderdeel 2 Kennis over STEM-onderwerpen
Onderdeel 3 Achtergrondinformatie

Als je nog vragen hebt, kun je deze stellen aan de onderzoeker die aanwezig is in het lokaal.

Namens de onderzoekers van de Universiteit van Twente,

Alvast bedankt voor het invullen van de vragenlijst.

Om de gegevens van deze vragenlijst te kunnen koppelen aan een volgende vragenlijst die je gaat invullen, hebben we een unieke code nodig. Deze wordt samengesteld uit de volgende informatie. Vul hieronder je gegevens in.

Identificatie	
Wat is je voornaam?	
Wat zijn de eerste 2 letters van je achternaam? (Bijv. De Vries wordt VR)	
Wat zijn de cijfers van je postcode?	
Wat is je geboortedatum? (Bijv. 01-02-1999)	
Op welke school zit je?	☐ Bonhoeffer College, Bruggertstraat
	☐ Bonhoeffer College, van der Waalslaan
	☐ Erasmus College
	☐ CSG Het Noordik
	☐ Greijdanus College
	☐ Reggesteyn

DEEL 1 Studiekeuze en houding

In het eerste onderdeel gaan de vragen over hoe jij denkt over je studiekeuze. Mocht je nu al weten dat je eerst een jaar gaat reizen of niet gaat studeren, beeld je dan in dat je een keuze zou moeten maken.

Kans op STEM-keuze						
	0%	20%	40%	60%	80%	99%
Hoe groot schat je de kans in dat jij een STEM-vervolgopleiding gaat kiezen? (we bedoelen hiermee alle natuurwetenschappelijke, technische richtingen met uitzondering van geneeskunde)	☐	☐	☐	☐	☐	☐

Intentie tot STEM keuze

Als ik zou gaan studeren…	Helemaal niet mee eens [1]	niet mee eens [2]	mee eens [3]	helemaal mee eens [4]
ben ik van plan een studie te kiezen waar je geen natuurkunde, scheikunde, informatica of andere STEMvakken voor nodig hebt	☐	☐	☐	☐
ben ik van plan om een natuurwetenschappelijke of technische vervolgopleiding te gaan volgen	☐	☐	☐	☐
ben ik van plan een studie te kiezen waar je natuurkunde en/of scheikunde voor nodig hebt	☐	☐	☐	☐
ben ik van plan om een studie te kiezen waarbij het belangrijkste accent niet op de STEM-kant ligt	☐	☐	☐	☐
ben ik van plan om een studie te kiezen die niets te maken heeft met een van de STEM-vakken	☐	☐	☐	☐
ben ik van plan om een studie te kiezen waarbij het belangrijkste accent ligt op de STEM-onderwerpen	☐	☐	☐	☐
Ik weet (bijna) zeker welke vervolgopleiding ik ga kiezen na het VWO.	☐	☐	☐	☐

De volgende stellingen gaan over je houding ten opzichte van STEM- en alfavakken.

STEM houding

pagina 1/4	Helemaal niet mee eens [1]	niet mee eens [2]	mee eens [3]	helemaal mee eens [4]
Ik denk dat ik een bepaalde mate van aanleg voor de STEM-vakken heb en zelf niet kan veranderen hoe goed ik daar in ben	☐	☐	☐	☐
Ik vind het belangrijk om het bij de STEM-vakken beter te doen dan andere leerlingen	☐	☐	☐	☐
Ik denk dat ik mijn intelligentie niet kan veranderen	☐	☐	☐	☐
Ik geloof dat ik altijd kan veranderen hoe goed ik ben in de STEM-vakken	☐	☐	☐	☐
Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe goed ik ben in STEM-vakken	☐	☐	☐	☐
Ik kan nieuwe dingen leren, maar ik denk niet dat ik het vermogen heb om mijn capaciteiten te veranderen.	☐	☐	☐	☐
Ik denk dat een STEM-studierichting tot goede loopbaankansen leidt	☐	☐	☐	☐
Ik wil alle onderwerpen die we bij de STEM-vakken krijgen helemaal onder de knie krijgen	☐	☐	☐	☐
Afgezien van hoe goed ik ben in de alfa-vakken op dit moment, denk ik dat ik het vermogen bezit om dit te veranderen	☐	☐	☐	☐
Ik zet me vooral in voor de STEM-vakken om te voorkómen dat ik slechte cijfers haal	☐	☐	☐	☐
Ik vind het belangrijk om voor de STEM-vakken een beter cijfer te halen dan de meeste andere leerlingen	☐	☐	☐	☐
Ik weet zeker dat ik bij de moeilijkste opdrachten binnen de STEM-vakken tot een oplossing kom	☐	☐	☐	☐

