Supporting autonomous motivation for chemistry in a controlling secondary school environment

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Abstract

This study addresses the motivational challenges faced by 9th-grade students in the Dutch educational system, during the decision-making process of their subject cluster choice (SCC). Halfway through ninth grade, these students have to choose which subjects they will elect for the rest of their secondary education career and which they will drop. However, it is mandatory for all students to continue with all subjects through 9th grade and all subjects are considered in the end-of-year evaluation, creating a motivationally controlling environment. This mixed-methods study, utilizing questionnaires and focus group interviews, examines the motivational profiles and perceived support for basic psychological needs (BPNs) of 9th-grade students who have elected chemistry in their SCC and students who have not.

In line with self-determination theory, the questionnaire results reveal a positive correlation between BPN support and autonomous motivation. Furthermore, students who had not elected chemistry (N=144) experienced significantly more controlled forms of motivation and significantly less support of their BPNs compared to the students (N=132) who had elected chemistry. Focus group interviews with the former group of students (12 participants in total) provided recommendations for supporting their BPNs. They expressed a desire for more autonomy by having control over their learning goals and more variety during the lessons. They also emphasized the need for structured instruction, demonstrations, and personal assistance. Additionally, a positive teacher-student relationship was identified as being crucial for them.

This research highlights the importance of need-supportive teaching, especially in an inherently controlling school situation. Implications are discussed.

Introduction

All Dutch secondary school students face a choice that determines their future career at a relatively early age, i.e., halfway through grade 9, when they are aged 13-15 (Ministerie van Onderwijs Cultuur en Wetenschap, 2020, 2021a). It is mandatory for them to decide which subjects they would like to elect for the remainder of their secondary education career and which ones they want to drop. This process is called the subject cluster choice (SCC) (*profielkeuze* in Dutch). The SCC is a critical moment in the student's educational career since the chosen cluster in part determines the available options for them in tertiary education. In the Netherlands, four different subject clusters exist that each contains mandatory subjects and electives (Ministerie van Onderwijs Cultuur en Wetenschap, 2020, 2021a). Mandatory subjects always include Dutch, English, and some level of mathematics. Electives belong to the STEM (science, technology, engineering, and mathematics) subjects, economics, arts, or social/health sciences, depending on the subject cluster.

The SCC takes place during 9th grade, typically around February-March (Ministerie van Onderwijs Cultuur en Wetenschap, 2021b). This timing is determined by practical reasons, i.e., the need for schools to organize the next school year based on students' SCC decisions (Haan, 2009). Every year, approximately 100,000 students decide on their SCC (Centraal Bureau voor de Statistiek, 2022). A major problem then arises for the teachers concerned. All students are still required to continue studying all subjects until the end of the school year and all subjects' results will be considered for the end-of-year student evaluations. As a result, from March onwards the classes of the elective subjects are composed of a mix of students who have and have not elected that particular subject (Ministerie van Onderwijs Cultuur en Wetenschap, 2021b), and all of them have to pass the subject at the end of the year.

About 55% of 9th graders in The Netherlands do not elect a natural STEM-based SCC and, therefore, consequently drop natural science subjects such as chemistry, physics, and biology (Centraal Bureau voor de Statistiek, 2022). As a chemistry teacher, I experienced the impact of this division between the two groups of students. For instance, during a lesson, a student who had not elected chemistry quoted: "I am not going to work for chemistry anymore, since I have not elected it and I will still pass this year even if I fail the upcoming test.". This division within each class evidently has far-reaching implications regarding students' motivation, since students who have not elected a subject are essentially in a controlling environment, i.e., in an environment that they have not chosen themselves (Wang & Degol, 2013).

Motivation is a multi-faceted concept referring to a person's factors that drive their behavior. Within the leading theory of motivation, self-determination theory (SDT, e.g., Deci & Ryan 2015) motivation is split into amotivation, controlled motivation, and autonomous motivation. Amotivation is the absence of motivation, to engage in any activity (Deci & Ryan, 2015). Autonomous motivation is when an individual engages in an activity driven by their internal desire, or when an individual is motivated by extrinsic sources that align with their sense of self (Deci & Ryan, 2015). Controlled motivation, on the other hand, is driven by external forces such as rewards, punishments, peer pressure, or embarrassment (Deci & Ryan, 2015). Returning to the situation of a chemistry class after the SCC has been determined, it is expected that both autonomous and controlled motivation (and even amotivation) are present in one class (Wang, 2012; Wang & Degol, 2013). Hypothetically, the autonomously motivated students are those who have elected to follow the subject in the subsequent years, while students who have not elected a subject are expected to experience mainly controlled (or a-) motivation, since they are forced to follow a subject they did not elect (Deci & Ryan, 2008, 2015; Ryan & Deci, 2000, 2017). For the latter group, an inherently controlling school environment is created.

A shift in students' motivational profiles toward more controlled forms of motivation could result in misbehavior and a decrease in student well-being, as previous research has shown that extrinsic goals are negatively associated with well-being (Kasser & Ryan, 1996; Sheldon et al., 2004; Sheldon & Elliot, 1998) and school misbehavior (Adelman & Taylor, 1990). In addition, a shift in students' motivational profiles toward more controlled forms is problematic for academic achievement (Black & Deci, 2000; Cerasoli et al., 2014; Wang & Degol, 2013).

The problematic situation becomes pressing for subjects like chemistry since students in The Netherlands start to follow chemistry subject lessons in 9th grade, approximately five months before deciding on their SCC (Ministerie van Onderwijs Cultuur en Wetenschap, 2020, 2021b, 2021a). Therefore, the final benchmarks for science subjects in lower secondary education (Ministerie van Onderwijs Cultuur en Wetenschap, 2010; SLO, 2022a, 2022b) and scientific literacy in general (OECD, 2019) may be at risk. For this reason, it is crucial to investigate the specific motivational problems students face after deciding on the SCC and ways to improve the situation.

The proposed theoretical lens to improve the quality of students' motivation can be found in the SDT as well (Deci & Ryan, 2015; Ryan & Deci, 2000). SDT argues that students' autonomous motivation can be fostered by supporting students' basic psychological needs (BPNs). These BPNs complement basic physiological needs and are autonomy, competence,

and relatedness. Autonomy refers to the ability to make their own choices and control one's behavior, competence addresses the need for mastery and the capacity to achieve desired outcomes, and relatedness refers to the need for positive relationships with others. Within SDT supporting BPNs has been shown to foster autonomous motivation across cultures (Chen, Vansteenkiste, et al., 2015; Milyavskaya & Koestner, 2011; Reis et al., 2000; Véronneau et al., 2005).

This study aims to study BPN support and motivation in an inherently controlling school environment, i.e., the situation in which 9th-grade students who have not elected chemistry in their SCC still need to continue following chemistry until the end of that school year. While the specific focus of this study is on chemistry, it exemplifies a broader issue: how to support the motivation of students who are compelled to study a subject they have little interest in, in a controlling school environment, which is a challenge that many students face throughout their academic journey. This research will be performed in the 9th grade of general secondary education (havo) and pre-university education (vwo). This study does not include pre-vocational education (vmbo) due to the distinctive process and timeframe of the SCC, which differ from those of general secondary education and pre-university education. The main research question is:

"How can the autonomous motivation for chemistry be supported in 9th-grade students who have not elected chemistry in their subject cluster choice?"

To answer this main question, two sub-questions are stated: (1) What are the differences in motivational profiles and perceived support of basic psychological needs between students who have and have not elected chemistry in their subject cluster choice? (2) What do students who have not elected chemistry in their subject cluster choice report on ways in which their basic psychological needs are satisfied or frustrated? To answer these questions, a questionnaire will be administered to students, and semi-structured interviews with focus groups will be conducted.

Theoretical framework

In this section, several key concepts are explained: the subject cluster choice and the self-determination theory, since these are the theoretical lenses adopted in this study.

Subject Cluster Choice (SCC)

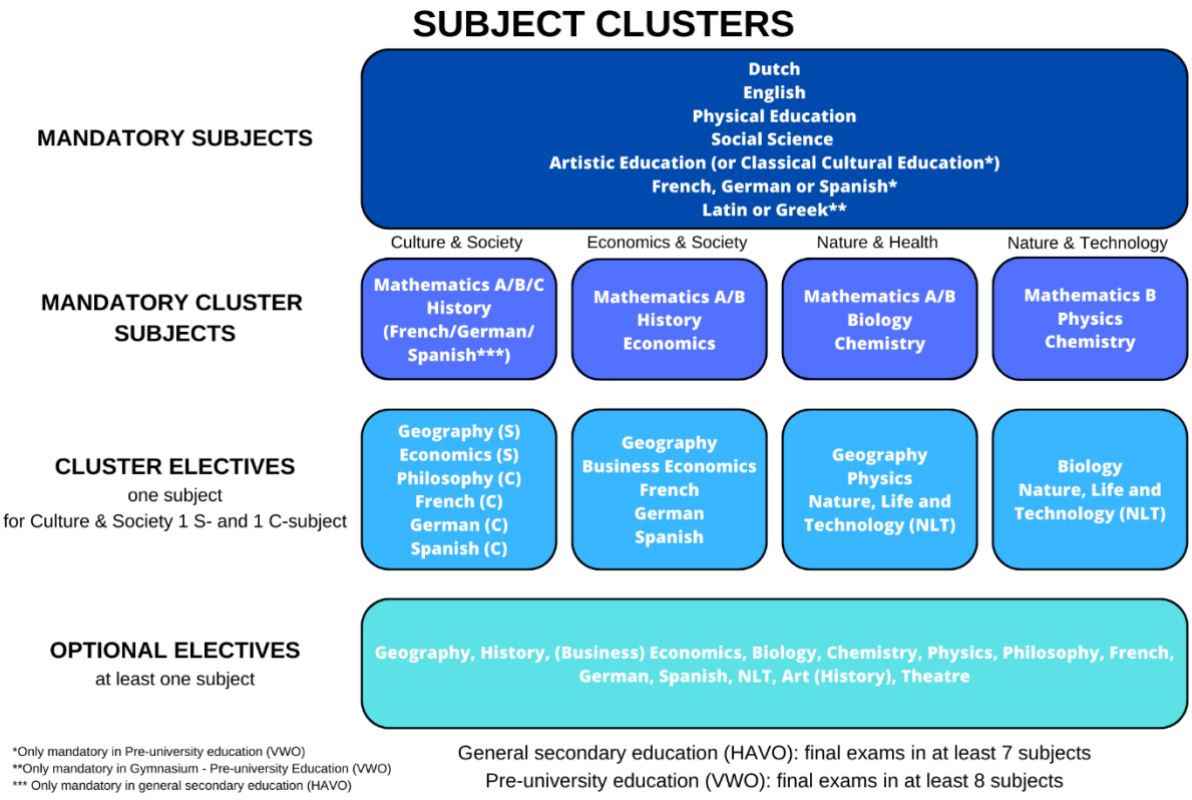
The SCC determines in which subjects the student will have to eventually take the final exams (Ministerie van Onderwijs Cultuur en Wetenschap, 2020, 2021a). Each subject cluster prepares students for certain disciplines in higher education. In The Netherlands, four different subject clusters exist, each consisting of mandatory subjects, mandatory cluster subjects, cluster electives, and optional electives (see Figure 1). Every student has to take their final exams in the mandatory subjects, always including Dutch, mathematics, and English. Depending on the subject cluster, subjects can be mandatory (mandatory cluster subjects), such as basic (C) or advanced mathematics (A/B), History, or Chemistry. Students must choose one of the cluster electives and at least one of the optional electives. In general secondary education (havo), students take their final exams in at least seven subjects, and in pre-university education (vwo) in at least eight subjects.

