Master thesis Learning Sciences

DEVELOPMENT AND VALIDATION OF THE DUTCH SCIENCE MOTIVATION QUESIONNAIRE (DSMQ).

Author:
Otto Stellmacher BSc

Date:
16 June 2010, Enschede

Supervisors:
Dr. P. Wilhelm
Dr. T.H.S. Eysink

UNIVERSITY OF TWENTE.

Abstract

Despite above average performance in science-related courses in secondary education, Dutch students seem to lack motivation for science studies in higher education (OECD, 2007). Interventions focused on this problem may profit from an instrument that can assess science motivation. Therefore, the aim of the study was to develop and validate a new Dutch science motivation questionnaire. Items covering fourteen personal and environmental science-related concepts of motivation were presented to both students in secondary education and university students.. After conducting factor analysis, both personal (*intrinsic task motivation*, *performance motivation*, *utility value*, *competence belief*, *self efficacy*, *goal setting*) and environmental factors (*peer support*, *feedback*) appeared in the factor structure. The reliability of the subscales and the total scale was satisfactory, measures of both construct and criterion validity showed that the questionnaire has initial potential for science motivation assessment in Dutch education.

Development and Validation of a the Dutch Science Motivation Questionnaire (DSMQ)

In December 2008, the science report of the TIMSS-2007 was published. Since 1995, the TIMSS project (Trends in International Mathematics and Science Study) compares the quality of science education between countries all over the world, every four years. Goal of the project is not only to find the strengths and weaknesses in the different national school systems, class or student characteristics, but also to contribute to the development of these within each country. Target groups of the 2007 study were fourth and eighth grade students whose knowledge was tested in the domains of mathematics, biology, geography, physics and chemistry (Martins, Mullis, & Foy, 2008). In the Netherlands, 4334 fourth grade students took part in the TIMSS-2007. As in 1995 and 2003, Dutch students were still in the top ten in the domain of mathematics. However in the other subjects (biology, geography, physics and chemistry) their performance lacked behind. The reason for this is not a decrease in school performance of Dutch students, but an increase in other countries. Physics and chemistry are the domains in which these differences were most outspoken (Meelissen & Drent, 2008).

Science courses seem to lack popularity in Dutch schools. Often, science courses are regarded something for boys more than girls. Compared to other courses, they are regarded less useful for a future career. Thus, students (but also schools or parents) seem to evaluate science education in a way that does not correspond with reality (Platform Bèta Techniek, 2008). Fisser (2009) states that this causes the increasing lack of science students in higher education. In 2006, on average 26% of the students in Europe graduated in science majors, compared to only 16% in the Netherlands (Platform Bèta Techniek, 2008).

The data seem to indicate that the main problem is not a lack of talent of students in schools. It is rather the view upon science, the attitude they hold for these science courses and the confidence in being able to perform in them. Here, Dutch students score much lower compared to other European countries (Platform Bèta Techniek, 2008). This is also shown in the TIMSS-2007. The pleasure to follow science courses and the confidence in their skills decreased in comparison to the TIMSS-2003 study (Meelissen & Drent, 2008). Research shows that negative attitude does not consequently leads to worse performance. But students, who think negatively about science, are less likely to take science majors in higher education (Platform Bèta Techniek, 2008). The PISA-study 2006 (Programme for International Student Assessment), which concentrated on science and technology skills of 15-year-olds, supports these findings. In addition to the skills test, attitudes with respect to science were measured. Results showed that Dutch students were less interested and had less confidence in their science skills than most of the students in other European countries, although they did not perform less in comparison with these countries (OECD, 2007).

To cope with this problem Platform Bèta Techniek initiated the Bètapartners program. It aims to increase the number of students in science related school profiles. A school profile is the subject area students choose at the end of grade 9. After graduation in this particular area in grade 11 or 12, they have access to studies in higher education, partly depending on their profile choice. Bètapartners tries to encourage students by making science classes more interesting and challenging (Bètapartners, 2010).

Altogether it seems that there is a lack of positive attitude and confidence rather than a lack of skills. Attitudes and confidence are both included in the concept of motivation. Thus, it seems useful to assess the comprehensive construct instead of considering only the two aspects. According to Alderman (2008) motivation is the internal state that activates, directs and regulates the persistence of behavior. In other words, motivation is responsible for starting and choosing a behavior over another and it helps to maintain the behavior when it becomes difficult in order to achieve a certain goal. Motivated students are actively and pleasurably engaged in academic tasks and are proud about their accomplishments (Stipek, 1996). With respect to the problems stated above, assessing students' science motivation seems very useful, for example to evaluate interventions like the Bètapartners program. However, there are no valid instruments to assess science motivation in the Netherlands. Therefore, aim of the study is the development of such an instrument.

There are different approaches (behaviorist, cognitive, social-cognitive and socio-cultural) to study motivation (Perry, Turner, & Meyer, 2006). However, in educational psychology, "it is difficult if not impossible to understand students' motivation without understanding the context they are experiencing" (Eccles & Wigfield, 2002, p. 128). Therefore, the social-cognitive approach (see Figure 1) is taken as the basis of this study. It focuses primarily on individual cognition, but assumes that cognitive factors, personal factors, environmental factors and behavior are all interrelated (Perry et al., 2006). Thus, each factor can influence the other factors.

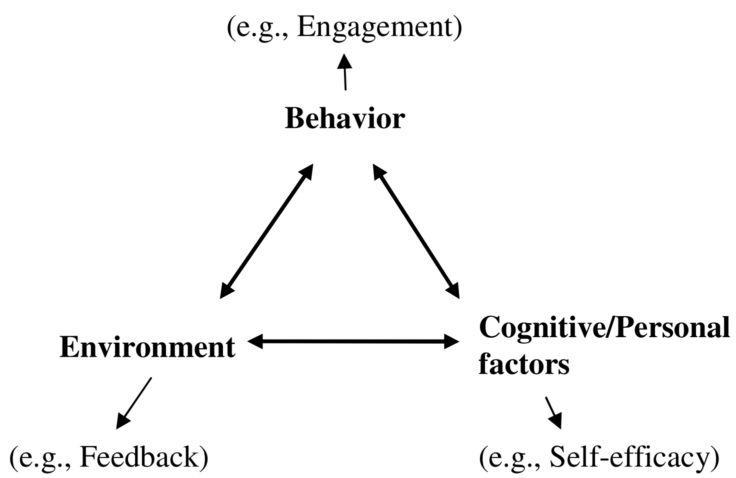

Figure 1. The Social-Cognitive Approach

In literature, several environmental and personal factors are identified to be important for academic motivation. For example, attitudes are positive or negative feelings about an object, a topic or even a person (Petty & Cacioppo, 1981). Strong attitudes alone will not necessarily influence science behavior, but they influence science motivation, which is directly linked to behavior (Koballa & Glynn, 2007). In a summary of motivational constructs in science, Koballa and Glynn (2007) mention several further influential personal factors. Intrinsic motivation depends on arousal, anxiety, interest and curiosity, whereas the extent to which students are motivated depends on students' self-determination, goal-directed behavior, self-regulation and self-efficacy. Other personal factors are competence and attributional beliefs, locus of control (Schunk & Zimmermann, 2006), expectancy-value (Anderman & Wolters, 2006) and goal setting (Alderman, 2008).

In addition to personal factors, Alderman (2008) indicates that environmental factors need to be considered. Thus, students' their sense of belonging, peer group, feedback and task characteristics are related to motivation as well. We will elaborate on cognitive, personal and environmental factors in the following sections, but because each factor is already a broad topic itself, we will do so only shortly.

Cognitive and Personal Factors

Performing a task for its own sake is related to intrinsic motivation, whereas performing a task for a specific purpose (e.g., getting a good grade) is related to extrinsic motivation. However, it is not always easy to draw a clear line between intrinsic and extrinsic motivation, since students often perform tasks for both reasons. They might work on a science project intrinsically because they could choose the topic themselves, but also be extrinsically motivated because they care about the grade they get (Koballa & Glynn, 2007). Interest, curiosity and arousal are requirements for intrinsic motivation and should therefore be considered (Pintrich & Schunk, 1996). The importance of interest and curiosity was also found in a study by Vispoel and Austin (1995). They studied reasons students give for their academic success and failure. Interest or the lack of it seemed to play a fundamental role. At least from the students' perspective, interest is an important factor for their achievements. According to Pintrich and Schunk (1996), interest and curiosity is triggered by surprise and new information that is inconsistent with students' prior knowledge. However, this does not mean, that the more inconsistent the information, the better. If information is too new or complex, students might find it irrelevant and not meaningful. In contrast, if it is too well-known, students might ignore it. Thus, moderately novel science information is best suited for triggering curiosity and interest. With respect to arousal, Koballa and Glynn state that "arousal is a state of physical and psychological readiness for action" (2007, p. 88). The level of arousal is associated with students' performance, because too much arousal leads to anxiety, the feeling of uneasiness and tension. In contrast, if students experience too little arousal, they easily get bored, have daydreams or even fall asleep. While these levels of arousal have negative implications, a counterbalanced level of arousal can enhance science motivation (Cassady & Johnson, 2002).

A related concept to intrinsic and extrinsic motivation is goal orientation. Goal orientation refers to the reasons for engaging in tasks (Anderman, Austin, & Johnson, 2002). There are two different types of goal orientation in educational context, which can influence the achievement actions. Students with learning or mastery goals are concerned with understanding the material, improving skills and increasing competence. Students with performance goals, on the other side, focus on the demonstration of one's competence and focus on the comparison to others. It is the motivation to perform, rather than the motivation to learn (Schunk & Zimmermann, 2006; Alderman, 2008).