Ik beleef plezier aan het bezig zijn met STEM-onderwerpen	☐	☐	☐	☐
Ik denk dat de meeste leerlingen een STEM-studierichting als een van de moeilijkste richtingen beschouwen	☐	☐	☐	☐
Mijn angst om slecht te presteren bij de STEM-vakken, is vaak datgene dat me motiveert	☐	☐	☐	☐
Ik heb een bepaalde mate van aanleg voor de alfa-vakken en kan zelf niet kan veranderen hoe goed ik daar in ben	☐	☐	☐	☐
Ik denk dat jongens beter zijn in STEM-vakken dan meisjes	☐	☐	☐	☐
Ik heb aanleg voor wiskunde	☐	☐	☐	☐

STEM houding

pagina 2/4	Helemaal niet mee eens	niet mee eens	mee eens	helemaal mee eens
	[1]	[2]	[3]	[4]
Ik geloof dat ik altijd kan veranderen hoe goed ik ben in de alfa-vakken	☐	☐	☐	☐
Ik denk dat ik niet kan veranderen hoe goed ik ben in alfa-vakken.	☐	☐	☐	☐
Ik denk dat ik het vermogen heb om mijn capaciteiten in de alfa-vakken te veranderen over tijd.	☐	☐	☐	☐
Ik denk dat ik met voldoende tijd en moeite mijn intelligentie kan veranderen	☐	☐	☐	☐
Ik denk dat ik nieuwe dingen kan leren, maar dat ik niet kan veranderen hoe goed ik ben in alfa-vakken.	☐	☐	☐	☐
Ik wil graag zo veel mogelijk leren te begrijpen bij de STEM-vakken	☐	☐	☐	☐
Het is belangrijk voor mij om het, vergeleken met anderen, goed te doen bij de STEM-vakken	☐	☐	☐	☐
Ik denk dat ik zelf niets kan doen om mijn intelligentie te veranderen	☐	☐	☐	☐

Ik denk dat jongens het leuker vinden om met STEM-onderwerpen bezig te zijn dan meisjes	☐	☐	☐	☐
Ik denk dat ik nieuwe dingen kan leren, maar dat ik niet kan veranderen hoe goed ik ben in STEM-vakken	☐	☐	☐	☐
Ik denk dat ik met voldoende tijd en moeite mijn capaciteiten voor de STEM-vakken kan veranderen	☐	☐	☐	☐
Ik denk dat een STEM-studierichting aansluit bij wat mijn omgeving van mij verwacht	☐	☐	☐	☐
Ik denk dat ik niet kan veranderen hoe goed ik ben in STEM-vakken	☐	☐	☐	☐
Hoe goed ik ben in STEM-vakken, is denk ik iets aan mij waar ik niets aan kan veranderen	☐	☐	☐	☐
Hoe goed ik ben in alfa-vakken, is denk ik iets aan mij waar ik niets aan kan veranderen	☐	☐	☐	☐
Ik denk dat jongens meer inzicht hebben in STEM-vakken dan meisjes	☐	☐	☐	☐

STEM houding

pagina 3/4	Helemaal niet mee eens	niet mee eens	mee eens	helemaal mee eens
	[1]	[2]	[3]	[4]
Ik denk dat ik het vermogen heb om mijn capaciteiten in de STEM-vakken te veranderen over tijd	☐	☐	☐	☐
Het is voor mij belangrijk om de stof die we behandelen bij de STEM-vakken zo goed mogelijk te begrijpen	☐	☐	☐	☐