Students are supported in deciding on their SCC by their tutor and careers counselor. After deciding on the SCC, students need to continue following all the subjects until the end of the 9th grade, including the subjects they have not elected in their subject cluster. At the end of the 9th grade, students need to achieve the final benchmarks for each subject, to ensure that each student achieves a certain basic level in a subject. For chemistry, the final benchmarks are established by the government (Ministerie van Onderwijs Cultuur en Wetenschap, 2010) and the SLO organization (SLO, 2022b, 2022a).

Every year, approximately 100,000 students in general secondary- and pre-university education decide on their SCC (Centraal Bureau voor de Statistiek, 2022). In the school year 2021-2022, approximately 56% (24,117) of the pre-university students had elected a STEM-based subject cluster and 43% (18,547) of the students had elected a social science-based subject cluster. In general secondary education, approximately 36% (23,076) had elected a natural science-based subject cluster, and 63% (40,594) a social science-based subject cluster. In both pre-university and general secondary education less than 1% of the students had elected a combination of these subject clusters (Centraal Bureau voor de Statistiek, 2022). The SCC process creates a unique situation where students are challenged since they are compelled to

study a subject in which there are not interested. This study focuses on how autonomous motivation can be supported in 9th-grade students who have not elected chemistry in their SCC.

Figure 1. Dutch subject clusters for general secondary education (HAVO) and pre-university education (VWO): Culture & Society, Economics & Society, Nature & Health, and Nature & Technology. The electives in this scheme could differ slightly for different secondary schools in The Netherlands.

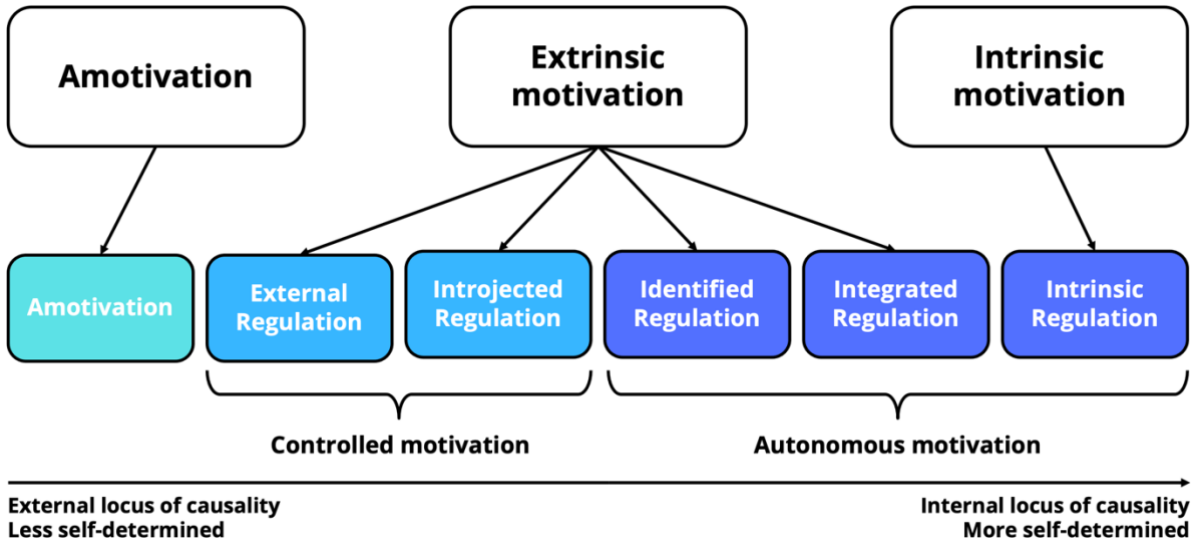


Self-Determination Theory: Motivational profiles

According to Self-Determination Theory (SDT), motivation can be placed on a continuum (Figure 2) (Deci & Ryan, 2008, 2015; Ryan & Deci, 2000, 2017). On the far-left side of the continuum, amotivation is found which relates to the total absence of any motivation. Next to amotivation, controlled motivation is found which includes extrinsic- and introjected regulation. External regulation is a drive to behave in a certain way based on external sources which result in external rewards or punishments, for instance, grading systems, awards, and work evaluations. Introjected regulation refers to behavior that is driven by feelings of guilt or obligation. An example of introjected regulation in education could be a student who is driven to study hard for an upcoming test due to the fear of disappointing their parents if they do not receive a good grade. These internalized pressures still fall within less self-determined motivation, as they are influenced by external expectations or societal standards, and therefore represent an external perceived locus of control (E-PLOC). Moving towards more self-determined motivation, autonomous motivation is found, representing a more internal

perceived locus of control (I-PLOC). Autonomous motivation is divided into identified-, integrated-, and intrinsic regulation. Identified regulation relates to the extrinsic source of motivation which is based on relevance and importance for one's goals or values. For example, when a student puts much effort to prepare for an exam since getting into college is important to them. Or a student might realize that studying grammar in English class is a crucial step toward becoming a writer (the goal of becoming a *successful* writer may have introjected connotations). Integrated regulation refers to the extrinsic source of motivation for completing a task because it very closely aligns with one's values and needs, e.g., sustainability, equity, or promoting diversity. On the far-right side of the continuum, intrinsic motivation can be found. Intrinsic motivation relates to the inner drive that inspires the individual to behave in a certain way, a task is done for its own sake, pleasure, and satisfaction.

Figure 2. The motivation continuum (Howard et al., 2017) *based on the Self-Determination Theory (Ryan & Deci, 2000, 2017).*



The different types of regulation in Figure 2 are measured by the Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989; Sierens & Vansteenkiste, 2009). Therefore, this questionnaire can give insights into the motivational profiles of students. Based on the SRQ-A, the construct of the Relative Autonomy Index (RAI) can be calculated, a measure of the ratio in which autonomous motivations and controlled motivations are present (Grolnick & Ryan, 1989). The RAI can be calculated by the following equation:

Equation 1

$$RAI = 2 \times Intrinsic + Identified - Introjected - 2 \times External$$

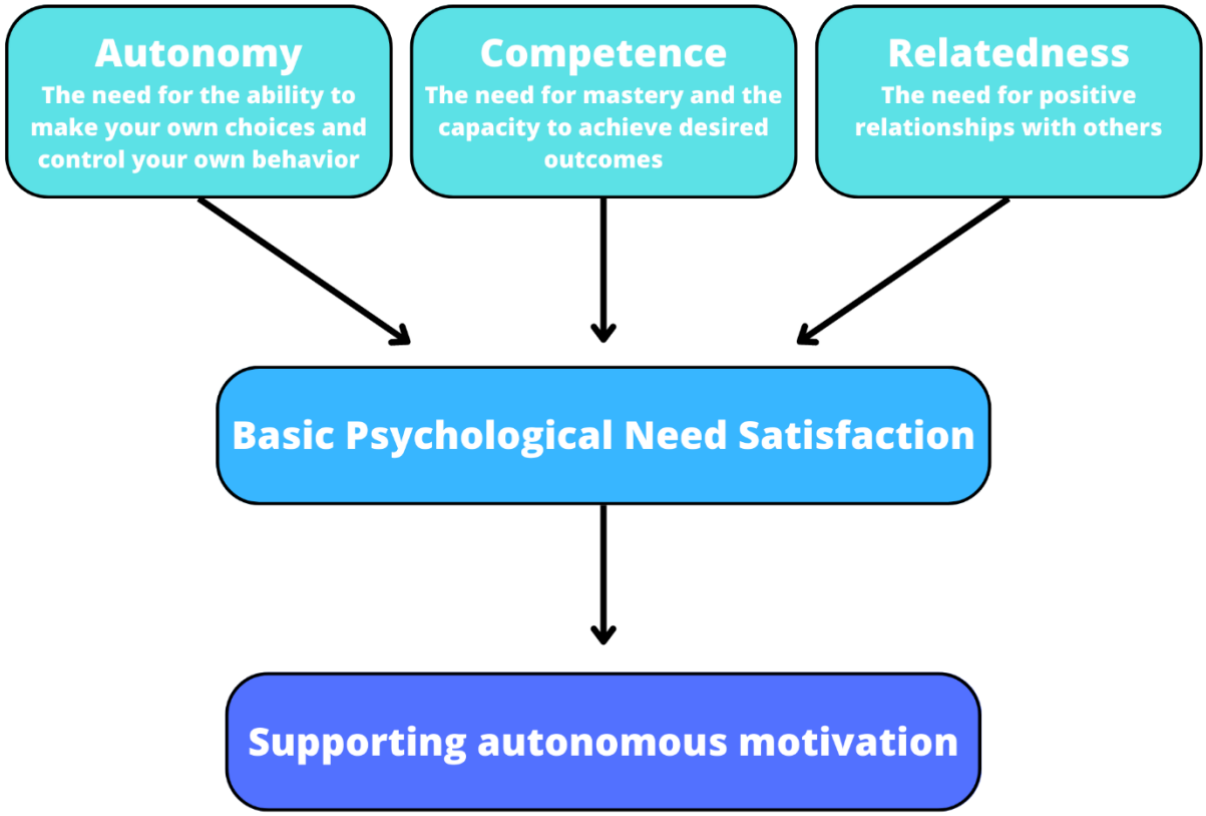
In other words, the autonomous subscales are weighted positively, and the controlled subscales are weighted negatively, with more controlling/autonomous subscales weighing in more heavily. A high value of RAI indicates a more autonomous regulated motivational profile, while a low value of RAI indicates a more controlled regulated motivational profile. Although the RAI has been often used (Grolnick & Ryan, 1989), it is important to note that this formula and the values are somewhat arbitrary. Note also that motivation is always situational, i.e., a person can be fully intrinsically motivated in one situation and amotivated in another.

Self-Determination Theory: Basic Psychological Needs Theory

At the core of the SDT is the idea that, apart from physiological needs, all individuals have three basic psychological needs (BPN) (Figure 3): autonomy, competence, and relatedness (Ryan & Deci, 2000). The need for autonomy refers to the ability to make their own choices and control one's behavior. Regarding education, this means the students need to have the freedom of choice to work on a task or an activity. Competence addresses the need for mastery and the capacity to achieve desired outcomes. In education, this translates into students having confidence in their ability to complete a certain subject. Finally, relatedness refers to the need for positive relationships with others. Regarding education, it is crucial that students feel connected to classmates and teachers and have trust in them. Moreover, students should feel comfortable asking questions and making mistakes. Previous research has shown that BPN satisfaction is strongly supportive of autonomous motivation and well-being, in a process often referred to as "internalization" (Milyavskaya & Koestner, 2011; Reis et al., 2000; Ryan & Deci, 2000; Véronneau et al., 2005) (Figure 3).

To determine how students perceive the support of their BPNs, the Basic Psychological Needs Satisfaction and Frustration Scale (BPNSFS; Chen, van Assche, et al., 2015; van der Kaap-Deeder et al., 2020) can be used. This questionnaire is built up of items related to satisfaction or frustration of the three basic psychological needs in an educational context. For each basic psychological need, a composite score can be calculated.