Another related model to the reasons why students engage in tasks is the expectancy-value model of achievement motivation. The origin lies in the assumption that the "perceived value of a task is a strong determinant of why an individual would want to become or stay engaged in an academic activity or task" (Anderman & Wolters, 2006, p. 373). According to Eccles and Wigfield (2002), achievement values consist of four different components: attainment value, intrinsic value, utility value and cost. The attainment value pertains to the personal importance to perform well on a task. A task that matches the self-schema and confirms the self-belief of the student has a higher attainment value than a task without these confirmations. The intrinsic value is the pleasure that students experience when performing a task. The utility value refers to the usefulness of a task and is linked to current and future goals (e.g., career at university, good grades, please family). It is important to mention that these values are independent from intrinsic values, because some students accomplish tasks that they do not like, but that are useful for another goal. Accordingly, the utility value represents extrinsic reasons for doing a task. Finally, costs are the negative aspects of engagement in a task, such as anxiety to fail or the amount of effort required (Eccles & Wigfield, 2002). Thus, in the scientific context, students are more motivated when they are interested in science and the task contains a scientific topic (attainment value), when the task is exciting (intrinsic value) and when the task supports students' aims (e.g., getting a good science diploma; utility value). At the same time, costs should be low.

Next to the reason why students engage in tasks, there are students' beliefs about the causes of the outcomes of their efforts. They are named attributional beliefs and are classified into three dimensions: internal/external, stable/unstable and controllable/uncontrollable. They refer to assumptions about whether a cause lies within or outside a person, if it is constant over time or not and if the individual can influence the cause or not (Weiner, 1992). For instance, winning the lottery is mostly caused by luck, which is an external, unstable and uncontrollable factor. Success can be attributed to internal, stable and uncontrollable factors (as ability). They often belief, that they need a certain ability to perform well in science classes. Thus, students do not belief having any influence upon their achievements in these classes and consequently are not motivated very well. A more favorable attribution for academic success is effort, because it is internal, but also changeable and controllable. Students who attribute their achievements to effort are more motivated, since they can directly influence their achievements (Alderman, 2008).

Tightly related to the control dimension is the concept of locus of control. It is the general assumption about the control over outcomes. Depending on the situation, people may believe that the outcomes are independent of their behavior (external locus of control) or that they can be influenced by people's actions (internal locus of control). As in the attribution theory, students with an internal locus of control are more motivated to engage and put effort in the task, than students with an external locus of control (Schunk & Zimmermann, 2006).

Whereas attributional control beliefs and locus of control are about the outcomes of a task, there is also the belief of control over the task itself. This control over what we do and how we do it is called self-determination (Reeve, Hamm, & Nix, 2003). For example, students should be allowed to make suggestions how to study a certain scientific phenomenon. According to Deci (1996) it can promote students' need to feel competent and independent (most students gain these feelings from intrinsically motivated activities), which leads to higher achievement and positive feelings. Thus, self-determination correlates with the feeling of intrinsic motivation. Lack of self-determination affects intrinsic motivation negatively (Koballa & Glynn, 2007).

After students start working on a task, motivation can direct and regulate the persistence of behavior (Alderman, 2008). However, the regulation of behavior is a concept itself and is named self-regulated learning. It consists of two components of cognitive activity: regulatory strategy use (monitoring, planning) and cognitive strategy use (organizing, elaborating). Through these strategies, students knowing what they want to accomplish when learning a subject, can control their progress and adjust to their learning goals (Neber & Schommer-Aikins, 2002). Here, goals refer to the actual outcomes students try to achieve (Dweck, 1992). They are especially important for motivation, because they provide information about current performance. For instance, if the goal is to write one page a day of a 30 page paper, students can monitor their progress and infer how much more has to be done in order to achieve the goal. As a result, goals promote persistence, effort and development of strategies and consequently motivation (Alderman, 2008).

Finally, the most important personal factors are expectancy beliefs. Paris, Byrnes and Paris (2001) state that the perception of ability and effort influences the perception of one’s competence. The expectancy about competence is named self-efficacy and refers to the belief in the ability to perform a certain task (Bandura, 1997). As in the case of attributions, if students expect to have certain competencies and thus have high self-efficacy, they are motivated to engage and put effort in tasks where these competencies are needed (Bandura, 1986). Students who do not believe in their scientific skills, will not be motivated to engage in scientific tasks.

Environmental Factors

Environmental factors are variables that lie outside of the students, but still influence their motivation to learn. The most obvious environmental factor is sense of belonging. It contains the feeling of acceptance, respect and support by others (Goodenow & Grady, 1993). Students with this sense of belonging are more likely to adopt goals that are valued by the school, which in turn has a positive influence on motivation. Thus, if students' basic needs for belonging are fulfilled, motivation is enhanced (Faircloth & Hamm, 2005).

Peers have a strong influence on the sense of belonging. Since "peers can encourage each other to view school experiences positively or negatively" (Alderman, 2008, p. 209), they also have a direct influence on motivation. Farrell (1990) observed this negative influence in his work with student drop-outs. He found that students hid their academic abilities to avoid rejection by their friends. Thus, friends can reinforce each other, either to like or dislike scientific tasks.

Whether tasks are liked or not, does not only depend on friends, but also on certain task characteristics. The setup and content of tasks and other learning activities influence students' motivational experience, because it can attract interest and attention (Alderman, 2008). Newman, Wehlage and Lamborn (1992) state that task should be "meaningful, valuable, significant and worthy of one's effort" (p. 23). According to them, such authentic work is connected to the real world of students. Thus, authentic tasks contain some sort of usability. This concept is related to the expectancy-value model. Explaining a scientific phenomenon by using examples students can identify with, will lead to enhanced attention and motivation.

Another concept that is related to environmental factors is feedback. According to Brookhart and DeVoge (1999), good feedback helps students to understand how they are doing, how they can improve and why something was right or wrong. Therefore, comments of praise and blame are not enough. Good feedback helps students to make good attributions, keeping record of progress (as in the case of goal setting or self-regulation) and in turn enhances self-efficacy (Alderman, 2008). Altogether feedback is an important factor, because it intersects with many other motivational factors mentioned above.

The Need for a New Science Motivation Questionnaire

From studies as TIMSS or PISA it can be concluded that there are attitudinal and motivational issues in Dutch science education. The Bètapartners program tries to cope with these problems. To determine the effectiveness of such programs, a precise assessment of science motivation could be very helpful. Motivation is the internal state that activates, directs and regulates the persistence of behavior and the short overview presented above indicates that many constructs are related to students' motivation. As shown by the examples, these constructs may also be relevant for science motivation. Two existing motivation questionnaires served as orientation for this study: the Science Motivation Questionnaire (SMQ; Glynn, Taasoobshirazi, & Brickman, 2009) and the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & DeGroot, 1990). Motivational concepts that are included in the SMQ are intrinsic motivation, personal relevance, self-efficacy, assessment anxiety, self-determination, career motivation and grade motivation. Motivational concepts that are included in the MSLQ are intrinsic and extrinsic goal orientation, task value, control beliefs, self-efficacy and test anxiety. Both questionnaires cover important personal and cognitive factors; however environmental factors are not included. According to Eccles and Wigfield (2002) the context of students is essential to understand students motivation, which also relates to the social-cognitive approach we adopted in this study (Perry, et al., 2006). Students are not independent from their context and environmental influence could have positive and negative effects on students' motivation. For example, low self-efficacy might be a result of weak teacher feedback (if the teacher does not emphasize progress). At the same time, low self-efficacy might be the result of missing goal-setting, which belongs to the personal factors. However, feedback about the progress or the awareness of achieved goals, strengthens the expectancy of performance ability. Consequently, self-efficacy and motivation are enhanced. Including both personal and environmental factors in one questionnaire thus results in a broader assessment of students' science motivation. The motivation questionnaires mentioned above may assess a motivation score, but do not provide information on environmental factors, they only focus only on personal factors. No studies were found that combines both personal and environmental factors in assessing science motivation. Therefore, this study makes the attempt for such a combination. Intrinsic and extrinsic motivation, goal orientation, attitude, self-efficacy, attributional beliefs, self-regulation, goal setting, anxiety, self-determination, expectancy-value, sense of belonging, peer support, feedback and task characteristics will be included in the development of the questionnaire. Evidence for the validity of the interpretation of the test score, reliability and internal consistency measures will also be gathered. Furthermore, additional data (gender, age, school profile and year of education) will be used to assess group differences. The target group will be students in secondary education who have access to higher education and university students. Two advantages result from the inclusion of university students. First, they can be used for further validation, because it can be expected that university students reach higher scores on the questionnaire. Second, it will indicate the possible age-range for the questionnaire.

The instrument might be useful in relation to the problem stated at the beginning of the introduction, namely the decrease in the number of science students in higher education in the

Netherlands. The questionnaire will provide for a differentiated view on science motivation, giving policy makers and others involved more information on how to design and improve interventions to solve this problem.