Ik denk dat een STEM-studierichting mijn baankansen vergroot	☐	☐	☐	☐
Ik vind STEM-onderwerpen interessant	☐	☐	☐	☐
Ik denk dat ik een bepaald niveau van intelligentie gekregen heb en dat niet kan veranderen	☐	☐	☐	☐
Ongeacht wat mijn capaciteiten nu zijn, denk ik dat ik mijn intelligentie altijd kan veranderen.	☐	☐	☐	☐
Mijn enige doel bij de STEM-vakken is te voorkómen dat ik slecht presteer	☐	☐	☐	☐
Ik denk dat jongens geschikter zijn voor STEM-vakken dan meisjes	☐	☐	☐	☐
Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe goed ik ben in alfa-vakken	☐	☐	☐	☐
Ik vind de inhoud van de STEM-vakken interessant om mee bezig te zijn	☐	☐	☐	☐
Ik denk dat ik het vermogen heb om mijn intelligentie te veranderen over tijd	☐	☐	☐	☐
Ik denk dat jongens sneller zijn in het begrijpen van natuurkundige fenomenen dan meisjes	☐	☐	☐	☐
Ook al is de stof lastig bij STEM-vakken, ik krijg het wel geleerd	☐	☐	☐	☐
Ik denk dat ik met voldoende tijd en moeite mijn capaciteiten voor de alfa-vakken kan veranderen	☐	☐	☐	☐
Ik denk dat de meeste leerlingen STEM-onderwerpen een van de ingewikkeldste onderwerpen vinden	☐	☐	☐	☐
Ik vind het leuk om over STEM-vraagstukken na te denken	☐	☐	☐	☐

STEM houding				
pagina 4/4	Helemaal niet mee eens	niet mee eens	mee eens	helemaal mee eens
	[1]	[2]	[3]	[4]
Ik heb aanleg voor talen	☐	☐	☐	☐
Ik kan alle stof begrijpen in STEM-vakken en alle opdrachten goed maken	☐	☐	☐	☐
Ik denk dat ik mijn intelligentie kan veranderen	☐	☐	☐	☐
Ik denk dat een STEM-studierichting een goed inkomen garandeert	☐	☐	☐	☐
Ik denk dat mijn intelligentie iets aan mij is waar ik zelf niets aan kan veranderen	☐	☐	☐	☐
Afgezien van hoe goed ik ben in de STEM-vakken op dit moment, denk ik dat ik het vermogen bezit om dit te veranderen.	☐	☐	☐	☐
Ik weet zeker dat ik de vaardigheden die we tijdens STEM-vakken aangeleerd krijgen onder de knie zal krijgen	☐	☐	☐	☐
Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe intelligent ik ben	☐	☐	☐	☐
Ik denk dat de meeste leerlingen STEM-onderwerpen als erg lastig te begrijpen beschouwen	☐	☐	☐	☐

Einde deel 1

DEEL 2

Kennis over STEM-onderwerpen

In dit tweede onderdeel zullen de stellingen gaan over alle kennis die je hebt over STEM-onderwerpen en waar je deze kennis hebt opgedaan. Wees eerlijk in je antwoorden en weet dat er geen goede of foute antwoorden zijn.

In je antwoord kun je aangeven hoe vaak je iets doet. De antwoordmogelijkheden zijn ‘zelden tot nooit’ , ‘een paar keer per jaar’, ‘1-3 keer per maand’, ‘elke week’ en ‘elke dag’.