Figure 3. Supporting Basic Psychological Needs (Autonomy, Competence, and Relatedness) fosters autonomous motivation (Ryan & Deci, 2000).



Need-supportive teaching

Students' need for autonomy, competence, and relatedness can be facilitated through so-called need-supportive teaching (Stroet et al., 2013, 2015b, 2015a; Y. Wang et al., 2021). A need-supportive learning environment can be defined as a class environment in which teachers provide autonomy support, structure, and involvement, to support students' psychological needs for autonomy, competence, and relatedness, respectively (Stroet et al., 2013, 2015b, 2015a; Y. Wang et al., 2021).

In a study by Stroet et al. (2015b), several components of need-supportive teaching were identified. Autonomy-supportive teaching includes providing students the freedom of choice while completing tasks and incorporating their interests, curiosities, or sense of challenge into the lesson (Stroet et al., 2015a, 2015b). Furthermore, it includes connecting the learning activity to a goal that is meaningful to students. Moreover, it includes showing respect toward students, with teachers listening and responding to students' thoughts, feelings, complaints, and perspectives. Additionally, Roth et al. (2007) argue that when teachers demonstrate

autonomous motivation in their teaching practices by supporting the students' sense of autonomy, they eventually foster students' autonomous motivation for learning. The argument by Roth et al. (2007) suggests that when students perceive their teachers as autonomy supportive, it positively influences the quality of their motivation, i.e., making it more autonomous. Competence-supportive teaching includes providing structure to students (Stroet et al., 2015a, 2015b). This can be done by providing consistent and clear guidelines, being available when students have questions regarding tasks, providing step-by-step directions, encouraging students based on internal controllable factors instead of inborn talents, and providing constructive, non-comparative feedback. Finally, relatedness-supportive teaching concerns the desire to create and maintain strong and stable relationships, to have a feeling of belongingness, and to connect with and be accepted by others (Stroet et al., 2015a, 2015b). This desire can be achieved by showing affection, showing understanding of what is important for students (attunement), and being available to all students in the class to offer support.

Based on the theoretical background presented in this section, it is hypothesized that the students who have not elected chemistry in their SCC experience more controlled forms of motivation. In contrast, it is expected that students who have elected chemistry experience more autonomous forms of motivation. Secondly, it is expected that a positive correlation exists between supporting BPNs and autonomous motivation. Finally, it is hypothesized that students who have not elected chemistry perceive a lack of support of their BPNs. These expectations will be assessed by analyzing the differences between the subscales of motivational profiles, the RAI, and BPN subscales of both groups, and by exploring what students report during the focus group interviews.

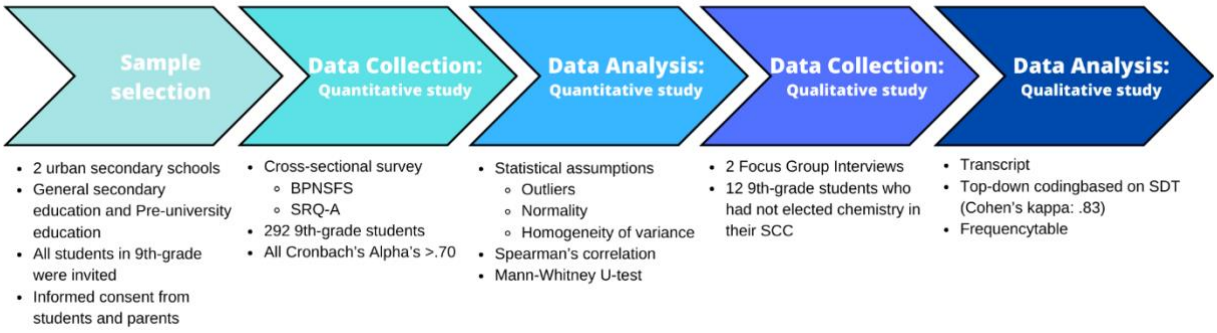
Methods

General approach

To answer the main research question, a mixed-methods, cross-sectional study is performed. To answer the first sub-question on what the differences in motivational profiles and perceptions of the support of BPNs are between students who have and have not elected chemistry in their subject cluster choice, a questionnaire was administered to a sample of students as part of the quantitative part of the study.

Subsequently, two focus group interviews were held as part of the qualitative part of the study to gain further insights into the motivational profiles and basic psychological needs of the students and to answer the second sub-question. Data collection was performed in accordance with the ethical guidelines of the Science Faculty of Utrecht University. Access to the data is available by contacting the main researcher. An overview of the research setup can be found in Figure 4.

Figure 4. Flowchart of research setup built up by Sample selection, Data Collection, and Data Analysis.



Participants

292 9th-grade students (14-15 years old) enrolled in general and pre-university chemistry courses from two urban secondary schools in The Netherlands participated in this study. The tutor of each selected class invited all students to participate at least one week in advance, and informed consent from both the students and their parents was obtained. The questionnaire was completed by 140 students from school A (conventional education) and 152 students from school B (Dalton education). Of these, 137 students were enrolled in general education classes, and 155 students were enrolled in pre-university classes.

The students were divided into two groups based on whether they had elected chemistry in their SCC or not (indicated by the students). The ‘YesChem’-group (N=132) consisted of students who had elected chemistry in their SCC and will take their final exams in chemistry. The group called ‘NoChem’ (N=144) consisted of students who had not elected chemistry in

their SCC: these students will not take their final exams in chemistry but need to continue following chemistry until the end of the 9th grade. Finally, there was the 'DontKnowChem' group (N=16) which included students who were still undecided about their SCC or were waiting for approval from their teachers or career counselors. This group was excluded from the analysis for different reasons. Firstly, the size of this group is much smaller than the other two groups, complicating statistical analyses. Secondly, this group will not contribute to answering either of the sub-questions of this study.

Within every class, a mix of students from the groups 'YesChem' and 'NoChem' are present. This mix within each class increases the internal validity of the comparison since both groups are in the same environment and have the same teacher and classmates. The number of students in each group varied between the classes (from 13% to 77% for YesChem).

The participants of the two focus group interviews are 12 students from the NoChem group (stratified sampling). All students within the 'NoChem'-group were invited to participate in the focus group interviews. Subsequently, from the list of volunteer students, 6 students were randomly selected at each school. The composition of each focus group was three students from general education and three students from pre-university education, of which at school A two were girls and four boys, and at school B four girls and two boys.

Instruments

Questionnaire

The questionnaire consists of 34 5-point Likert scale items, which can be found in Appendix I. The questionnaire will be administered in Dutch (see Appendix II). This questionnaire contains questions related to constructs as measured in the Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989; Sierens & Vansteenkiste, 2009) and Basic Psychological Needs Satisfaction and Frustration Scale (BPNSFS; Chen, van Assche, et al., 2015; van der Kaap-Deeder et al., 2020). The SRQ-A part of the questionnaire includes 16 questions, with four questions per category of motivational profile (External-, introjected-, identified-, intrinsic regulation), while the BPNSFS section consists of 18 questions, with six questions per BPN, three items referring to frustration and three items referring to satisfaction. Both questionnaires have been subjected to validity and reliability testing for different ages, domains, and languages (Chen, van Assche, et al., 2015; Ryan & Connell, 1989; Sierens & Vansteenkiste, 2009; van der Kaap-Deeder et al., 2020), including in educational settings. Cronbach's Alphas were calculated after administering the questionnaire in this study. The subscale for autonomy ($\alpha = .80$), competence ($\alpha = .82$), and relatedness ($\alpha = .72$) consisted of 6

items each. The subscale for external- (α = .78), introjected- (α = .77), identified- (α = .81), and intrinsic regulation (α = .93) consisted of 4 items each. The internal consistencies for these subscales are considered acceptable (Landis & Koch, 1977).

Focus group interviews

Focus group interviews have specific advantages and limitations (Smithson, 2000). The interaction in focus group interviews allows participants to clarify or elaborate their views on the discussion considering points raised by other participants, thus expanding on views that might be left unheard in an in-depth one-to-one interview (Powell & Single, 1996). In addition, focus group interviews can help researchers quickly identify the wide range of perspectives the participants may hold (Powell & Single, 1996).

One issue that may occur is individuals dominating the focus group interviews with their opinions and, therefore, the possibility that other opinions may remain unheard (Smithson, 2000). It is important that during the focus group interviews, all individuals are offered the opportunity to provide their opinion. Another issue to consider is that the moderator's behavior and attitude can affect group interaction (Smithson, 2000). The moderator should take care to react objectively to varying answers. When individuals suppress conflicting, controversial, non-normative opinions in a focus group by fear of peer group disapproval (Smithson, 2000), the moderator can use the same terms as the group uses or can use inclusive terms. Moreover, the moderator can encourage the participants in discussing their different opinions with each other.

The focus group interview protocol (Table 1) was designed based on the satisfaction or frustration of autonomy, competence, and satisfaction (Ryan & Deci, 2000; van der Kaap-Deeder et al., 2020), autonomous- and controlled motivation described in SDT (Ryan & Deci, 2000, 2017), and need-supportive teaching described in a paper by Stroet et al. (2015).

Table 1. Protocol for focus group with questions and concepts.

Question	**Concept**
What do you think of the chemistry lessons?	General opinion
Why didn't you elect chemistry in your subject cluster choice?	General motivation
Do you find chemistry easy or difficult? Why...?	Need for competence
How do you feel about the classroom atmosphere?	Need for relatedness
Do you feel that the teacher is considering that you had not elected chemistry in your SCC?	Need for autonomy
What is it like to have to go to chemistry classes now even though you have not elected chemistry in your SCC?	General motivation
Do you have any suggestions on how we could improve this situation?	Suggestions for improvement

Data collection

Questionnaire

To answer the first sub-question on what the differences in motivational profiles and perceived support of BPNs are between students who have and have not elected chemistry in their subject cluster choice, the questionnaire was administered to 292 students through the online environment of Qualtrics. Before administering the questionnaire, the main researcher read out identical instructions in every class. Every student was asked to fill out the questionnaire individually without discussing it with classmates. When the students had questions, the main researcher provided process guidance.

Focus group interviews

Two semi-structured focus group interviews were held at least one month after administering the questionnaire at the school concerned. Both focus group interviews lasted approximately 30 minutes and were moderated by the main researcher. The interviews took place in an empty classroom during school hours. A potential concern is raised regarding the presence of researcher bias due to some of the students knowing the main researcher. This bias could include the possibility of participants providing socially desirable answers. It was therefore crucial for the main researcher to maintain objectivity during the interviews.

Data analysis

Questionnaire

After administering the questionnaire, data analysis was performed. The initial step involved computing composite variables for the SRQ-A and BPNSFS questions. In the case of the SRQ-A, there are 4 different types of motivation (external-, introjected-, identified-, and intrinsic regulation), and each of them had four questions with a 5-point Likert scale. For each type of regulation, the mean score was calculated by averaging the responses to the four related questions. Subsequently, the RAI was calculated for each student using Equation 1. It is important to consider that the Likert scale used in the questionnaire is converted into an interval scale for data analysis (Wu & Leung, 2017).

For the BPNSFS, several steps were taken to calculate the composite score for every BPN. The three BPNs can be frustrated or satisfied in any given situation. Per BPN, there are three questions related to satisfaction and three questions related to frustration, thus in total 6 questions on a 5-point Likert scale. Firstly, to ensure consistency in interpretation, the scores for the frustration-related questions were reversed. Secondly, a mean score was calculated for

each BPN by averaging the responses to three satisfaction-related items and three frustration-related items. The BPN subscales reflect the level of support for each BPN, with higher scores indicating better support.