Method

Participants

Two hundred and seventy three students from five different schools and one university were asked to fill out the questionnaire. The schools participated in the program of Bètapartners and were found via www.betapartners.nl. Participation was voluntary. Thirty students did not answer any of the motivation questions and therefore, were not taken into account. An inclusion criterion was science experience. Three items were generated to assess science experience (items 7 "I know what is meant by doing research", item 8 "I already did research on my own", item 9 "I can remember very well the last time I did research"). A cut-off score of two of the four point Likert scale and the inclusion of all three science experience items resulted in exclusion of 115 participants. To prevent this information loss, only the most meaningful item was used as indicator for science experience (item 7) and the cut-off score was set at one. Thirteen students *strongly disagreed* with item 7 and were therefore excluded. Of the remaining 230 participants, 58.3% was female (n = 134) and 41.7% was male (n = 96). The students' age ranged from 13.59 till 28.61 years (*M*: 17.33, *SD*: 2.47). All participants attended a secondary school (HAVO, VWO, Gymnasium, Atheneum[1]) or university[2]. Frequency statistics are shown in Table 1. Students from grade 9 or higher were included, since this is the transition to the senior classes

[1] VWO, Gymnasium and Atheneum provide direct access to university education. HAVO provides access to vocational education.

[2] The studies of students were psychology or communication studies.

(grade 10, 11 and 12). Also students decide during the third school year for a school profile for the next 2 or 3 years. Frequency statistics for the year of education is shown in Table 2.

Table 1.
Frequencies of School Type

School type	Frequency	Percent
Gymnasium	19	8.3
Atheneum	42	18.3
HAVO	92	40.0
VWO	38	16.5
University	39	17.0
Total	230	100

Note. Gymnasium, Atheneum, HAVO and VWO are different types of Dutch secondary education.

Table 2.
Frequencies of Year of Education

Year of education	Frequency	Percent
Grade 9	70	30.4
Grade 10	50	21.7
Grade 11	71	30.9
1st year university	13	5.7
2nd year university	10	4.3
3rd year university	9	3.9
4th year university	6	2.6
7th year university	1	0.4
Total	230	100

Materials

Intrinsic and extrinsic motivation, goal orientation, attitude, self-efficacy, attributional beliefs, self-regulation, goal setting, anxiety, self-determination, expectancy-value, sense of belonging, peer support, feedback and task characteristics were included in the questionnaire. Items for these concepts were adopted from already existing questionnaires. All of these questionnaires were in English, one was already in Dutch (Dutch adaptation of the general self-efficacy scale[3], Schwarzer & Jerusalem, 1995). Items were translated in Dutch by a native speaker who was also proficient in the English language. When necessary, items were adapted to Likert scale format. An overview of the subscales and from which source they originated is shown in Table 3. Five additional attribution items were added. They were developed for further information that were not part of Russell's causal dimension scale (1982).

Table 3.
Subscales and Sources

Scale	Sources	Number of adopted Items
Goal Orientation	Achievement Goal Questionnaire Items (Elliot & McGregor, 2001)	10
Expectancy value	Expectancy value (Wigfield, 1994)	9
Self-Efficacy	Dutch Adaptation of the General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995)	3
	Science Motivation Questionnaire (Glynn, Taasoobshirazi, & Brickman, 2009)	5
Intrinsic Motivation	Science Motivation Questionnaire (Glynn, et al., 2009)	5
Extrinsic Motivation	Science Motivation Questionnaire (Glynn, et al., 2009)	4
Anxiety	Science Motivation Questionnaire (Glynn, et al., 2009)	5

[3] Self-efficacy questionnaires are available in many different languages, because it is one of the best studied motivational concepts.

Table 3. (continued)

Scale	Sources	Number of adopted Items
Attribution	Causal Dimension Scale (Russell, 1982)	9
Goal Setting	Goal Setting Assessment (Quereau, 2010)	7
Attitude	Science Attitude Questionnaire (Walma-van der Molen, 2007)	5
Self-Determination	Self-Determination Scale (Sheldon & Deci, 2010)	5
Self-Regulation	Motivated Strategies for Learning Questionnaire (Pintrich & DeGroot, 1990)	7
Task	Motivated Strategies for Learning Questionnaire (Pintrich & DeGroot, 1990)	6
Feedback	Assignment Feedback Questionnaire (Lizzio & Wilson, 2008)	14
Peer Support	Assignment Feedback Questionnaire (Lizzio & Wilson, 2008)	3
	Attitude of Friends toward Science Subscale (Talton & Simpson, 1985)	2
	Science Attitude Questionnaire (Walma-van der Molen, 2007)	3
Sense of Belonging	Encouragement Scale (Evans, Dedrick, & Epstein, 1997)	4

The questionnaire consisted of three parts. The first part included 11 biographical questions concerning gender, age, grade, type and year of education, school profile and science experience. Next, 111 concept related questions followed, containing the translated subscales and presented in randomized order. In the third part, students answered general, but still science related questions which served to validate the interpretation of the test score. These questions could be grouped in two categories. The first category contained 26 questions concerning activities (e.g., “How regular do you read the following magazines?”), ideas (e.g., “Could you imagine being a scientist?") and interests (e.g., "Are you interested in new scientific findings?"). The second category contained 22 questions from a Dutch science attitude questionnaire (Walma-van der Molen, 2007). Subscales of this questionnaire and their Cronbach alpha's as reported by Walma-van der Molen are: gender stereotypical view about science (gender; α = 0.85), difficulty of science (difficulty; α = .60), importance of science (importance; α = .70), pleasure of doing science (pleasure; α = .88), plans about future science carrier (future; α = .84). See Appendix A for an overview of all questions. Due to the number of items (in total 171) a four-point Likert scale was used. Using a five or six-point scale, makes answering more difficult, since students have more possibilities to answer (DeVellis, 2003). Biographical and validation questions (part one and part three of the questionnaire) contained some open and yes/no questions. The questionnaire was administered online with ThesisTool (van Rixtel, 2010). The questionnaire was named Dutch Science Motivation Questionnaire (DSMQ, see Appendix B).

Procedure

Before students filled out the questionnaire during mentor hours, students were informed by their mentors about the aim of the study. Mentors supervised these sessions in the schools' computer lab. To complete the questionnaire, students spent approximately 30 minutes. No debriefing was done, but students had the possibility to write down their opinion about the questionnaire and questions could be asked via email to the researcher. University students filled out the questionnaire at home via the online tool or at university using paper and pencil. Either way, they were informed about the aim of the study. Participation was voluntary.

Data Analysis

Evidence for the validity of the test score indicates to what extent the predicted feature is measured (DeVellis, 2003). Two kinds of validity were used: construct validity and criterion validity. Construct validity is theory driven and defined as the fit between the theoretical structure and the empirical structure.

As inclusion criterion for factor analysis, each item was first analyzed for normal distribution (skewness, kurtosis), the range of acceptable mean and intercorrelation. Then, Principle Component Analysis (PCA) and varimax rotation were used in order to clarify the underlying structure. The Kaiser-Guttman rule was used for extracting factors and thus, eigenvalues had to be greater than one to be considered as common factors (Child, 2006). For a clear interpretation of these factors, specific inclusion criteria were used concerning the heights of the factor loadings. In literature, many different criteria for the significance of factor loadings can be found. General loadings of .30 are assumed as a minimum level, loadings of .40 are assumed more important and loadings of .50 and greater are assumed practically significant (see e.g., Backhaus, Erichson, & Plinke, 2006; Hair, Anderson, Tatham, & Black, 1995). However, Hair et al. (1995) suggest to relate the significance of loadings on the sample size. For the sample size of this study, they suggest considering factor loadings of .40 as significant. Items that loaded significant on two factors were excluded in order to make interpretation as clear as possible. Possibly due to the large number of items, there were students who had overlooked or had skipped items. Therefore, cases with missing values were excluded pairwise instead of listwise to prevent information loss. With pairwise exclusion, data of 188 to 216 respondents could be analyzed, listwise exclusion should have resulted in only 147 complete questionnaires.

Criterion validity is defined as the association between science motivation scores and other relevant external variables (DeVellis, 2003). All Likert scores were summed up and divided by the total number of included items to calculate an overall science motivation score. This score was used as the dependent variable. To study whether the interpretation of the test score was valid, general questions concerning science-related activities, ideas and interests, and scores on the Dutch science attitude questionnaire (Walma-van der Molen, 2007) were related to the science motivation score. During the validation with the different questions, missing values were excluded listwise (n = 100; 43% male and 57% female students; mean age = 17.05). Otherwise this might have influenced the mean science motivation score and hence, the validation results.

In his paper, *Misunderstandings Concerning Cronbach's Alpha* Sijtsma (2009) discusses the most frequently made error with Cronbach's alpha. The alpha value is often seen as a measure for internal consistency of a scale. That is not true, since inconsistent scales also can have high alpha values. Sijtsma gives the solution to examine internal consistency with factor analysis and rather taking Cronbach's alpha as an indicator of reliability of the subscales. However, he warns that actual reliability then often is underestimated (Sijtsma, 2009). For these reasons, we decided to investigate internal consistency and reliability in relation to construct validity. The Split-Half method (DeVellis, 2003) was used as a second measure of reliability.

To determine motivational group differences in age, school type, year of education and chosen school profile, univariate analysis of variance and a post hoc test (Bonferroni) were used.

Results

Construct Validity

First, all items of the questionnaire were examined for intercorrelations lower than $r = .90$ (Child, 2006). No items were excluded based on this criterion. Then, skewness and kurtosis served as indicators of normality for each single item, which is an assumption underlying principal component analysis (Hatcher, 1994). According to Kline (1997), absolute skewness values greater than 3 and absolute kurtosis values greater than 8 indicate normality problems. No item fell out of this range. Also, all items lay in the range of the acceptable mean, which was defined here between 20 and 80 percent of the range in the mean. In this case, all items lay between 1.8 and 3.2. So, all items were used for factor analysis.