Kennis over STEM-onderwerpen					
	Zelden tot nooit	een paar keer per jaar	1-3 keer per maand	elke week	elke dag
	[1]	[2]	[3]	[4]	[5]
Ik ga met school naar science musea (zoals Nemo, Naturalis, of Techniekmuseum 't Heim)	☐	☐	☐	☐	☐
Ik heb met vrienden gesprekken over STEM-wetenschappelijke onderwerpen	☐	☐	☐	☐	☐
In mijn vrije tijd ben ik bezig met het sleutelen aan dingen	☐	☐	☐	☐	☐
Ik ga met school op excursie of projectweek om veldwerk op het gebied van STEM-vakken te doen	☐	☐	☐	☐	☐
Op school doen we projecten op het gebied van STEM-onderwerpen	☐	☐	☐	☐	☐
We praten thuis over oplossingen voor grotere, technische maatschappelijke vraagstukken	☐	☐	☐	☐	☐
Ik kijk populair- wetenschappelijke programma's (zoals Proefkonijnen, Hoezo?!, Katja's bodyscan, De Wereld Leert Door)	☐	☐	☐	☐	☐

In de klas doen we practica binnen de STEM-vakken	☐	☐	☐	☐	☐
In mijn vrije tijd ben ik bezig met het maken/ ontwerpen van iets	☐	☐	☐	☐	☐
Ik volg sociale media kanalen die gaan over STEM-wetenschap	☐	☐	☐	☐	☐
Ik kijk series die iets te maken hebben met STEM-wetenschap (bijvoorbeeld 'The Big Bang Theory', 'CSI', 'Bones')	☐	☐	☐	☐	☐
In de klas hebben we discussies over STEM-wetenschappelijke onderwerpen	☐	☐	☐	☐	☐
Mijn ouders stimuleren bezoek aan science musea (zoals Nemo, Naturalis, Techniekmuseum 't Heim)	☐	☐	☐	☐	☐
Ik kijk naar YouTube filmpjes over STEM-wetenschappelijke onderwerpen	☐	☐	☐	☐	☐
Ik lees populair- wetenschappelijke tijdschriften, zoals de Quest, de Kijk, National Geographic	☐	☐	☐	☐	☐
In mijn vrije tijd ben ik bezig met het uitvogelen van hoe iets het beste werkt	☐	☐	☐	☐	☐
Ik lees populair- wetenschappelijke boeken over STEM-onderwerpen	☐	☐	☐	☐	☐
Ik kijk naar documentaires op het gebied van STEM-wetenschap (zoals op Discovery Channel en National Geographic)	☐	☐	☐	☐	☐
We hebben thuis gesprekken over STEM-wetenschappelijk onderwerpen	☐	☐	☐	☐	☐

Einde deel 2

DEEL 3

Achtergrondinformatie

Het laatste deel bevat nog een paar vragen over je persoonlijke kenmerken en ervaringen. Wanneer je alle vragen hebt beantwoord, zal er om je e-mailadres worden gevraagd. Deze gebruiken we zodat we over een paar jaar kunnen navragen of en welke studie je na de middelbare school bent gaan volgen en of je deze dan nog steeds volgt.

Achtergrondinformatie				
Ik ben een …	☐ jongen	☐ meisje		
Wat is je leeftijd?		… jaar		
Welk profiel heb je gekozen?	☐ N&G	☐ N&T	☐ NG&NT	☐ ……..
Ben je wel eens blijven zitten op de middelbare school?	☐ Ja, in 4VWO	☐ Ja, in 5VWO	☐ Ja, in onderbouw	☐ Nee
Heb je voor het VWO een andere opleiding gedaan, zoals de HAVO?	☐ Ja, de HAVO	☐ Ja, iets anders	☐ Nee	