The assumptions for a statistical test for interval scales were evaluated once the indexes had been calculated. Outliers were checked following two criteria: firstly, any participant who answered all questions with the same label on the 5-point Likert scale, and secondly, any participant who did not answer the open-ended question. If both criteria were met, participants were excluded from the analysis since it is expected that the student did not fill out the questionnaire seriously. In the end, no outliers were found that met both criteria. Therefore, no participants were excluded from the analysis.

Subsequently, to test the normality of the variables, the Kolmogorov-Smirnov normality test was performed. The results indicated that most of the variables were not normally distributed ($p < .05$). Furthermore, the homogeneity of variances was tested using Levene's test, which was found to be good ($p > .05$) for most of the variables. Given that the normality tests showed that the data did not meet the assumption of normality in most of the cases and that some of the variables showed inequality of variances, it was decided to perform non-parametric tests.

Consequently, descriptive statistics were calculated for all variables (see Appendix IV). Spearman's rank correlation was computed to assess the relationships between the different types of regulation, RAI, and the three BPNs. To analyze if there are significant differences in the motivational profiles between the 'YesChem' and 'NoChem', the means of the variables of these groups were compared by performing a Mann-Whitney U-test (supplemental data for differences between the two schools and different school levels are available in Appendices VI and VII). A Mann-Whitney U-test was performed since sample means were compared from two independent groups (McCrum-Gardner, 2008).

Focus group interviews

The audio recordings of the interviews were transcribed verbatim and were coded by a top-down approach based on the satisfaction or frustration of autonomy, competence, and satisfaction (Ryan & Deci, 2000; van der Kaap-Deeder et al., 2020), and need-supportive teaching described in a paper by Stroet et al. (2015). The categories are summarized in the codebook (Appendix III). After transcribing two other categories were created through a bottom-up approach, namely autonomous- and controlled motivation described in SDT (Ryan

& Deci, 2000, 2017). Moreover, the category named ‘suggestions’ was further separated into the categories: suggestions for autonomy-, competence- and relatedness support, through bottom-up coding. Subsequently, the categories were assigned to self-contained quotes in the transcripts. An independent researcher acted as a second coder to determine interrater reliability. The second coder was in near-perfect agreement (Cohen’s Kappa: .83) (Landis & Koch, 1977). The frequency of mentioned quotes coded in a specific category was determined. Analyzing the frequency of each category can give insights into how students perceive the support of their basic psychological needs during chemistry classes, what categories students need more support in, and what suggestions students provide on how these needs could be supported. The results of both focus group interviews were merged was justified by various factors: the students in both interviews were of similar ages, had elected a social science-based subject cluster, attended urban schools, and included students from both general secondary education and pre-university education.

Results

Questionnaire

Spearman's rank correlation was computed to assess the relationships between the different types of regulation (external-, introjected-, identified-, and intrinsic regulation), RAI, and the three BPNs (autonomy, competence, and relatedness). In Table 2 the results of the Spearman's rank correlation can be found. The results reveal that there is a positive and significant correlation between autonomous motivation (identified- and intrinsic regulation) and the support of the BPNs. There were negative and significant correlations between external regulation (part of controlled motivation) and the support of the BPNs.

*Table 2. Spearman's Correlations between different forms of motivation and basic psychological needs. **. Correlation is significant at the 0.01 level (2-tailed).*

		Autonomy	Competence	Relatedness
External Regulation	Correlation Coefficient	-.268**	-.262**	-.212**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	276	276	276
Introjected Regulation	Correlation Coefficient	.057	-.071	-.034
	Sig. (2-tailed)	.348	.242	.574
	N	276	276	276
Identified Regulation	Correlation Coefficient	.499**	.387**	.319**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	276	276	276
Intrinsic Regulation	Correlation Coefficient	.604**	.537**	.350**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	276	276	276
RAI	Correlation Coefficient	.593**	.541**	.383**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	276	276	276

Subsequently, a comparative analysis using the Mann-Whitney U-test was performed to analyze if there were significant differences in the motivational profiles between students who had elected chemistry in their SCC (YesChem) and those who had not (NoChem) (Table 3). The results indicated that students who had elected chemistry (YesChem) had scored significantly higher in introjected regulation ($Z = -1.964$, $p = .050$, $d = .237$, $\eta^2 = .014$), identified regulation ($Z = -10.544$, $p < .001$, $d = 1.632$, $\eta^2 = .400$), intrinsic regulation ($Z = -9.848$, $p < .001$, $d = 1.465$, $\eta^2 = .349$), and the RAI ($Z = -8.572$, $p < .001$, $d = 1.204$, $\eta^2 = .266$) as compared to students who had not elected chemistry (NoChem). No significant differences

were found between the two groups in terms of external regulation (Z = -1.503, p = .133, d = .181, η^2 = .008). In Figures 5 and 6 a visual representation of these results can be found.

*Figure 5. Differences in motivation profiles (external-, introjected-, identified-, intrinsic regulation) between students who had elected chemistry (YesChem) and those who had not (NoChem). *. Significant at the 0.05 level (2-tailed). **. Significant at the 0.01 level (2-tailed).*

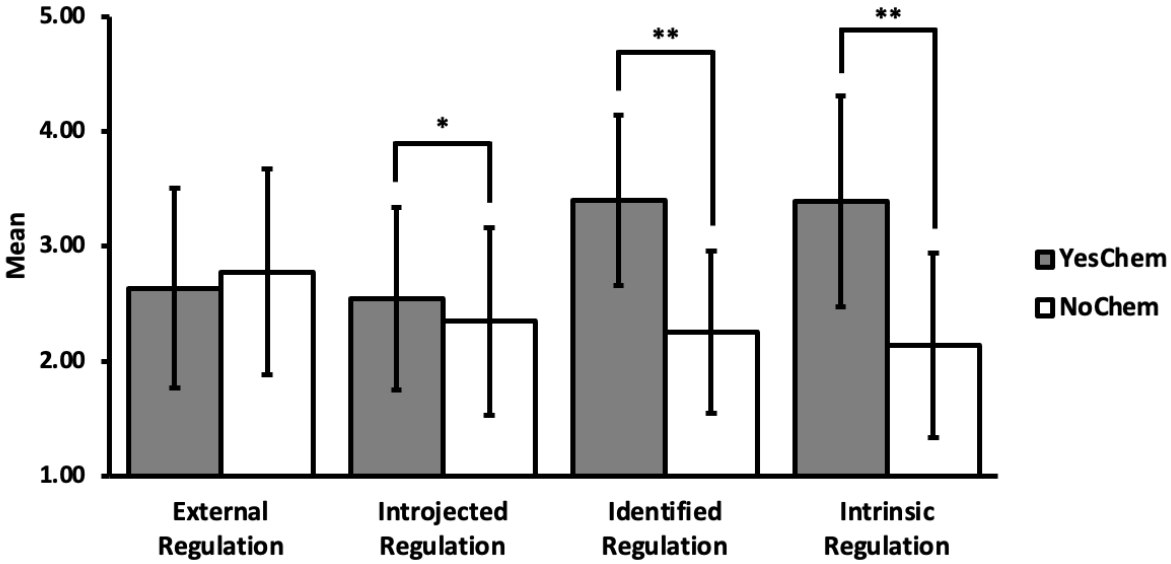
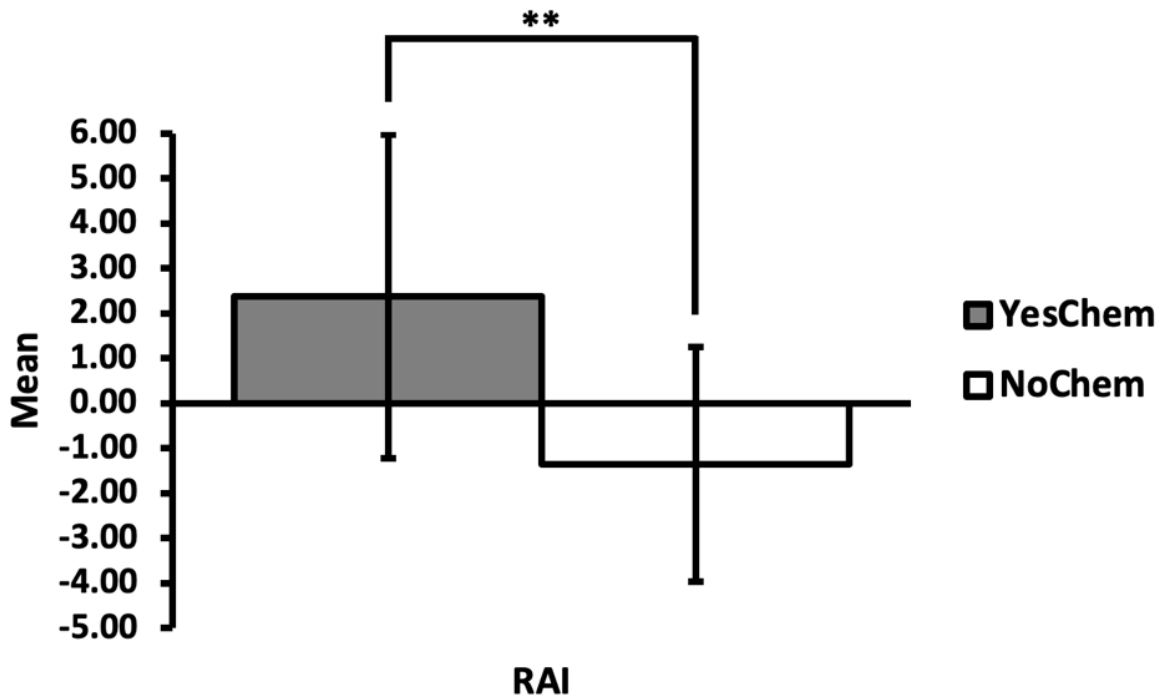


*Figure 6. Differences in RAI between students who had elected chemistry (YesChem) and those who had not (NoChem). **. Significant at the 0.01 level (2-tailed).*



Finally, to analyze whether a significant difference can be observed in the perceived support of BPNs between the two groups (YesChem and NoChem), a Mann-Whitney U-test was performed (Table 3). The results revealed that students who had elected chemistry in their SCC

(YesChem) had significantly higher scores on the support of autonomy (Z=-4.734, p<.001, d=.593, η^2=.081), competence (Z=-5.226, p<.001, d=.660, η^2=.098), and relatedness (Z=-2.251, p=.024, d=.272, η^2=.018) compared to students who had not (NoChem). In Figure 7 a visual representation of these results can be found.