In order to find the underlying structure of the items, factor analysis was used. A first trial with all 111 items resulted in 31 factors (eigenvalue > 1) and no interpretable structure. Neither the Kaiser-Meyer-Olkin (KMO) value nor an Anti-image matrix could be calculated, probably due to the large number of items for the small number of participants. The standard procedure of deleting items one by one was not useful, because the sequence of deletion influences the resulting factor structure. So, no clear fit between the theoretical and the empirical structure could be detected. Therefore, a different approach was used to make sense out of the data and to select items that would show a clear factor structure.

Child (2006) suggests investigating the correlation matrix. Patterns (or clusters) of high correlations between certain items may indicate underlying factors. However, this has to be done with caution, as Child states: “Eyeballing R matrices is not a standard statistical procedure! Hidden beneath the correlation patterns so obvious to the naked eye are other relationships not visible even to the most observant.” (Child, 2006, p. 15)

Thus, the first step was to identify patterns in the correlation matrix. This was done by examining the intercorrelations between the items. Items that belonged to the same theoretical construct or that were comparable in their content were considered to be similar. The aim was to identify items that correlated high with similar items (> .50), but low with dissimilar items (< .50). Items that met this criterion provided a framework for further investigation.

Following this procedure, the resulting framework existed of 16 items and 10 factors that could be interpreted as measuring self-efficacy, intrinsic and extrinsic motivation, anxiety, goal setting, self-regulation, utility value, feedback, sense of belonging and self-determination.

In the second step, each remaining item was added one by one to the framework to investigate changes in the structure. Items that had significant contributions to the factors (loading of .40 on only one factor) were included. So, factor analysis started with only a few items resulting from analysis of the correlation matrix. To these items, each time one item was added before another factor analysis was conducted. If the item matched the structure and made contributions to it, the item was kept. To this new structure, another remaining item was added and so on. Some included items also loaded significant on one or another factor (higher than .40), depending on which newer item was added. Item which loadings switched several times between factors at each analysis, were excluded. Sometimes, new factors emerged. A factor needed to be defined by at least three items (Child, 2006). Some items did not fit into the framework and were excluded.

As a result of this procedure, the final factor structure contained 30 items and 7 factors (see Table 4). As criterion for the factor extraction, the Kaiser-Guttman rule was used. The Scree Test (Child, 2006) was adopted to verify the choice of extraction. This method also resulted in seven factors.

Table 4.
Final Factor Structure

	Factor						
Item	1	2	3	4	5	6	7
77. In general, I like doing science.	**.69**						
89. When researching, I like finding out new things.	**.60**						
71. I like researching things.	**.81**						
91. I love doing research.	**.74**						
88. I think that the content of a research tasks is useful to me.	**.57**				.34		
80. Research is useful to me.	**.78**						
90. Compared to other learning activities, science is very useful.	**.56**			.31		.30	
35. I expect to do science as well as other students.		**.74**					
19. I believe I can get an "A" for a research task.		**.78**					
22. Concerning research, I am one of the best students in class.		**.70**					
13. My teachers show me how to critically assess my own research.			**.81**				
52. My teachers give critical feedback and suggestions concerning the quality of my research.			**.42**				
54. My teachers acknowledged my good points and ideas in my research.	.34		**.65**				
68. My teachers recognized the effort I put in research tasks.			**.53**	.35			

Table 4. (continued)

Item	Factor						
	1	2	3	4	5	6	7
74. Whatever happens, I believe I can bring my research to a good end.				**.54**			
49. I am confident that I can master unexpected events during a research task.				**.59**			
48. I think I can learn to do science.	.35			**.54**			
43. When receiving a good grade for my research, I am responsible for it.				**.73**			
45. Even when research materials are dull and uninteresting, I keep working until I finish.				**.59**			
31. Before I start my research, I think of current short -term and long -term goals.					**.69**		
62. I have a clear idea of what has to be accomplished during a research task.					**.60**		
97. During my research I keep a "to do list" for things that need to be done.					**.61**		
115. Before I begin researching I think about the things I will need to do.					**.65**		
121. My best friend likes doing science.	.35					**.70**	
56. My friends find science interesting.	.33					**.68**	
108. My friends like to come up with new ideas during research.						**.81**	
104. My friends like to find out new things during research.	.32					**.74**	

Table 4. (continued)

Item	Factor 1	2	3	4	5	6	7
64. During research, it is important for me to do well compared to other students in class.							**.85**
70. I want to do better in science than other students.							**.80**
84. I like to do better than the other students on a research task.							**.72**

Note: Items translated in English, for Dutch translation, see Appendix A.

Interpretation of Factor Matrix

To investigate the stability of the subscales, orthogonal (varimax) rotation was used as well as an oblique (promax) rotation method. If both methods reveal the same factor structure, it can be seen as evidence for the stability of the factors found (Bühner, 2006). This was the case[4]. Since varimax rotation assumes independence between factors (Bühner, 2006), this matrix was used for further interpretation. The KMO value of the factor structure was .88, which is very good (Dziuban & Shirkey, 1974).

Significant factor loadings in the matrix ranged from .42 to .85. Some items also loaded on other factors, but since loadings < .40 were considered to have no significance for this sample size (Hair et al., 1995) their loading was ignored during interpretation of the other factors.

Altogether, the 7 factors explain 62.64% of the total variance. Values around 60% are considered satisfactory in behavioral sciences (Child, 2006). The eigenvalue associated with each factor, the percentage of variance explained by each factor and the cumulative percentage

[4] During promax rotation, the factor loading of item 52 on factor 3 decreased to .37 and therefore, was below the minimum level of considered significance. Because the factor structure stayed constant, the item was kept.

of variance are shown in Table 5. In the next, we present the items of each factor and interpret their common content.

Table 5.
Results of Factor Analysis (Varimax Rotation)

Factor	Eigenvalue	% of Variance	Cumulative %
Factor 1	4.38	14.62	14.62
Factor 2	3.01	10.04	24.65
Factor 3	2.56	8.55	33.21
Factor 4	2.50	8.34	41.56
Factor 5	2.26	7.53	49.09
Factor 6	2.14	7.14	56.23
Factor 7	1.92	6.41	62.64

Factor 1 contains items what students think of research, if they like it (item 77, 89, 71, 91) and if research is seen as useful (item 88, 80, 90). This factor was labeled *intrinsic task motivation* (item 77, 89, 71, 91) and *utility value* (item 88, 80, 90). Factor 2 contains the assumption of students' expectancies about their performance. This factor was labeled as *competence belief*. Factor 3 contains the constructive and emotional support by the teacher. However, because these two concepts load on the same factor, the label *feedback* was used. Factor 4 contains students' assumptions about their coping potential and responsibility. The content shows that students high on this factor believe that they are responsible for managing a research situation, but also that they believe being able to do so. Thus, the factor was labeled as *self efficacy*. Factor 5 contains items that show students' habits of thinking about research tasks before performing them. Because the questions relate to goals and how to work towards them, the factor was labeled as *goal setting*. Factor 6 contains the attitudes of the students' friends. It is assumed that positive attitudes of friends will motivate and support the student (Alderman, 2008). Hence, the factor was labeled as *peer support*. Factor 7 refers to students' need of performing better than their classmates. Therefore, the factor was labeled as *performance motivation*.

The factor analysis has shown which questions belong to one factor. According to Sijtsma (2009) the factor structure points to the internal consistency of the subscales and Cronbach's alpha should be used to measure reliability of the subscales. The results range from .66 (feedback) to .86 (intrinsic task motivation). Alfa for the scale as a whole was .91. All values are shown in Table 6. Calculating split-half reliability (Spearman-Brown) yielded a high correlation between the two halves of the total scale (r =.85). According to Fesseni (1997) values from .80 and higher are preferable.

Table 6.
Reliability of the Scales

Subscale	Cronbach's alpha
Intrinsic task motivation	.86
Utility value	.81
Competence belief	.72
Feedback	.66
Self efficacy	.71
Goal setting	.67
Peer support	.84
Performance motivation	.85
Total scale	.91

Criterion Validity

Scores on 22 criterion related items were correlated with the mean science motivation score (see Table 5). The self estimated motivation (item 123) showed a moderate correlation (n = 142, r = .61, $p < 0.01$) with students' motivation score. Low to moderate correlations were found with interest in new scientific findings (item 142; n = 147, r = .27, $p < 0.01$), whether science is a topic of conversation (item 146; n = 147, r = .25, $p < 0.01$), whether students could picture themselves doing a scientific study (item 147; n = 120, r = .45, $p < 0.01$) and how often they watch the Discovery Channel (item 130; n = 147, r = .18, $p < 0.05$). The general question pertaining to the frequency of science-related activities in spare time (item 143) showed a weak negative correlation (n = 147, r = -.16, $p < 0.05$), which was contrary to the expectations. However, the negative correlation can be explained by the distribution of answers. Only 15% of students answered this question with *yes*. No significant correlation could be found between students' motivation score and their school subject-related spare time activities (item 129, 131 – 141), regularity of reading scientific magazines (items 124 – 128) and grade (item 11) on the last science project. Item 144 ("What do you do in your spare time?"), item 145 ("Which study do you want to do after your graduation?") and item 148 ("What profession do you want to pursue later in life?") were open questions. Because only very few students gave serious answers (11, 50 and 25, respectively) these items were ignored in the analysis.