Open vragen
Wat heb je tot nu toe gedaan om je voor te bereiden op je studiekeuze? Denk aan het bezoeken van open dagen, gesprekken met vrienden en/of je ouders, meelopen met iemand, informatie lezen etc.
Wat is de baan van jouw *moeder of verzorgster*? (Als ze op dit moment geen werk heeft, schrijf dan op wat haar laatste baan was. Als ze nooit een baan heeft gehad, je het niet weet, of deze vraag niet van toepassing is, zet dan een x.)
Omschrijf wat je *moeder/verzorgster* doet in deze baan (Schrijf in 1 zin wat voor soort werk ze doet in die baan. Als ze nooit een baan heeft gehad of je weet het niet, zet dan een x.
Wat is de hoogst genoten opleiding van je *moeder of verzorgster*? ☐ Universiteit ☐ HBO (Hoger beroeps onderwijs) ☐ MBO (Middelbaar beroepsonderwijs) ☐ Voortgezet onderwijs (VMBO, HAVO of VWO) ☐ Basisvorming (bijvoorbeeld eerste jaren van het VMBO, HAVO of VWO) ☐ Basisschool ☐ Basisschool niet afgemaakt ☐ Weet ik niet
Wat is de baan van jouw *vader of verzorger*? (Als hij op dit moment geen werk heeft, schrijf dan op wat zijn laatste baan was. Als hij nooit een baan heeft gehad, je het niet weet, of deze vraag niet van toepassing is, zet dan een x.)
Omschrijf wat je *vader/verzorger* doet in deze baan (Schrijf in 1 zin wat voor soort werk hij doet in die baan. Als hij nooit een baan heeft gehad, je weet het niet, of deze vraag niet van toepassing is, zet dan een x.

Wat is de hoogst genoten opleiding van je *vader of verzorger*?	☐ Universiteit ☐ HBO (Hoger beroeps onderwijs) ☐ MBO (Middelbaar beroepsonderwijs) ☐ Voortgezet onderwijs (VMBO, HAVO of VWO) ☐ Basisvorming (bijvoorbeeld eerste jaren van het VMBO, HAVO of VWO) ☐ Basisschool ☐ Basisschool niet afgemaakt ☐ Weet ik niet
Als je toestemming geeft om je over twee jaar nog eens te benaderen om deel te nemen aan het onderzoek vul dan hieronder je emailadres in:	

Einde deel 3

Bedankt voor het invullen van de vragenlijst!

Appendix B

Vragen over SET YOUR MIND!

Beantwoord de volgende vragen als je hebt deelgenomen aan de lessen ‘Set Your Mind!’. Beantwoord zo eerlijk mogelijk, dus als je bijvoorbeeld geen huiswerk hebt gemaakt, zeg dat dan eerlijk. Dit heeft namelijk invloed op ons onderzoek en we willen een zo eerlijk mogelijk beeld krijgen. Het heeft geen enkele consequentie voor je als je geen huiswerk hebt gemaakt of de teksten niet hebt gelezen.

	Les 1	Les 2	Les 3	Geen
Ik was aanwezig bij de volgende lessen:	❑	❑	❑	❑
Ik heb de tekst gelezen in de map die hoort bij les:	❑	❑	❑	❑
Ik heb het huiswerk (deels) gemaakt dat hoort bij les:	❑	❑	❑	❑

Mijn ervaring met de lessen:

	Helemaal niet mee eens	Niet mee eens	Mee eens	Helemaal mee eens
Ik ben me meer bewust geworden van hoe ik reageer op tegenslag	❍	❍	❍	❍
Ik ben me meer bewust geworden vanuit welke mindset ik vaak reageer	❍	❍	❍	❍
Ik heb geleerd hoe ik positief kan reageren op tegenslag	❍	❍	❍	❍
Deze lessen hebben me een ander beeld gegeven van mijn eigen kunnen in de STEMvakken	❍	❍	❍	❍
Deze lessen helpen me bewuster nadenken over mijn studiekeuze	❍	❍	❍	❍

Mijn mening over de lessen:

	Helemaal niet mee eens	Niet mee eens	Mee eens	Helemaal mee eens
Ik vond de lessen leuk	❍	❍	❍	❍
Ik zat met tegenzin bij de lessen	❍	❍	❍	❍
Ik vond de lessen interessant	❍	❍	❍	❍
Ik denk dat wat ik in de lessen heb geleerd nuttig is voor mijn eigen toekomst	❍	❍	❍	❍
Ik zou deze lessen aanraden aan een vriend of vriendin	❍	❍	❍	❍

Wat zouden we volgens jou aan de lessen kunnen veranderen om deze beter te maken? (iets toevoegen of weglaten? Informatie anders brengen? etc.)

Bedankt voor het invullen van de vragenlijst!

Je hebt ons enorm geholpen. Zonder data van leerlingen kunnen we namelijk geen onderzoek doen en het studiekeuze proces niet verbeteren.