*Figure 7. Differences in perceived support of BPNs between students who had elected chemistry (YesChem) and those who had not (NoChem). *. Significant at the 0.05 level (2-tailed). **. Significant at the 0.01 level (2-tailed).*

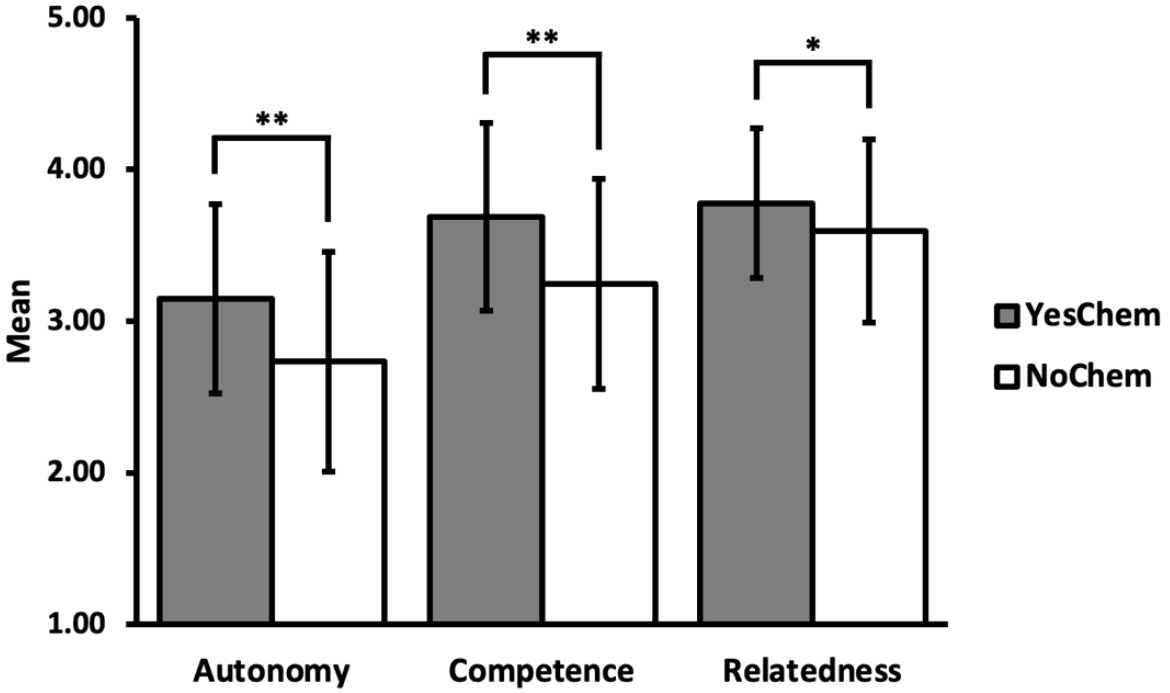


*Table 3. Test statistics of the Mann-Whitney U-test between the two groups (YesChem and NoChem), with their corresponding Cohen's d and Eta squared. Significant at the 0.05 level (2-tailed). **. Significant at the 0.01 level (2-tailed).*

Test Statistics[a]

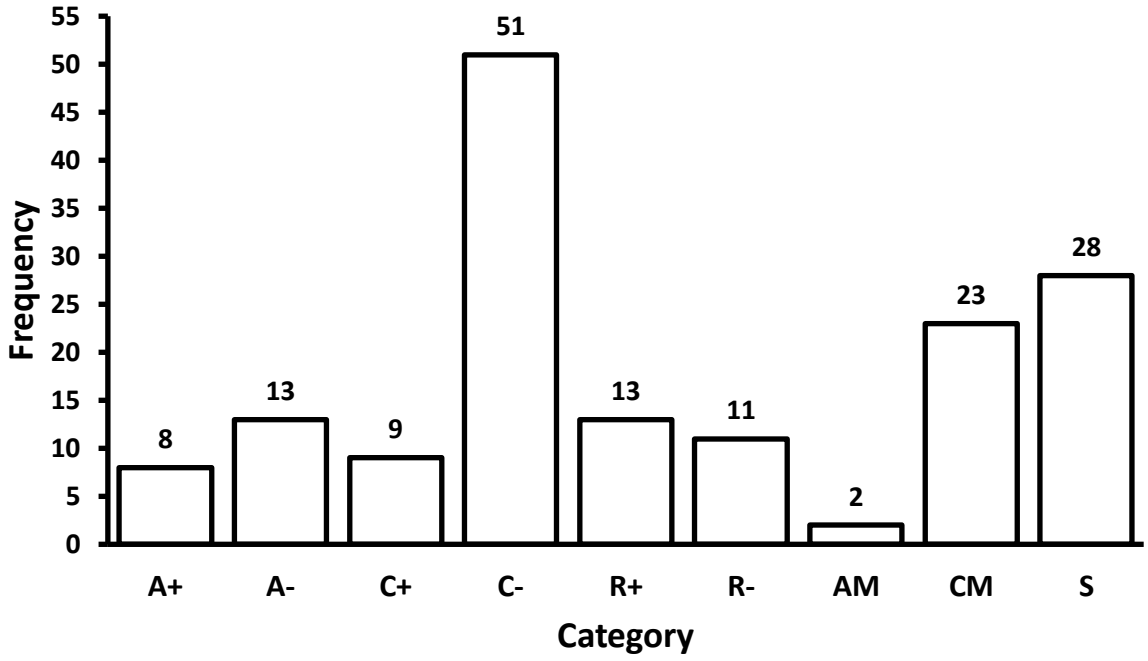
	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)	Cohen's d	Eta squared (η^2)
Autonomy	6377.500	-4.734	<.001**	.593	.081
Competence	6053.500	-5.226	<.001**	.660	.098
Relatedness	8020.500	-2.251	.024*	.272	.018
External Regulation	8512.500	-1.503	.133	.181	.008
Introjected Regulation	8209.500	-1.964	.050*	.237	.014
Identified Regulation	2545.500	-10.544	<.001**	1.632	.400
Intrinsic Regulation	3000.500	-9.848	<.001**	1.465	.349
RAI	3828.500	-8.572	<.001**	1.204	.266

a. Grouping Variable: YesChem or NoChem

Focus group interviews

During the focus group interviews with students from the NoChem group, 158 self-contained quotes were coded. The frequencies of each category (see Figure 8) reveal that most quotes from the focus group interviews belong to competence frustration (C-), followed by suggestions (S) and controlled motivation (CM). The categories in Figure 8 will now be examined in more detail.

Figure 8. Frequency of mentioned quotes (N = 158) within a category (Autonomy-, Competence- and Relatedness satisfaction (A+, C+, and R+) and frustration (A-, C-, R-), Autonomous motivation (AM), Controlled motivation (CM), Suggestions for improvement (S)) during focus group interviews.



Autonomy

During the focus group interviews, 13 quotes were mentioned highlighting autonomy frustration, representing an externally perceived locus of control. This category refers to quotes where students show a negative perception of autonomy, feel that their choices and behavior are externally controlled, are forced to engage in meaningless activities, and encounter disrespect from their teachers toward their opinions and complaints. Quotes illustrating this category are:

[1] "During break time, we're not allowed to use our phones, leave the classroom, eat, drink, and we just have to sit on our chairs."

[2] "It's just very boring, and it takes a long time."

[3] "Because what we do during each class has been pretty much the same."

On the other hand, eight quotes referring to autonomy satisfaction were mentioned, reflecting an internal perceived locus of control. This category refers to quotes where students show a positive perception of autonomy, feel in control of their own choices and behaviors, engaged in relevant learning activities, and have their feelings, thoughts, perspectives, and complaints respected by the teachers. Examples of quotes belonging to this category are:

[4] "It's only fun when we get to do some kind of experiment."
[5] "I like variety in lessons, that you don't do the same thing every time. Sometimes it is that we have to learn from our book, other times we have a Kahoot or a quiz."
[6] "Working in the lab I find more fun and interesting than just making assignments on paper."

Competence

A total of 51 quotes fell into the category of 'competence frustration'. This category refers to quotes where students show a negative perception of competence, feel inadequate, and lack mastery in their activities and tasks, including the difficulty of the subject. There is an absence or lack of structure, order in the class, clarity, guidance, effective instruction, encouragement, and informational feedback from the teacher. Quotes falling into this category include:

[6] "If you're doing assignments, for example, and you just raise a finger to ask a question, the teacher never comes over to help you."
[7] "The teacher is just trying to keep the class quiet. But the teacher can't do that well. The teacher can't really keep order."
[8] "If you get failing grades now, you'll probably get that next year too, so why wouldn't I just drop the subject?"
[9] "Because of bad instruction. Most subjects you can just learn and then understand, but for chemistry, you really need a good explanation to understand it."
[10] "It also builds up, so if you don't get it at the beginning of the year, you're not going to get it at the end of the year either. It just gets harder."

In contrast, nine quotes reflected the category 'competence satisfaction'. This category includes quotes where students show a positive perception of competence and feel a sense of mastery and success in their activities and tasks. There is structure, clarity, guidance, and

encouragement, and the teacher provides informational (constructive, non-comparative) feedback. Examples of quotes illustrating autonomy support include:

[11] "If you ask for individual instruction, the teachers can explain fine."
[12] "For example, if you learn something about those methods of separation and If you see it afterward in the lab, I understand it better because of that."

Relatedness

Within the focus groups, 11 quotes reflected the category of 'relatedness frustration'. This category refers to quotes where students show a negative perception of relatedness, feel disconnected and distrustful toward classmates or teachers, and perceive that teachers show disaffection, lack attunement, and are unavailable for support. Examples of this category are:

[13] "Then the teacher says "[student name], be quiet.", and then the teacher writes my name on the whiteboard, while I haven't even talked."
[14] "Personally, I don't like the teacher."
[15] "I don't know at all if the teacher knows that we are dropping chemistry."

On the other hand, 13 quotes reflected the category of 'relatedness satisfaction'. This category refers to quotes where students show a positive perception of relatedness, feel connected and trusting toward classmates or teachers, and perceive that teachers show affection, are attuned, and are available for support. Quotes from this category include:

[16] "The teacher is kind. I like the teacher. At the beginning of class, the teacher always asks how things are going."
[17] "The class atmosphere is nice and funny."
[18] "The teacher is very proud of us, the teacher often says: 'Well done, very well done!'."
[19] "And, I can just make a good joke with the teacher."

Autonomous- and controlled motivation

During the focus group interviews, only two quotes were mentioned highlighting autonomous motivation. This category refers to quotes where students express a genuine interest, curiosity, or enjoyment in the task or activity, or where students recognize the

importance or relevance of the task or activity and voluntarily choose to engage in it based on their personal beliefs, values, or aspirations. Quote [18] illustrates this category:

[18] " I don't really have a problem with chemistry lessons because I think chemistry is an interesting subject."

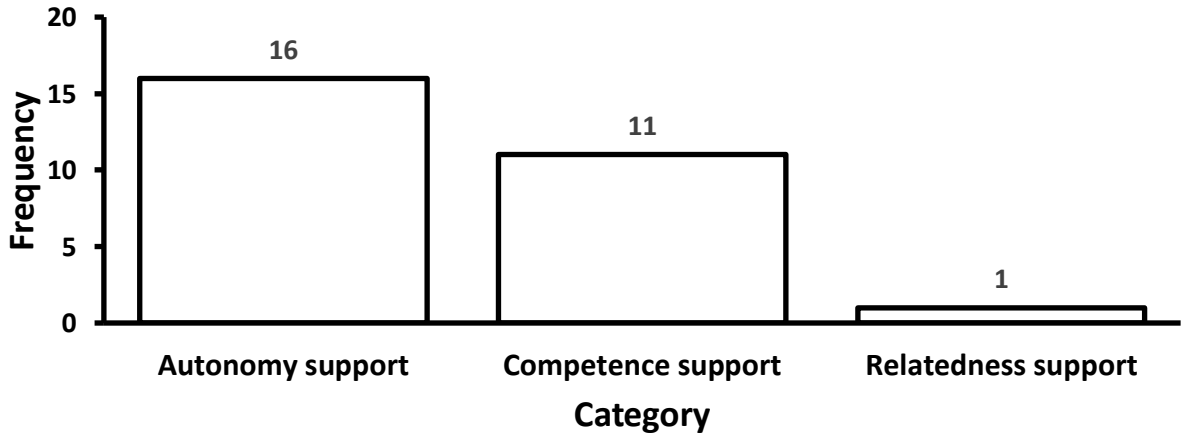
In contrast, 23 quotes were mentioned highlighting controlled motivation. This category refers to situations where a student's engagement in a task or activity is primarily driven by external factors, such as rewards, punishments, or social pressures, rather than an intrinsic desire. Examples of quotes belonging to this category are:

[19] "I don't like the subject chemistry anyway."
[20] "It really has absolutely nothing to do with the direction I want to go in. I don't know what that is yet, but I do know it's not chemistry."
[21] "It's kind of the same if you get a failing grade in a subject you don't elect, you still have to get a passing grade. You still have to learn."