Students' science motivation score was also correlated with scores of the five subscales of the science attitude questionnaire (Walma-van der Molen, 2007). Subscale 3 (importance), subscale 4 (pleasure) and subscale 5 (future) revealed moderate correlations. Hence, students who valued science as more important, had also higher science motivation scores (n = 132, r = .39, $p < 0.01$). The same applied to pleasure of doing science (n = 132, r = .64, $p < 0.01$) and plans about a possible science carrier (n = 132, r = .50, $p < 0.01$). However, subscale 1 (gender) and subscale 2 (difficulty) showed no significant correlations. All criteria related results are shown in Table 7.

Table 7.
Correlations between Science Motivation Score and Criterion Related Items

Item	Correlation	
11. What was your last science grade?	.20	
123. I think I am very motivated to do science	.61	**
124 – 128 On what regular basis do you read the following magazines?		
Quest	.03	
Kijk	.04	
Explore	.11	
Wetenschap in Beeld	.06	
NWT (Natuurwetenschap & Techniek)	.08	
129 – 130 On what regular basis you watch the following TV programs?		
National Geographic	.16	
Discovery channel	.18	*
131 – 141 Do you delve into one of the following school subjects in your spare time?		
Biology	.10	
Mathematics	-.01	
Technology	-.04	
Physics	.04	
Chemistry	.11	
History	-.10	
Economy	-.13	
Geography	-.10	
Social science	.03	
Computer science	-.06	
Languages	-.12	

Table 7. (continued)

Item	Correlation	
142. Are you interested in new scientific findings?	.27	**
143. Do you do something in you spare time that has to do with research?	-.16	*
146. Are science and research at your home topic of conversation?	.25	**
147. Can you picture yourself, doing a study where research plays a role?	.45	**
Attitude subscale		
Gender	.16	
Difficulty	.09	
Pleasure	.61	**
Future	.48	**
Importance	.47	**

* *p* < .05. ** *p* < .01

Effects of Age, Gender, School Type and School Profile

A small, but significant correlation between age and motivational score (n = 144, $r = .26$, $p < .01$) existed. Because it can be expected that the effect of age corresponds to the year of education, an ANOVA was applied. The ANOVA revealed significant differences between groups ($F(7, 139) = 5.68$, $p < .01$). Multiple comparisons (using Bonferroni) showed that grade 9 scored significantly lower on the questionnaire than grade 10 and 11 of schools, first, third and fourth year of university. No other group differences were found. An ANOVA using type of education as independent variable (VWO, HAVO, Gymnasium, Atheneum, university) revealed no differences ($F(4, 142) = 2.17$, $p = .08$). Because no clear differences could be found when taking all groups into account, the motivation scores of the students in school were taken together and compared to the scores of university students. Although the difference in science motivation score between students in secondary education and university students was small (mean score of school students: 2.5, $SD = 0.44$; mean score of university students: 2.7; $SD = 0.40$), the difference was significant ($F(1, 145) = 6.84$, $p < .01$). No effects of gender ($F(1, 145) = 0.09$, $p = .76$) and school profile ($F(3, 106) = 1.98$, $p = .13$) were found. No significant interaction effects could be found. An overview over the mean motivation score of the different groups and their standard deviation is shown in Table 8.

Table 8.
Motivation Scores of Different Groups

Group	Mean motivation score	Minimum	Maximum	SD	n
Gender					
Male	2.5	1.0	3.4	0.44	57
Female	2.5	1.6	3.8	0.44	90
Type of education					
Secondary education	2.5	1.0	3.8	0.44	110
University	2.7	1.8	3.4	0.40	37
School profile					
Culture and Society	2.5	1.6	3.8	0.50	29
Economy and Society	2.4	1.2	3.0	0.40	31
Nature and Health	2.6	1.0	3.7	0.48	28
Nature and Technology	2.5	2.2	3.0	0.28	12

Note. A school profile is a subject area students choose in the ninth grade. In the eleventh or twelfth grade, they graduate in this particular area.

Conclusion and Discussion

The aim of the study was the development and validation of a Dutch science motivation questionnaire. The need was inspired by the results of the TIMSS 2007 and PISA 2006 projects. In these projects, it was found that Dutch adolescent students have negative attitudes for science classes and less confidence in their performance, compared to other European countries. Based on these two problems, the development of a Dutch science motivation questionnaire seemed useful, for example to inform policy makers and others involved on how to design and improve interventions to solve this problem. The social cognitive approach was used as a basis to develop the questionnaire. This model includes both personal and environmental factors. Other instruments often include personal factors only. Items stemming from different sources and related to fourteen personal and environmental factors were translated in Dutch, resulting in 111 concept related items. Careful item selection and factor analysis resulted in 30 items and 7 identifiable factors. The KMO value of .88 indicated that assessing factor analysis on the data was appropriate. Factor loading ranged from .42 to .85 and altogether, the item explained 62.64% of the total variance. These factors were: *intrinsic task motivation*, *utility value*, *competence belief*, *feedback*, *self efficacy*, *goal setting*, *peer support* and *performance motivation*. Thus, construct validation confirmed the assumption of personal and environmental factors (feedback and peer support). The factor structure also points to the internal consistency of the found factors. Cronbach's alpha was used as reliability measure of the subscales. The alpha's ranged from .66 to .86. The split-half reliability (Spearman-Brown) resulted in high correlation between the two halves of the total scale (r =.85).

Initial evidence for criterion validity emerged, science motivation scores correlated with measures of science activities, ideas and interest, as well as science attitude, supporting the validity of the interpretation of the test score. Small group effects for age and year of education were found. University students scored significantly higher on the questionnaire than students in schools. The results comply with the expectations that students, who already have chosen for higher scientific education, have higher motivation. It might also be that motivated students more often choose a scientific study, but the mere-exposure effect (Clore & Schnall, 2005) may also have caused this difference. The mere exposure effect assumes that the more familiar with a stimulus, the more this stimulus is preferred. Nevertheless, the difference found, supports criterion validity. No effects of gender or school profile could be found.

The new questionnaire seems to be a suitable instrument for science motivation assessment in secondary and higher education in the Netherlands.

The inclusion of environmental factors has theoretical implications, since other motivation questionnaires only concentrate on personal factors. Nevertheless, a comparison with the SMQ (Glynn, et al., 2009) and the MSLQ (Pintrich & DeGroot, 1990) reveals important similarities. Both questionnaires contain the concepts of intrinsic and extrinsic motivation, self-efficacy and utility value. Especially interesting is that in the DSMQ as well as in the SMQ, intrisic task motivation and utility value are found to be one factor instead of two. This can be evidence for the strong relationship between liking science (intrinsic task motivation) and the perceived relevance of it (utility value). Because this relationship returns in the two science motivation questionnaires, it might be especially important in the science context. An explanation for this might be the nature of science. Often science is related to practical and utilitarian topics. It results in knowledge that could contribute to the solution of practical issues. For example, this newly developed questionnaire aims to simplify motivation assessment, which might be useful in a certain context. Thus, the utility for individuals is often present in scientific research.

However, differences between the questionnaires also exist. Both, the SMQ and the MSLQ have included the concept of control beliefs (responsibility for and control over actions) and the concept of anxiety. The DSMQ does not include these important concepts.

During analysis two items concerning self-determination loaded significantly on another factor (item 69 “During research, I can decide how to approach the task”, item 92 “I can determine how to set up my research“). Because no further item could be found, the factor was not defined by at least three items and both items were excluded. In further validation studies, these two items should be considered next to new self-determination items.

Differences between thestructure of the different questionnaires might also result from the different samples, educational systems or even cultures[5]. The DSMQ does not include the concepts of attributional beliefs, self-regulation, sense of belonging and task characteristics. A theoretical reason might be that these concepts are strongly related to other concepts and consequently are not independent factors. More likely, it is a result of the general limitations of the study. We will consider them now.

First, there have been relatively few participants for the large number of items. Comrey (1973) characterizes a sample of 100 as poor, 200 as fair, 300 as good, 500 as very good and 1000 as excellent. In general, the more items are included, the more participants are needed (DeVellis, 2003). Perhaps, as a consequence, only the most obvious factors were found, whereas other factors stayed hidden. Second, many items seemed to be too similar in content, although belonging to different concepts originating from different source questionnaires. This similarity

[5] The samples of the SMQ and the MSLQ existed of American university students, whereas our sample mainly existed of Dutch students from secondary education.

was also criticized by the participating students. A more thorough selection at the outset of the study might have resulted in a shorter initial questionnaire, which would have been easier to fill in and to analyze. Third, depending on the sequence of adding or deleting items, the analysis might have resulted in a different factor structure. Still, the found structure seems to be a good reflection of science motivation. Fourth, there were many missing values in the data set. This could have been avoided by using a survey tool that does not allow missing values. Otherwise, given the large number of items, this could have led to frustration in participants. Finally, participating schools were found via the Bètapartners program, which aims to make science more interesting. Therefore, this sample might have influenced students' motivation score positively. However, items showed normal distribution and so no negative consequences concerning the factor structure are expected.

Despite the limitations, a reliable and stable factor structure with seven important concepts was found. This structure can be used as a basis for further research. The remaining concepts should be carefully studied again, because they might still play an important role. The reasons why they did not return in the final factor structure could not be clarified. However, the most obvious reason is the small number of participants. Therefore, the items concerning task characteristics, sense of belonging, extrinsic motivation, anxiety, attribution, self-determination and self-regulation should be added again. Factor analysis could show which concepts still seems to be important. Further validation studies should also focus on broader target groups (e.g., including Ph.D. students) and different criterion related measures (e.g., science skills tests, external assessments).