We verloten na afloop van het onderzoek 5 exemplaren van het boek ‘Kijken in het brein’. Als je hiervoor in aanmerking wilt komen vul dan hieronder je emailadres in:

…….

Wil je meer weten over het onderzoek dan kun je contact opnemen met de projectleider, Sandra van Aalderen, sandra.vanaalderen@utwente.nl

Appendix C

Factor Loadings presented in the Pattern Matrix obtained by Factor Analysis using Direct Oblimin Rotation on 24 items (n = 173)

Code	Items	Factor			
		1	2	3	4
INTENTIEP1	om een natuurwetenschappelijke of technische vervolgopleiding te gaan volgen.		,762		
INTENTIEP2	een studie te kiezen waar je natuurkunde en/of scheikunde voor nodig hebt.		,766		
INTENTIEP3	om een studie te kiezen waarbij het belangrijkste accent ligt op de STEM -onderwerpen		,835		
INTENTIEN1	om een studie te kiezen die niets te maken heeft met een van de STEM -vakken		-,689		
INTENTIEN2	een studie te kiezen waar je geen natuurkunde, scheikunde, informatica of andere STEM -vakken voor nodig hebt		-,747		
INTENTIEN3	om een studie te kiezen waarbij het belangrijkste accent niet op de STEM -kant ligt		-,756		
TOIGE1	Ik denk dat mijn intelligentie iets aan mij is waar ik zelf niets aan kan veranderen.	-.830			
TOIGE2	Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe intelligent ik ben.	-.763			
TOIGE3	Ik kan nieuwe dingen leren, maar ik denk niet dat ik het vermogen heb om mijn intelligentie te veranderen.	-.619			
TOIGE5	Ik denk dat ikzelf mijn intelligentie niet kan veranderen	-.668			
TOIGI1	Ik denk dat ik met voldoende tijd en moeite mijn intelligentie kan veranderen.	.420			
TOIGI2	Ik denk dat ik mijn intelligentie kan veranderen.	.901			
TOIGI3	Ongeacht wat mijn capaciteiten nu zijn, denk ik dat ik mijn intelligentie altijd kan veranderen.	.590			
TOIGI4	Ik denk dat ik het vermogen heb om mijn intelligentie te veranderen over tijd.	.634			
TOIBE1	Ik denk dat ik niet kan veranderen hoe goed ik ben in STEM -vakken.				-.682
TOIBE2	Hoe goed ik ben in STEM -vakken, is denk ik iets aan mij waar ik niets aan kan veranderen.				-.774
TOIBE3	Om eerlijk te zijn, denk ik niet dat ik kan veranderen hoe goed ik ben in STEM -vakken.				-.701
TOIBE4	Ik denk dat ik een bepaalde mate van aanleg voor de STEM-vakken heb en zelf niet kan veranderen hoe goed ik daar in ben *				
TOIBI1	Ik denk dat ik met voldoende tijd en moeite mijn capaciteiten voor de STEM-vakken kan veranderen				.611
TOIBI2	Ik geloof dat ik altijd kan veranderen hoe goed ik ben in de STEM -vakken.				.503
TOIBI4	Ik denk dat ik het vermogen heb om mijn capaciteiten in de STEM -vakken te veranderen over tijd.				.616
ATT_SE1	Ik weet zeker dat ik de vaardigheden die we tijdens STEM -vakken aangeleerd krijgen onder de knie zal krijgen			,709	
ATT_SE2	Ik weet zeker dat ik bij de moeilijkste opdrachten binnen de STEM -vakken tot een oplossing kom			,536	
ATT_SE3	Ik kan alle stof begrijpen in STEM -vakken en alle opdrachten goed maken			,700	
ATT_SE5	Als ik mijn best doe kan ik de moeilijkste opdrachten maken in de STEM -vakken			.850	
	Cronbach's Alpha	.899	.871	.796	.839
	Explained Variance (Rotation Sum of Squared loadings)	6.54	5.21	3.19	6.10

*Item TOIBE4 was removed from the dataset after analysis of internal variance.