Suggestions

Within the focus groups, 28 quotes were mentioned that reflected the category of 'suggestions'. This category refers to quotes where students provide recommendations, ideas, or suggestions related to the task or activity, or support their need for autonomy, competence, or relatedness. Figure 9 shows the frequency of suggestions separated by the support of the different BPNs.

Figure 9. Frequency of mentioned quotes within the suggestions category (N = 28), divided into the categories of autonomy-, competence- and relatedness support.



Most suggestions were mentioned related to autonomy support (16 suggestions), including the desire for autonomy in choosing the mode of learning, more variety in instructional methods, interactive elements, topics that are relevant to everyday life, and hands-on experiences. Examples of quotes illustrating autonomy support include:

[22] "That you have to listen less. That the teacher just talks for fifteen minutes and then just gives assignments, or a Kahoot and then do assignments."

[23] "We do a lot just on paper, but it would actually be more fun if you could do a lot in the lab."

[24] "For example, you have a choice: either you're going to do the assignments or you're going to do a quiz."

[25] "Topics we encounter in everyday life. That would make it better."

During the focus group interviews, 11 suggestions were mentioned related to competence support. Students desired better instruction, more demonstrations, and individualized approaches. Quotes from this category include:

[26] "Better instruction. That we really understand it, that everybody thinks: 'Oh yes, now I understand.'."

[27] "If possible, a demonstration for example. For instance, you have a sheet of paper and you set it on fire and then discuss what exactly happens. A video or something like that is also possible."

At last, only 1 suggestion was mentioned related to relatedness support, highlighting the importance of the teacher recognizing and considering the students' individual needs:

[28] "As a teacher, you have to determine how everyone learns and take that into account."

Different levels of education and schools

In Appendix VII, the results of the questionnaire for the different levels of education and different schools can be found. When considering different levels of education, it was found that students in Pre-university Education exhibit significantly higher levels of autonomous motivation compared to students in general secondary education. A small but significant difference was observed in the perceived support for the need for relatedness, favoring students

in Pre-university education. Regarding the different schools, students in school 2 experience significantly less controlled forms of motivation and perceive slightly better support for the need for relatedness than students in school 1.

In Appendix VIII, the frequency table per focus group interviews conducted at the different schools can be found. These results revealed that students in school 2 reported a higher number of ways in which their BPNs were satisfied than students in school 1. Moreover, they reported fewer ways where their BPNs were frustrated. Specifically, the difference in number of quotes within ‘competence frustration’ is remarkable, in which students in school 1 reported 38 quotes and students in school 2 13.

Conclusions

The research questions will now be revisited, starting with the sub-questions.

Sub-question 1

What are the differences in motivational profiles and perceived support for basic psychological needs between students who have and have not elected chemistry in their subject cluster choice?

The findings of this study reveal a positive and significant correlation between autonomous motivation (identified- and intrinsic regulation) and the support of the BPNs. This suggests that when students perceive greater support for their autonomy, competence, and relatedness, they are more likely to experience higher levels of autonomous motivation. Conversely, external regulation (part of controlled motivation) showed negative and significant correlations with the support of the BPNs. These findings provide general support for the SDT (Ryan & Deci, 2000) since they are consistent with internalization as a process that translates BPN support into more autonomous forms of motivation (Ryan & Deci (2000).

Furthermore, students who had elected chemistry scored significantly higher on autonomous motivation (identified- and intrinsic regulation) than those who had not. However, no significant differences were found in external regulation between the two groups. These findings suggest that students who had elected chemistry in their SCC were more autonomously motivated in comparison to those who had not. This is in line with the hypothesis and implies that when students have chosen to pursue the subject, they are more likely to experience more autonomous forms of motivation. Moreover, it suggests elective choice may play a role in shaping students' motivational profiles and influencing their level of autonomous motivation.

Thirdly, students who had elected chemistry reported significantly higher scores for their perceived support compared to those who had not. These findings imply that students who had not elected chemistry mostly perceive a lack of support for autonomy and competence, thereby confirming the hypothesis. In some way, students who had not elected chemistry perceive a lack of support for relatedness, however, it is not as significant and does not seem to be directly related to the elective choice of the subject. These findings emphasize the importance of creating supportive environments that foster autonomy, competence, and relatedness to promote students' autonomous motivation and engagement in their chosen subjects.

Sub-question 2

What do students who have not elected chemistry in their subject cluster choice report on ways in which their basic psychological needs are satisfied or frustrated?

The overall results of the focus group interviews align with the findings from the questionnaire, emphasizing the prevalence of controlled motivation and the perceived lack of support for autonomy and competence within the group that had not elected chemistry in their SCC. Students are eloquent in explaining when and how their BPNs are satisfied or frustrated and offering suggestions to address the issue of a lack of BPN support.

Firstly, regarding autonomy support, students expressed negative perceptions of external control, monotonous activities, and a lack of choice in the classroom. Students desired more opportunities to have control over their learning experience. Students would like to see more opportunities for hands-on activities, lab experiments, engaging or interactive tasks, and a variety of instructional methods. Allowing students to have more control over their learning experience and providing choices could enhance their perception of support for autonomy, especially for the student who had not elected chemistry.

Secondly, in terms of competence support, students expressed frustrations and concerns with inadequate instruction, a lack of (individual) support, and difficulties in understanding chemistry concepts. In terms of competence support, students expressed the need for better instruction, more demonstrations to enhance understanding of the subject matter, personal assistance, and opportunities to improve their grades. These findings highlight the importance of addressing competence frustrations among students who have not elected chemistry.

Finally, Students had mixed opinions regarding the support of relatedness. Overall, students valued a friendly and caring teacher who showed interest in their well-being. They emphasized the importance of positive teacher-student relationships, a positive class atmosphere, and recognition from teachers. The need for relatedness support is not necessarily specific to the subject of chemistry or the choice of elective subjects. Rather, it reflects the importance of creating a positive and supportive classroom environment for all students, including those who have not elected chemistry, where students feel valued, respected, and understood, which can enhance their sense of relatedness. Specifically, it could be that the students that had not elected chemistry emphasized relatedness satisfaction, as if they want to have fun, they probably need it from the fun atmosphere. This finding suggests that

emphasizing relatedness satisfaction can be a way to engage and retain students who have not chosen chemistry as their subject.

Main research question

How can the autonomous motivation for chemistry be supported in 9th-grade students who have not elected chemistry in their subject cluster choice?

Supporting students' basic psychological needs is crucial in fostering autonomous motivation for chemistry, especially in 9th-grade students who have not elected chemistry in their SCC. It is this group that suffers from a more controlled educational environment, they experience more controlled forms of motivation and a lack of perceived BPN support. Particularly, autonomy and competence frustration were prevalent among this group of students. This group of students expressed negative perceptions of external control, monotonous activities, lack of choice in the classroom, feelings of inadequacy, lack of support from teachers, and difficulty understanding chemistry concepts. In order to support them, teachers could adopt need-supportive teaching practices (Stroet et al., 2015b). In this research, the group of students that had not elected chemistry indicated what they need. Students' suggestions for improvement primarily focused on autonomy support, including more interactive and varied instructional methods, hands-on experiences, and relevant topics. Competence support suggestions focused on the need for better instruction, more demonstrations, and individualized approaches. Students emphasized the importance of positive teacher-student relationships, a positive class atmosphere, and recognition from teachers. These suggestions align with the concept of need-supportive teaching and emphasize the importance of autonomy, competence, and relatedness support in the classroom.

Considering the differences in motivational profiles and perceived BPNs support, the results suggest that the Dalton education approach implemented in School 2 may contribute to a more supportive and satisfying learning environment for students, resulting in lower levels of frustration and higher levels of satisfaction regarding their BPNs. When considering different levels of education, students in Pre-university Education exhibited significantly higher levels of autonomous motivation compared to students in general secondary education. The educational level and the type of school may have an impact on motivational profiles and perceived BPN support.

Discussion

Every school environment is controlled to some extent. However, this study revealed an explicitly controlled educational environment, which approximately 60,000 Dutch 9th-grade students face as soon as they have decided on their SCC. Their autonomous motivation is very much under pressure, especially for subjects like chemistry as these students are required to continue studying these subjects until the end of the school year. This research provides insights into the motivational profiles of students who have and have not elected chemistry in their SCC and their perception of the support of their BPNs. It is crucial for teachers to acknowledge this inherently controlled environment and find solutions to support this specific group of students. Fortunately, in this study, students reported useful suggestions to support their BPNs that align with previous research (Stroet et al., 2015b, 2015a). These findings highlight the importance of need-supportive teaching.

Regarding autonomy-supportive teaching, teachers should include a broader variety of interactive elements or hands-on activities, for instance, lab experiments, demonstrations, or websites like Kahoot.it or LessonUp.com. Moreover, the subject matter should be connected to their personal interests, curiosity, or real-world challenges. These conclusions align with the concept of providing students the freedom of choice while completing tasks and incorporating their interests, curiosity, or sense of challenge into the lesson, and connecting the learning activity to a goal that is meaningful to students, as described by Stroet et al. (2015b, 2015a). Allowing students to have a say in their learning process, such as selecting topics of interest or designing their own experiments, can enhance their autonomy and engagement.

In terms of competence support, teachers should offer clear instructions and explanations in the chemistry lessons, offer consistent guidelines, provide personal assistance and be available for questions, and provide constructive feedback. Stroet et al. (2015b, 2015a) describe the same concepts for competence-supportive teaching. Moreover, demonstrations can help students to gain a better understanding of the explained subject matter. Students also mentioned the importance of classroom management to maintain order and structure in the classroom.

Finally, relatedness support can be achieved by creating positive teacher-student relationships. Teachers must create a supportive and inclusive classroom environment where students feel valued and respected. Moreover, the teachers must listen and respond to teachers to show understanding of the student's thoughts, feelings, and perspectives and be available to offer support. These conclusions align with relatedness-supportive teaching, described by Stroet et al. (2015b, 2015a).

This study reveals the importance of adopting strategies for need-supportive teaching, especially for students who had not elected chemistry. Teachers can create a learning environment that supports students' basic psychological needs, thereby fostering their autonomous motivation for learning chemistry. It provides a foundation for developing interventions and can help educators and policymakers design strategies to support the BPNs and the specific needs of students. Furthermore, it provides valuable insights and strategies that can be applied across all subjects, not just limited to chemistry or the inherently controlled environment in which this research was performed. It is worth noting that secondary schools inherently possess controlling aspects, making the findings of this research relevant to other educational contexts.