As a practical implication, the questionnaire could be used for the evaluation of science encouragement programs. As already mentioned in the Introduction section, one example is the

Bètapartners program. The aim of this program, to increase the number of students in science related school profiles, shall be achieved by making science classes more interesting and challenging (Bètapartners, 2010). One expectation of such programs would be the increase of science motivation and thus, the effectiveness regarding this expectation could be evaluated with the DSMQ. An advantage in this respect is that the questionnaire also includes the assessment of environmental factors (feedback and peer support). This sharpens the awareness for environmental influences on science motivation, which might also contribute to a more optimal design of intervention programs.

With the development and validation of this Dutch science motivation questionnaire we wanted to emphasize the importance of personal and environmental factors with respect to science motivation. Although the questionnaire does not reflect all of the theoretical expectations, we feel we have created a sound basis for the assessment of science motivation for Dutch students in secondary and higher education.

References

Alderman, K. M. (2008). *Motivation for achievement: possibilities for teaching and learning* (3rd ed.). New York: Routledge.

Anderman, E. M., & Wolters, C. A. (2006). Goals, values, and effect: influences on student motivation. In P. A. Alexander, & P. H. Winne, *Handbook of educational psychology* (2nd ed., pp. 369-389). Mahwah: Lawrence Erlbaum Associates.

Anderman, E. M., Austin, C. C., & Johnson, D. M. (2002). The development of goal orientation. In A. Wigfield, & J. S. Eccles, *Development of achievement motivation* (pp. 197-220). San Diego: Academic Press.

Backhaus, K., Erichson, B., & Plinke, R. (2006). *Multivariate Analysemethoden. Eine anwendungsorientierte Einführung.* (11th ed.). Berlin: Springer.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Bandura, A. (1986). *Social foundations of thought and action.* Englewood Cliffs: Prentice-Hall.

Bètapartners. (2010, May 29). *Bètapartners.* Retrieved May 29, 2010, from Doelstellingen: http://www.betapartners.nl/Betapartners/Doelstellingen_Betapartners.pdf

Brookhart, S. M., & DeVoge, J. G. (1999). Testing a theory about the role of classroom assessment in student motivation and achievement. *Applied Measurement in Education , 12* (4), 409-425.

Bühner, M. (2006). *Einführung in die Test und Fragebogenkonstruktion.* München: Pearson.

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology , 27*, 270-295.

Child, D. (2006). *The essentials of factor analysis* (3rd ed.). London: Continuum.

Clore, G. L., & Schnall, S. (2005). The influences of affect on attitude. In D. Albarracín, B. T. Johnson, & M. P. Zanna, *Handbook of attitudes and attitude change* (pp. 437-489). Mahwah: Erlbaum.

Comrey, A. L. (1973). *A first course in factor analysis.* New York: Academic Press.

Deci, E. L. (1996). Making room for self-regulation: Some thoughts on the link between emotion and behavior: Comment. *Psychological Inquiry , 7*, 220-223.

DeVellis, R. F. (2003). *Scale development: Theory and applications* (2nd ed.). London: Sage Publications Ltd.

Dweck, C. S. (1992). The study of goals in psychology. *Psychological Science , 3* (3), 165-166.

Dziuban, C. D., & Shirkey, E. C. (1974). When is a correlation matrix appropriate for factor analysis? *Psychological Bulletin , 81* (6), 358-361.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology , 53*, 109-132.

Elliot, A., & McGregor, H. A. (2001). A 2×2 achievement goal framework. *Journal of Personality and Social Psychology , 80*, 501-519.

Evans, T. D., Dedrick, R. F., & Epstein, M. J. (1997). Development and initial validation of the encouragement scale (educator form). *Journal of Humanistic Education & Development , 35* (3), 163-174.

Faircloth, B. S., & Hamm, J. V. (2005). Sense of belonging among high school students representing 4 ethic groups. *Journal of Youth and Adolescence , 34* (4), 293-309.

Farrell, E. (1990). *Hanging in and dropping out.* New York: Teachers College Press.

Fesseni, H. J. (1997). *Lehrbuch der psychologischen Diagnostik.* Göttingen, Bern, Toronto, Seattle: Hogrefe.

Fisser, P. (2009). *Natuurlijk nieuwsgierig. Kinderen als onderzoekende ontwerpers.* Hengelo: Hogeschool Edith Stein/Onderwijscentrum Twente en Expertis Onderwijsadviseurs.

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. *Journal of research in science teaching , 46* (2), 127–146.

Goodenow, C., & Grady, K. E. (1993). The relationship of school belonging and friends' values of academic motivation among urban adolescent students. *Journal of Experiemntal Education , 62* (1), 60-71.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis* (4th ed.). New Jersey: Prentice Hall.

Hatcher, L. (1994). *A step-by-step approach to using the SAS system for factor analysis and structural equation modeling.* Cary: SAS Publishing.

Kline, R. B. (1997). *Principles and practice of structural equation modeling.* New York: Guilford Press.

Koballa, T. R., & Glynn, S. M. (2007). Attitudinal and motivational constructs in science learning. In S. K. Abell, & N. G. Lederman, *Handbook of research on science education* (pp. 75-102). Mahwah: Lawrence Erlbaum Associates.

Lizzio, A., & Wilson, K. (2008). Feedback on assessment: students' perceptions of quality and effectiveness. *Assessment & Evaluation in Higher Education , 33* (3), 263–275.

Martins, M. O., Mullis, I. V., & Foy, P. (2008). *TIMSS 2007 International science report. Findings from IEA's trends in international mathematics and science study at the fourth and eight grade.* Boston: Boston College, TIMSS & PIRLS International Study Center.

Meelissen, M., & Drent, M. (2008). *TIMSS-2007 Nederland. Trends in leerprestaties in exacte vakken in het basisonderwijs.* Enschede: Universiteit Twente, Vakgroep Onderwijsorganisatie en -management.

Neber, H., & Schommer-Aikins, M. (2002). Self-regulated science learning with highly gifted students: The role of cognitive, motivational, epistemological, and environmental variables. *High Ability Studies , 13* (1), 51-74.

Newman, F. M., Wehlage, G. G., & Lamborn, S. D. (1992). The significance and sources of student engagement. In F. M. Newman, *Student engagement and achievement in American secondary schools* (pp. 11-39). New York: Teachers College Press.

OECD (2007). *PISA 2006. Science competencies for tomorrow's world. Volume I: Analysis.* Paris: OECD Publishing.

Paris, S. G., Byrnes, J. P., & Paris, A. H. (2001). Constructing theories, identities, and actions of self-regulated learners. In B. J. Zimmermann, & D. H. Schunk, *Self-regulated learning and academic achievement* (pp. 253-287). Mahwah: Lawrence Erlbaum Associates.

Perry, N. E., Turner, J. C., & Meyer, D. K. (2006). Classrooms as contexts for motivating learning. In P. A. Alexander, & P. H. Winne, *Handbook of educational psychology* (2nd ed., pp. 327-348). Mahwah: Lawrence Erlbaum Associates.

Petty, R. E., & Cacioppo, J. T. (1981). *Attitude and persuasion: classic and contemporary approaches.* Dubuque: Wm. C. Brown.

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology , 82*, 33-40.

Pintrich, P. R., & Schunk, D. H. (1996). *Motivation in education: Theory, research, and applications.* Columbus: Merrill.

Platform Bèta Techniek. (2008). *Technomonitor 2008.* Nijmegen: ResearchNed.

Quereau, T. (2010, May 6). *Personal assessment lists.* Retrieved January 5, 2010, from Austin Community College: http://www.austincc.edu/behscitf/HD%20Personal%20Assessment%20Sheets.htm

Reeve, J., Hamm, D., & Nix, G. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology , 95*, 375-392.

Russell, D. (1982). The causal dimension scale: A measure of how individuals perspective causes. *Journal of Personality and Social Psychology , 42* (6), 1137-1145.

Schunk, D. H., & Zimmermann, B. J. (2006). Competence and control beliefs: distinguishing the means and ends. In P. A. Alexander, & P. H. Winne, *Handbook of educational psychology* (2nd ed., pp. 349-367). Mahwah: Lawrence Erlbaum Associates.

Schwarzer, R., & Jerusalem, M. (1995). Generalized self-efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35-37). Windsor: NFER-NELSON.

Sheldon, K., & Deci, E. (2010, May 6). *The self-determination scale (SDS).* Retrieved January 5, 2010, from Self-determination theory: An approach to human mtivation & prsonality: http://www.psych.rochester.edu/SDT/measures/sds_description.php

Sijtsma, K. (2009). Over misverstanden rond Cronbachs alfa en de wenselijkheid van alternatieven. *De Psycholoog* , 561-567.

Stipek, D. J. (1996). Motivation and instruction. In D. C. Berliner, & R. C. Calfee, *Handbook of educational psychology* (pp. 85-113). New York: Macmillan.

Talton, E. L., & Simpson, R. D. (1985). Relationships between peer and individual attitudes toward science among adolescent students. *Science Education , 69* (1), 19-24.

van Rixtel, J. (2010, January 1). *ThesisTools Online Enquêtes*. Retrieved January 1, 2010, from ThesisTools Online Enquêtes: http://www.thesistools.com/

Vispoel, W. P., & Austin, J. R. (1995). Success and failure in junior high school: A critical incident approach to understanding students' attributional beliefs. *American Educational Research Journal , 32*, 377-412.

Walma-van der Molen, J. H. (2007). De ontwikkeling van een attitude-instrument op het gebied van wetenschap en techniek voor leerlingen in het basisonderwijs. Platform Bèta Techniek.

Weiner, B. (1992). *Human motivation: Metaphors, theories and research.* Newbury Park: Sage.

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. *Educational Psychology Review , 6* (1), 49-78.

Appendix A

Biographical Questions

1 Ik ben een (jongen; meisje)

2 Wat is jouw geboortedatum?

3 In welk klas zit jij?

4 Welke soort onderwijs doe jij? (Gymnasium; Atheneum; HAVO; VWO; Universiteit)

5 Voor welk profiel heb jij gekozen? (Cultuur en Maatschappij; Economie en Maatschappij; Natuur en Gezondheid; Natuur en Techniek)

6 Als je nu jouw profiel opnieuw zou mogen kiezen, wat is dan je keuze? (Cultuur en Maatschappij; Economie en Maatschappij; Natuur en Gezondheid; Natuur en Techniek)

7 Ik weet wat wordt bedoeld met onderzoek doen.

8 Ik heb al zelf onderzoek gedaan.

9 Ik kan mij nog goed herinneren dat ik voor het laatst onderzoek deed.

10 Hoe vaak deed je in dit schooljaar en het vorige in totaal onderzoek? (Ik heb geen onderzoek gedaan; 1 keer; 2 keer; 3 keer; 4 keer; 5 keer of meer)

11 Welk cijfer of beoordeling kreeg je de laatste keer dat je een onderzoeksopdracht uitvoerde?

Motivational Questions

12 Ik heb geen controle over de beoordeling die ik krijg voor een onderzoeksopdracht. (Reversed)

13 Mijn leraren helpen mij om zelf te kunnen beoordelen hoe ik onderzoek doe.

14 Als een onderzoeksopdracht moeilijk wordt heb ik de neiging me op makkelijkere onderdelen van de opdracht te gaan richten.

15	Ik vind het niet leuk om beoordeeld te worden als het om onderzoek doen gaat. (Reversed)
16	Ik geniet van onderzoek doen.
17	Een onderzoek begrijpen geeft mij het gevoel echt te presteren.
18	Ik zorg ervoor dat ik niet slechter presteer op onderzoeksopdrachten dan mijn klasgenoten.
19	Ik denk dat ik minstens een 8 kan halen voor een onderzoeksopdracht.
20	Ik ben verantwoordelijk voor de beoordeling die ik krijg voor een onderzoeksopdracht.
21	Als ik onderzoek doe vind ik het leuk om nieuwe ideeën te bedenken.
22	In onderzoek doen ben ik één van de besten van mijn klas.
23	Bij een onderzoeksopdracht waarderen mijn klasgenoten mijn opmerkingen en ideeën.
24	Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan komt dat meestal omdat ik mijn best heb gedaan.
25	De beoordelingen die ik krijg onderzoeksopdrachten zijn vrij constant. (Reversed)
26	De beoordeling die ik krijg voor onderzoeksopdrachten kan ik zelf beïnvloeden.
27	De beoordeling die ik krijg voor een onderzoeksopdracht hangt af van de omstandigheden. (Reversed)
28	Bij een onderzoeksopdracht krijg ik van mijn klasgenoten positieve opmerkingen.
29	Opmerkingen en suggesties van leraren op mijn onderzoeksopdrachten zijn vaak tegenstrijdig. (Reversed)
30	Onderzoek doen lijkt mij belangrijk om te leren.
31	Als ik onderzoek doe bedenk ik van tevoren wat er op korte en lange termijn moet gebeuren.
32	Ik ben altijd zenuwachtig hoe ik word beoordeeld als ik onderzoek heb gedaan. (Reversed)
33	Ik vind onderzoek doen interessant.
34	Ik wil voorkomen slechter te presteren op onderzoeksopdrachten dan mijn klasgenoten.

35 Ik kan minstens zo goed onderzoek doen als mijn klasgenoten.

36 Ik denk er wel eens over na of onderzoek doen goed is voor mijn carrière later.

37 Ik maak me er zorgen over dat ik onvoldoendes haal voor onderzoeksopdrachten. (Reversed)

38 Ik beloon mezelf, wanneer ik een deel van een onderzoeksopdracht heb afgerond.

39 Als ik onderzoek doe dwalen mijn gedachten vaak af. (Reversed)

40 Ik denk dat onderzoek doen relevant is voor mijn leven.

41 Ik vind het fijn om met mijn klasgenoten onderzoek te doen.

42 Het voelt als een verplichting om onderzoek te doen. (Reversed)

43 Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan ben ik daar zelf verantwoordelijk voor geweest.

44 Ik ben heel geïnteresseerd in onderzoek.

45 Zelfs als onderdelen van een onderzoeksopdracht oninteressant en saai zijn, werk ik door totdat ik klaar ben.

46 Ik word zenuwachtig als mijn onderzoeksopdracht aan de beurt is om beoordeeld te worden. (Reversed)

47 Ik streef ernaar om betere beoordelingen te krijgen voor onderzoekopdrachten dan mijn klasgenoten.

48 Ik denk dat ik kan leren hoe je onderzoek moet doen.

49 Ik heb er vertrouwen in dat ik onverwachte gebeurtenissen in een onderzoeksproject doeltreffend kan aanpakken.

50 Ik wil zo veel mogelijk leren als ik onderzoek doe.

51 Ik stel mijzelf doelen als ik onderzoek doe en controleer of ik ze bereikt heb.

52 Van mijn leraren krijg ik kritische op- en aanmerkingen over de kwaliteit van mijn onderzoeksopdrachten.

53 Als ik onderzoek doe durf ik mijn mening vaak niet te geven. (Reversed)

54 Mijn leraren waarderen mijn suggesties en ideeën als ik onderzoek doe.

55 In vergelijking met andere dingen op school zijn onderzoeksopdrachten voor mij heel belangrijk.

56 Mijn vrienden vinden onderzoek doen interessant.

67 Meestal bieden de onderzoeksopdrachten op school weinig ruimte voor eigen ideeën. (Reversed)

68 De beoordeling van mijn onderzoeksopdrachten is wisselend.

69 Als ik een onderzoeksopdracht doe kan ik zelf bepalen hoe ik hem aanpak.

60 Ik denk dat ik in vergelijking met andere leerlingen heel goed ben in onderzoek doen.

61 Mijn leraren wijzen me niet alleen op fouten, maar vertellen ook hoe het beter kan als ik onderzoek doe.

62 Ik heb vooraf een duidelijk idee van wat in een onderzoeksopdracht bereikt moet worden.

63 Een goede beoordeling voor een onderzoeksopdracht krijgen is belangrijk voor mij.

64 Als ik onderzoek doe is het belangrijk voor mij om beter te presteren dan mijn klasgenoten.

65 Het is belangrijk voor mij om bij onderzoeksopdrachten precies te weten waar ik mee bezig ben.

66 Mijn leraren geven vaak op- en aanmerkingen over onderzoek doen die ik niet begrijp. (Reversed)

67 Als ik onderzoek doe heb ik vaak het gevoel dat er niet naar mij geluisterd wordt. (Reversed)

68 Mijn leraren waarderen de moeite die ik doe voor onderzoeksopdrachten.

69 Ik stel mijzelf vragen om te controleren of ik alles wel begrijp als ik onderzoek doe.

70 Ik wil beter zijn in onderzoek doen dan andere leerlingen.

71 Ik vind het leuk om dingen te onderzoeken.

72 Als ik een goede beoordeling krijg voor een onderzoeksopdracht heb ik meestal geluk gehad.

73 Ik maak me zorgen dat ik niet genoeg leer van onderzoeksopdrachten dan eigenlijk de bedoeling is.

74 Wat er ook gebeurt, ik breng onderzoeksopdrachten altijd tot een goed einde.

75 Als het voor het hoofddoel van een onderzoeksopdracht noodzakelijk is, ga ik dingen anders aanpakken.

76 Als ik lees over mijn onderzoeksopdracht weet ik vaak niet meer waar het over gaat. (Reversed)

77 Ik vind onderzoek doen over het algemeen leuk.

78 Uit op- aan aanmerkingen van mijn leraren over onderzoeksopdrachten kan ik afleiden wat ik goed heb gedaan.

79 Als ik onderzoek doe vind ik de sfeer vaak vijandig. (Reversed)

80 Onderzoek doen is voor mij heel nuttig.

81 Mijn vrienden vinden onderzoek doen leuk.

82 Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan ligt dat meestal aan de opdracht.

83 Ik weet zeker dat ik goed presteer als het om onderzoek doen gaat.

84 Ik houd ervan beter te presteren dan andere leerlingen bij onderzoek doen.

85 Ik stel tijdens een onderzoeksopdracht een hoofddoel en deel deze op in kleinere doelen die ik probeer te bereiken.

86 Als ik onderzoek doe zijn de op- en aanmerkingen van mijn leraren ook nuttig voor onderzoeksopdrachten die ik later nog moet gaan uitvoeren.

87 Ik krijg positieve opmerkingen als ik onderzoek doe.

88 Ik denk dat de inhoud van een onderzoeksopdracht nuttig voor mij is.

89 Als ik onderzoek doe vind ik het leuk om dingen uit te vinden.

90 In vergelijking met andere leertaken is onderzoek doen heel nuttig.

91 Ik houd van onderzoek doen.

92 Ik kan zelf bepalen hoe ik mijn onderzoek inricht.

93 Ik heb geen invloed op de beoordeling die ik krijg voor een onderzoeksopdracht. (Reversed)

94 Bij een onderzoeksopdracht waarderen mijn klasgenoten dat ik mijn best doe.

95 Als ik op- of aanmerkingen van mijn leraren over een onderzoeksopdracht niet begrijp zijn ze altijd bereid toelichting te geven.