The main limitation of this research is its cross-sectional and descriptive design. Longitudinal studies could offer more insights into, for instance, the change in motivational profiles and perception or support of the BPNs over time. This would make it possible to provide evidence for causal relationships between supporting BPNs and eventually a shift toward more autonomous forms of motivation. This research only shows correlations between the variables. Moreover, it is important to take into consideration that the Likert scale used in the questionnaire is converted into an interval scale for data analysis (Wu & Leung, 2017). However, statistical assumptions for interval data considering normality, homogeneity of variances, and outliers were tested. On the other hand, the sample size of approximately 300 respondents for the questionnaire and the good values obtained for both Cronbach's Alpha and Cohen's Kappa need to be included here. The mixed-method approach, combining quantitative and qualitative data collection methods, adds considerable insight to the world of the 9th grader taking chemistry by enriching the quantitative findings with a more comprehensive understanding. Through qualitative data, students can express their experiences, and perspectives, and provide detailed examples related to their motivation and perceived support for basic psychological needs, which may not be fully captured by quantitative data alone.

As mentioned before, a longitudinal study could offer more insights into the change in motivational profiles and the perception or support of the BPNs over time. Additionally, further research can be done for other subjects or in other educational settings to investigate whether similar issues arise in other elective subjects or indeed in mandatory subjects such as Dutch, English, or mathematics. Secondly, other factors influencing student motivation or perceived support of the BPNs, such as demographic, cultural, or contextual, can be investigated. Thirdly, investigating how motivational factors influence students' career choices related to chemistry or STEM fields would be beneficial for understanding the long-term impact of motivation on

career pathways. Lastly, an intervention considering the findings of this study can be designed and evaluated to improve students' motivation and engagement in chemistry.

References

Adelman, H. S., & Taylor, L. (1990). Intrinsic motivation and school misbehavior: some intervention implications. In *Journal of learning disabilities* (Vol. 23, Issue 9, pp. 541–550). https://doi.org/10.1177/002221949002300903

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*(6), 740–756. https://doi.org/10.1002/1098-237X(200011)84:6<740::AID-SCE4>3.0.CO;2-3

Centraal Bureau voor de Statistiek. (2022, April 22). *Vo; leerlingen, onderwijssoort in detail, leerjaar 2003/'04-2021/'22*. https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80040ned/table?dl=910C9

Cerasoli, C. P., Nicklin, J. M., & Ford, M. T. (2014). Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis. *Psychological Bulletin*, *140*(4), 980–1008. https://doi.org/10.1037/A0035661

Chen, B., van Assche, J., Vansteenkiste, M., Soenens, B., & Beyers, W. (2015). Does Psychological Need Satisfaction Matter When Environmental or Financial Safety are at Risk? *Journal of Happiness Studies*, *16*(3), 745–766. https://doi.org/10.1007/S10902-014-9532-5

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, R. M., Sheldon, K. M., Soenens, B., Van Petegem, S., & Verstuyf, J. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, *39*(2), 216–236. https://doi.org/10.1007/s11031-014-9450-1

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, *49*(3), 182–185. https://doi.org/10.1037/A0012801

Deci, E. L., & Ryan, R. M. (2015). Self-Determination Theory. In *International Encyclopedia of the Social & Behavioral Sciences: Second Edition* (Second Edi, Vol. 11). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.26036-4

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, *81*(2), 143–154. https://doi.org/10.1037/0022-0663.81.2.143

Haan, F. (2009, January 21). Profielkeuze komt voor scholieren veel te vroeg. *De Volkskrant*. https://www.volkskrant.nl/nieuws-achtergrond/profielkeuze-komt-voor-scholieren-veel-te-vroeg~b175045b/

Howard, J. L., Gagné, M., & Bureau, J. S. (2017). Testing a continuum structure of self-determined motivation: A meta-analysis. *Psychological Bulletin*, *143*(12), 1346–1377. https://doi.org/10.1037/BUL0000125

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin*, *22*(3), 280–287. https://doi.org/10.1177/0146167296223006

Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

McCrum-Gardner, E. (2008). Which is the correct statistical test to use? *British Journal of Oral and Maxillofacial Surgery*, *46*(1), 38–41. https://doi.org/10.1016/j.bjoms.2007.09.002

Milyavskaya, M., & Koestner, R. (2011). Psychological needs, motivation, and well-being: A test of self-determination theory across multiple domains. *Personality and Individual Differences*, *50*(3), 387–391. https://doi.org/10.1016/J.PAID.2010.10.029

Ministerie van Onderwijs Cultuur en Wetenschap. (2010). *Kerndoelen onderbouw voortgezet onderwijs*.

Ministerie van Onderwijs Cultuur en Wetenschap. (2020). *Hoe zit het vwo in elkaar?* https://www.rijksoverheid.nl/onderwerpen/voortgezet-onderwijs/vraag-en-antwoord/hoe-zit-het-vwo-in-elkaar

Ministerie van Onderwijs Cultuur en Wetenschap. (2021a). *Hoe zit de havo in elkaar?* https://www.rijksoverheid.nl/onderwerpen/voortgezet-onderwijs/vraag-en-antwoord/hoe-zit-de-havo-in-elkaar

Ministerie van Onderwijs Cultuur en Wetenschap. (2021b). *Wat is de onderbouw van het voortgezet onderwijs?* https://www.rijksoverheid.nl/onderwerpen/voortgezet-onderwijs/vraag-en-antwoord/onderbouw-voortgezet-onderwijs

OECD. (2019). PISA 2018 Assessment and Analytical Framework. *PISA 2018 Science Framework*, 97–117. https://doi.org/10.1787/b25efab8-en

Powell, R. A., & Single, H. M. (1996). Focus Groups. *International Journal for Quality in Health Care*, *8*(5), 499–504. https://doi.org/10.1093/INTQHC/8.5.499

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily Well-Being: The Role of Autonomy, Competence, and Relatedness. *Personality and Social Psychology Bulletin*, *26*(4), 419–435. https://doi.org/10.1177/0146167200266002

Roth, G., Assor, A., Kanat-Maymon, Y., & Kaplan, H. (2007). Autonomous Motivation for Teaching: How Self-Determined Teaching May Lead to Self-Determined Learning. *Journal of Educational Psychology*, *99*(4), 761–774. https://doi.org/10.1037/0022-0663.99.4.761

Ryan, R. M., & Connell, J. P. (1989). Perceived Locus of Causality and Internalization: Examining Reasons for Acting in Two Domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R. M., & Deci, E. L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness* (R. M. Ryan & E. L. Deci, Eds.). Guilford Press. https://doi.org/10.1521/978.14625/28806

Sheldon, K. M., & Elliot, A. J. (1998). Not all personal goals are personal: Comparing autonomous and controlled reasons for goals as predictors of effort and attainment. *Personality and Social Psychology Bulletin*, *24*(5), 546–557. https://doi.org/10.1177/0146167298245010

Sheldon, K. M., & Kasser, T. (1995). Coherence and Congruence: Two Aspects of Personality Integration. *Journal of Personality and Social Psychology*, *68*(3), 531–543. https://doi.org/10.1037/0022-3514.68.3.531

Sheldon, K. M., Ryan, R. M., Deci, E. L., & Kasser, T. (2004). The Independent Effects of Goal Contents and Motives on Well-Being: It's Both What You Pursue and Why You Pursue It. *Personality and Social Psychology Bulletin*, *30*(4), 475–486. https://doi.org/10.1177/0146167203261883

Sierens, E., & Vansteenkiste, M. (2009). *Wanneer 'meer minder betekent': motivatieprofielen van leerlingen in kaart gebracht*. https://www.researchgate.net/publication/293670840

SLO. (2022a). *Doorlopende leerlijn scheikunde havo*. https://leerplaninbeeld.slo.nl/regulier-onderwijs/5ca732b3-3ec2-4b13-9f08-d55b8739fe31/learning-path?subject=364c2519-7d9e-47d8-b3bd-371cee8583df

SLO. (2022b). *Doorlopende leerlijn scheikunde vwo*. https://leerplaninbeeld.slo.nl/regulier-onderwijs/b5a4f104-fb2d-4c71-8f36-702d9567a752/learning-path?subject=364c2519-7d9e-47d8-b3bd-371cee8583df

Smithson, J. (2000). Using and analysing focus groups: Limitations and possibilities. *International Journal of Social Research Methodology*, *3*(2), 103–119. https://doi.org/10.1080/136455700405172

Stroet, K., Opdenakker, M. C., & Minnaert, A. (2013). Effects of need supportive teaching on early adolescents' motivation and engagement: A review of the literature. In *Educational Research Review* (Vol. 9, pp. 65–87). https://doi.org/10.1016/j.edurev.2012.11.003

Stroet, K., Opdenakker, M. C., & Minnaert, A. (2015a). Need supportive teaching in practice: a narrative analysis in schools with contrasting educational approaches. *Social Psychology of Education*, *18*(3), 585–613. https://doi.org/10.1007/s11218-015-9290-1

Stroet, K., Opdenakker, M. C., & Minnaert, A. (2015b). What motivates early adolescents for school? A longitudinal analysis of associations between observed teaching and motivation. *Contemporary Educational Psychology*, *42*, 129–140. https://doi.org/10.1016/j.cedpsych.2015.06.002

van der Kaap-Deeder, J., Soenens, B., Ryan, R. M., & Vansteenkiste, M. (2020). *Manual of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS)*.

Véronneau, M. H., Koestner, R. F., & Abela, J. R. Z. (2005). Intrinsic need satisfaction And well-being in children and adolescents: AN application of the self-determination theory. *Journal of Social and Clinical Psychology*, *24*(2), 280–292. https://doi.org/10.1521/JSCP.24.2.280.62277

Wang, M.-T. (2012). Educational and career interests in math: A longitudinal examination of the links between classroom environment, motivational beliefs, and interests. *Developmental Psychology*, *48*(6), 1643–1657. https://doi.org/10.1037/a0027247

Wang, M.-T., & Degol, J. (2013). *Motivational pathways to STEM career choices: Using expectancy-value perspective to understand individual and gender differences in STEM fields*. https://doi.org/10.1016/j.dr.2013.08.001

Wang, Y., King, R. B., Wang, F., & Leung, S. O. (2021). Need-supportive teaching is positively associated with students' well-being: A cross-cultural study. *Learning and Individual Differences*, *92*. https://doi.org/10.1016/j.lindif.2021.102051

Wu, H., & Leung, S. O. (2017). Can Likert Scales be Treated as Interval Scales?—A Simulation Study. *Http://Dx.Doi.Org/10.1080/01488376.2017.1329775*, *43*(4), 527–532. https://doi.org/10.1080/01488376.2017.1329775

Appendices

Appendix I: English version of altered SRQ-A and BPNSFS questionnaire

Table 4. English questionnaire, adapted from SRQ-A (Ryan & Connell, 1989; Sierens & Vansteenkiste, 2009) and BPNSFS (Chen, van Assche, et al., 2015; van der Kaap-Deeder et al., 2020)

Question	Answer
Will you be choosing chemistry in your subject cluster choice?	"Yes", "No" and "I don't know"

Basic Psychological Need Satisfactory and Frustration Scale (BPNSFS)