96 Als onderzoek doen moeilijk wordt heb ik de neiging ermee op te houden. (Reversed)

97 Tijdens een onderzoeksopdracht maak ik gebruik van een lijstje met dingen die gedaan moeten worden.

98 Ik denk er wel eens over na hoe leren om onderzoek te doen kan helpen om later een goede baan te krijgen.

99 Ik weet zeker dat ik een goede beoordeling krijg voor onderzoeksopdrachten.

100 Ik maak me er zorgen over dat andere leerlingen beter zijn dan ik in onderzoek doen. (Reversed)

101 De op- en aanmerkingen van leraren helpen mij om verder te komen met een onderzoeksopdracht.

102 Ik vind het leuk om meer te leren over onderzoek doen.

103 Het is voor mij heel belangrijk goed in onderzoek doen te zijn.

104 Mijn vrienden vinden het leuk om dingen uit te vinden als zij met onderzoek bezig zijn.

105 Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan komt dat omdat ik het kan.

106 De beoordelingen die ik krijg voor onderzoeksopdrachten zijn wisselend.

107 Ik doe onderzoeksopdrachten alleen omdat ik ze moet doen. (Reversed)

108 Mijn vrienden vinden het leuk om nieuwe ideeën te bedenken als zij met onderzoek bezig zijn.

109 Over het algemeen vind ik onderzoek doen saai. (Reversed)

110 Ik ben heel goed in onderzoek doen.

111 Als ik onderzoek doe vind ik het leuk om dingen uit te pluizen.

112 Ik weet vaak niet wat er van mij wordt verwacht als ik onderzoek moet doen. (Reversed)

113 Op- en aanmerkingen van mijn leraren helpen mij om beter te leren onderzoek te doen.

114 Ik denk dat wat ik leer over onderzoek doen, ik op verschillende gebieden kan gebruiken.

115 Voordat ik met een onderzoeksopdracht begin, denk ik erover na wat ik precies moet doen.

116 Ik houd van uitdagende onderzoeksopdrachten.

117 Wat ik leer van onderzoeksopdrachten is belangrijker dan de beoordelingen die ik krijg.

118 Ik maak me zorgen dat ik niet zo goed ben in onderzoek doen als ik graag zou willen.

119 De zorg om slecht te presteren motiveert mij om me in te zetten voor een onderzoeksopdracht.

120 Ik blijf kalm als ik bij onderzoekopdrachten voor moeilijkheden kom te staan, ik vertrouw erop dat ik ze kan oplossen.

121 Mijn beste vrienden houden van onderzoek doen.

122 Hieronder staan een aantal redenen voor het halen van een goede beoordeling voor een onderzoeksopdracht. Alle redenen kunnen in meer of mindere mate een rol spelen, maar het kan zijn dat in jouw geval bepaalde redenen meer naar voren komen dan andere als je onderzoeksopdrachten uitvoert. Plaats een 1 bij de reden die het meest op jou van toepassing is, een 2 bij de reden die daarna het meest van toepassing is, enzovoort. Geef redenen die in jouw geval in gelijke mate van toepassing zijn hetzelfde rangnummer.

Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan komt dat door:

Toeval/geluk
Mijn aanpak van de onderzoeksopdracht
Mijn geleverde inspanning
Mijn kennis en vaardigheden in onderzoek doen
De moeilijkheidsgraad van de opdracht
Mijn stemming toen ik de opdracht deed

Validation Questions

123 Ik vind dat ik heel gemotiveerd ben om onderzoek te doen

124 - 128 Hoe regelmatig lees je de volgende tijdschriften?

124 Quest

125 Kijk

126 Explore

127 Wetenschap in Beeld

128 NWT (Natuurwetenschap & Techniek)

129 - 130 Hoe regelmatig kijk je naar de volgende televisiezenders?

129 National Geographics

130 Discovery channel

131 - 141 In welke mate verdiep jij je in je vrije tijd in de onderwerpen/vakken:

131 Biologie

132 Wiskunde

133 Techniek

134 Natuurkunde

135 Scheikunde

136 Geschiedenis

137 Economie

138 Aardrijkskunde

139 Maatschappijleer

140 Informatica

141 Talen

142 Ben je geïnteresseerd in mediaberichten over de nieuwste wetenschappelijke uitvindingen en ontdekkingen?

143 Doe jij iets in je vrije tijd dat met onderzoek heeft te maken?

144 Zo ja, kun je in het kort omschrijven wat dat is?

145 Welke vervolgstudie wil jij doen? (Vul niets in als je het nog niet weet)

146 Wordt bij jou thuis w el eens over onderzoek/w etenschap gesproken?

147 Zou jij je kunnen voorstellen dat je later een studie gaat volgen waarin onderzoek een rol speelt?

148 Wat zou je later willen worden? (Vul niets in als je het nog niet weet)

Science Attitude Questionnaire

149 Het is moeilijk om over wetenschap te leren.

150 Ik vind het leuk om meer te leren over wetenschap.

151 Mensen die nieuwe ideeën bedenken zijn belangrijk voor de samenleving.

152 Jongens zijn betere onderzoekers dan meisjes.

153 Als wetenschapper moet je slim zijn.

154 Ik vind het leuk om nieuwe ideeën te bedenken.

155 Ik wil later graag een baan in de wetenschap.

156 De wetenschap heeft een grote invloed op de samenleving.

157 Ik vind het leuk om dingen uit te pluizen.

158 Jongens zijn beter in wiskunde dan meisjes.

159 Er moet meer geld uitgegeven worden aan nieuw onderzoek in Nederland.

160 Wetenschap is alleen voor slimme mensen.

161 Ik wil later graag een wetenschappelijke opleiding gaan doen.

162 Jongens zijn beter in proefjes doen dan meisjes.

163 Ik vind het leuk om dingen uit te vinden.

164 Door de wetenschap zijn we steeds meer gaan weten over alles om ons heen.

165 Als in een land belangrijk onderzoek wordt gedaan wordt het land daar rijker van.

166 Ik vind wetenschap interessant.

167 Mensen die belangrijk onderzoek doen zouden meer geld moeten krijgen.

168 Door de wetenschap worden bestaande dingen steeds beter.

169 Ik wil later graag onderzoeker worden.

170 Ik vind het leuk om dingen te onderzoeken.

Other Questions

171 Welke opmerkingen over deze vragenlijst heb je?

Appendix B

Nederlandse Vragenlijst voor Onderzoeksmotivatie (NVOM)

1 Ik denk dat ik minstens een 8 kan halen voor een onderzoeksopdracht.

2 Als ik onderzoek doe vind ik het leuk om dingen uit te vinden.

3 Mijn leraren helpen mij om zelf te kunnen beoordelen hoe ik onderzoek doe.

4 Mijn vrienden vinden het leuk om dingen uit te vinden als zij met onderzoek bezig zijn.

5 Ik houd ervan beter te presteren dan andere leerlingen bij onderzoek doen.

6 Mijn vrienden vinden het leuk om nieuwe ideeën te bedenken als zij met onderzoek bezig zijn.

7 In onderzoek doen ben ik één van de besten van mijn klas.

8 Wat er ook gebeurt, ik breng onderzoeksopdrachten altijd tot een goed einde.

9 Als ik onderzoek doe bedenk ik van tevoren wat er op korte en lange termijn moet gebeuren.

10 Voordat ik met een onderzoeksopdracht begin, denk ik erover na wat ik precies moet doen.

11 In vergelijking met andere leertaken is onderzoek doen heel nuttig.

12 Van mijn leraren krijg ik kritische op- en aanmerkingen over de kwaliteit van mijn onderzoeksopdrachten.

13 Mijn beste vrienden houden van onderzoek doen.

14 Ik kan minstens zo goed onderzoek doen als mijn klasgenoten.

15 Ik denk dat ik kan leren hoe je onderzoek moet doen.

16 Ik wil beter zijn in onderzoek doen dan andere leerlingen.

17 Mijn leraren waarderen de moeite die ik doe voor onderzoeksopdrachten.

18 Ik denk dat de inhoud van een onderzoeksopdracht nuttig voor mij is.

19 Ik vind het leuk om dingen te onderzoeken.

20	Ik heb er vertrouwen in dat ik onverwachte gebeurtenissen in een onderzoeksproject doeltreffend kan aanpakken.
21	Ik vind onderzoek doen over het algemeen leuk.
22	Mijn leraren waarderen mijn suggesties en ideeën als ik onderzoek doe.
23	Zelfs als onderdelen van een onderzoeksopdracht oninteressant en saai zijn, werk ik door totdat ik klaar ben.
24	Tijdens een onderzoeksopdracht maak ik gebruik van een lijstje met dingen die gedaan moeten worden.
25	Als ik onderzoek doe is het belangrijk voor mij om beter te presteren dan mijn klasgenoten.
26	Onderzoek doen is voor mij heel nuttig.
27	Als ik een goede beoordeling krijg voor een onderzoeksopdracht, dan ben ik daar zelf verantwoordelijk voor.
28	Ik houd van onderzoek doen.
29	Ik heb vooraf een duidelijk idee van wat in een onderzoeksopdracht bereikt moet worden.
30	Mijn vrienden vinden onderzoek doen interessant.

Note. The questionnaire contains the following motivational concepts: intrinsic task motivation (item 2, 19, 21, 28), utility value (item 11, 18, 26), competence belief (item 1, 7, 14), feedback (item 3, 12, 17, 22), self-efficacy (item 8, 15, 20, 23, 27), goal setting (item 9, 10, 24, 29), peer support (item 4, 6, 13, 30) and performance motivation (item 5, 16, 25).