Question	Basic Psychological Need	Answer
During the chemistry classes …		5-point Likert scale 1 = disagree 2 = rather disagree 3 = agree nor disagree 4 = rather agree 5 = agree
… I feel a sense of choice and freedom in the things I do in class.	Autonomy satisfaction	
… most of the things I do at school feel like an obligation.	Autonomy frustration	
… I feel excluded from the group of classmates I want to be a part of.	Relatedness frustration	
… I feel confident that I can do things well in school.	Competence satisfaction	
… I feel I can do what I really want to do.	Autonomy satisfaction	
… I feel forced in class to do many things I would not choose to do.	Autonomy frustration	
… I feel close to my friends at school	Relatedness satisfaction	
… I feel that my teachers and classmates are cold and distant toward me.	Relatedness frustration	
… I feel disappointed in my school performances	Competence frustration	
… I feel close to and connected with my teachers and classmates.	Relatedness satisfaction	
… I feel insecure about my skills.	Competence frustration	
… I feel I can successfully complete difficult tasks.	Competence satisfaction	
… I have a good time with people who are important to me.	Relatedness satisfaction	
… I feel that my decisions reflect what I really want	Autonomy satisfaction	
… I feel obliged to do too many things.	Autonomy frustration	
… I feel competent to achieve my goals.	Competence satisfaction	
… I feel insecure in relationships with some people who are important to me.	Relatedness frustration	
… I sometimes feel like a failure when I make mistakes.	Competence frustration	

Academic Self-Regulation Questionnaire (SRQ-A)

Question	Regulation	Answer
I am motivated for the subject chemistry because…		5-point Likert scale 1 = disagree 2 = rather disagree 3 = agree nor disagree 4 = rather agree 5 = agree
… I am supposed to do this.	External regulation	
... others (parents, friends, teachers...) force me to do this.	External regulation	
... others (parents, friends, teachers...) don’t get mad at me.	External regulation	
... I will get in trouble if I don't.	External regulation	
... I want others (parents, friends, teachers...) to think I am wise.	Introjected regulation	
... I feel bad about myself when I don’t	Introjected regulation	
... I would feel ashamed if I didn't.	Introjected regulation	
... I want to give others (parents, friends, teachers...) the impression that I am a good student.	Introjected regulation	
... I want to learn new things.	Identified regulation	
... I find chemistry very important.	Identified regulation	
... chemistry is important for what I want to do in the future.	Identified regulation	
... it's important for me to do my best.	Identified regulation	
... studying chemistry interests me a lot.	Intrinsic regulation	
... studying chemistry is fun.	Intrinsic regulation	
... I find chemistry a fascinating subject.	Intrinsic regulation	
... I find studying chemistry an enjoyable activity.	Intrinsic regulation	

Appendix II: Dutch version of altered SRQ-A and BPNSFS questionnaire

Table 5. Dutch questionnaire, adapted from SRQ-A (Ryan & Connell, 1989; Sierens & Vansteenkiste, 2009) and BPNSFS (Chen, van Assche, et al., 2015; van der Kaap-Deeder et al., 2020)

Vraag	
Heb je scheikunde gekozen of ga je scheikunde kiezen in je profiel?	
Tijdens de scheikunde lessen…	**Antwoord**
… heb ik in de klas een gevoel van keuze en vrijheid in de dingen die ik doe.	5-point Likert scale 1 = disagree 2 = rather disagree 3 = agree nor disagree 4 = rather agree 5 = agree
… voelen de meeste dingen die ik doe aan alsof 'het moet'.	
… voel ik me uitgesloten uit de groep medeleerlingen waar ik bij wil horen.	
… heb ik er vertrouwen in dat ik dingen goed kan doen.	
… voel ik dat ik kan doen wat ik echt wil.	
… voel ik me in de klas gedwongen om dingen te doen waar ik zelf niet voor zou kiezen.	
… voel ik me verbonden met mijn vrienden op school.	
... voel ik dat mijn docent en medeleerlingen koud en afstandelijk zijn tegen mij.	
… voel ik me teleurgesteld in mijn schoolprestaties.	
... heb ik een warm gevoel bij de leerlingen en docent waarmee ik tijd doorbreng.	
… voel ik me onzeker over mijn vaardigheden.	
… voel ik dat ik moeilijke opdrachten succesvol kan voltooien.	
… heb ik het fijn met mensen die belangrijk voor me zijn.	
… is wat ik doe, ook echt wat ik wil doen.	
… voel ik me verplicht om te veel dingen te doen.	
… kan ik mijn doelen bereiken.	
... voel ik dat de banden die ik heb met medeleerlingen en de docent snel verloren zullen gaan.	
… voel ik me soms een mislukking door de fouten die ik maak.	
Ik doe mijn best voor het vak scheikunde…	
… omdat ik slecht over mijzelf denk als ik dat niet doe.	
… omdat ik scheikunde een aangename bezigheid vind.	
… omdat dat moet.	
… omdat ik vind dat scheikunde belangrijk is.	
… omdat scheikunde leuk is.	
… omdat ik problemen krijg als ik dat niet doe.	
... omdat ik anderen (ouders, vrienden, docenten…) de indruk wil geven dat ik een goede leerling ben.	
… omdat scheikunde belangrijk is voor wat ik later wil doen.	
… omdat ik wil dat anderen (ouders, vrienden, docenten…) denken dat ik verstandig ben.	
… omdat scheikunde erg interessant is.	
… omdat ik nieuwe dingen wil leren.	
… zodat anderen (ouders, vrienden, docenten…) niet boos worden op mij.	
… omdat ik me zou schamen als ik het niet zou doen.	
… omdat ik scheikunde een fascinerend vak vind.	
… omdat het voor mij belangrijk is om mijn best te doen.	
… omdat anderen (ouders, vrienden, docenten…) me hiertoe verplichten.	

Appendix III: Codebook for the focus group interviews

Table 6. Codebook

Category	Name	Description	
A+	Autonomy satisfaction	Quotes by students showing a positive perception of autonomy: students are in control of one's own choices and behaviors, fostering relevance, and respect for students' feelings/thoughts/perspectives/complaints.	Top-down coding
A-	Autonomy frustration	Quotes by students showing a negative perception of autonomy: students have a feeling that their choices and behavior are being controlled by external sources, forcing meaningless activities, and disrespect for students' feelings/thoughts/perspectives/complaints.	
C+	Competence satisfaction	Quotes by students showing a positive perception of competence: students have a feeling of mastery and success in one's activities and tasks. There is structure, clarity, guidance, encouragement, and informational (constructive, non-comparative) feedback.	
C-	Competence frustration	Quotes by students showing a negative perception of competence: students have a feeling of inadequacy and lack of mastery in one's activities and tasks. There is no structure, disorder in the class, no clarity, no guidance, discouragement. There is chaos and no informational feedback from the teacher.	
R+	Relatedness satisfaction	Quotes by students showing a positive perception of relatedness: students have a feeling of connection and trust with classmates or teachers. Teachers show affection, and attunement and are available for support.	
R-	Relatedness frustration	Quotes by students showing a negative perception of relatedness: students have a feeling of disconnection and distrust with classmates or teachers. Teachers show disaffection, no attunement, and are unavailable for support.	
S	Suggestions	Quotes by students providing suggestions for the support of basic psychological needs	
AM	Autonomous motivation	Quotes by students showing autonomous forms of motivation described in SDT.	Bottom-up coding
CM	Controlled motivation	Quotes by students showing controlled forms of motivation described in SDT.	
AS	Autonomy support	Quotes by students providing suggestions for the support of the need for autonomy	
CS	Competence support	Quotes by students providing suggestions for the support of the need for competence	
RS	Relatedness support	Quotes by students providing suggestions for the support of the need for relatedness	

Appendix IV: Descriptive statistics for basic psychological needs and different forms of motivation for YesChem and NoChem

Table 7. Descriptive statistics

		Autonomy		Competence		Relatedness		External Regulation		Introjected Regulation		Identified Regulation		Intrinsic Regulation		RAI	
		YesChem	NoChem	YesChem	NoChem	YesChem	NoChem	YesChem	NoChem	YesChem	NoChem	YesChem	NoChem	YesChem	NoChem	YesChem	NoChem
Mean		3.1477	2.7326	3.6869	3.2465	3.7765	3.5938	2.6345	2.7760	2.5455	2.3455	3.4015	2.2535	3.3902	2.1389	2.3674	-1.3663
95% Confidence Interval for Mean	Lower Bound	3.0404	2.6135	3.5803	3.1324	3.6916	3.4942	2.4848	2.6285	2.4087	2.2109	3.2737	2.1375	3.2322	2.0066	1.7473	-1.7961
	Upper Bound	3.2550	2.8518	3.7934	3.3606	3.8614	3.6933	2.7841	2.9236	2.6822	2.4801	3.5294	2.3694	3.5481	2.2712	2.9876	-.9365
5% Trimmed Mean		3.1613	2.7451	3.7017	3.2693	3.7767	3.6173	2.6086	2.7635	2.5156	2.3248	3.4087	2.2562	3.4108	2.1092	2.3927	-1.3383
Median		3.1667	2.8333	3.6667	3.2500	3.8333	3.6667	2.5000	2.7500	2.5000	2.2500	3.5000	2.2500	3.3750	2.0000	1.7500	-1.1250
Variance		.388	.523	.383	.480	.243	.365	.755	.802	.631	.668	.551	.496	.842	.645	12.973	6.808
Std. Deviation		.62315	.72346	.61884	.69267	.49288	.60454	.86900	.89566	.79407	.81721	.74249	.70400	.91752	.80306	3.60177	2.60914
Minimum		1.33	1.00	2.00	1.00	2.67	1.00	1.00	1.00	1.00	1.00	1.50	1.00	1.00	1.00	-9.00	-8.50
Maximum		4.67	4.33	5.00	4.67	5.00	4.83	4.75	5.00	5.00	5.00	5.00	3.75	5.00	4.00	10.75	5.00
Range		3.33	3.33	3.00	3.67	2.33	3.83	3.75	4.00	4.00	4.00	3.50	2.75	4.00	3.00	19.75	13.50
Interquartile Range		1.00	1.13	.79	.96	.79	.79	1.25	1.00	1.00	1.25	.75	1.00	1.19	1.25	5.19	3.50
Skewness		-.282	-.258	-.380	-.561	-.087	-.822	.433	.160	.577	.350	-.147	-.254	-.235	.297	.007	-.157
Kurtosis		.282	-.365	.019	.614	-.444	1.440	-.324	-.313	.693	-.334	-.354	-.740	-.383	-.711	-.009	-.095

Appendix V: Means per questionnaire item for YesChem and NoChem

Table 8. Means and standard deviation (SD) per questionnaire item for YesChem and NoChem

	YesChem (N=132)		NoChem (N=144)	
	Mean	SD	Mean	SD
During the chemistry classes …				
… I feel a sense of choice and freedom in the things I do in class.	3.45	.903	2.98	1.041
… most of the things I do at school feel like an obligation.	3.24	.926	3.48	1.064
… I feel excluded from the group of classmates I want to be a part of.	1.75	.928	1.85	.888
… I feel confident that I can do things well in school.	3.80	.759	3.19	.991
… I feel I can do what I really want to do.	3.08	.938	2.75	.972
… I feel forced in class to do many things I would not choose to do.	2.52	.842	3.01	1.087
… I feel close to my friends at school	3.67	.788	3.46	.989
… I feel that my teachers and classmates are cold and distant toward me.	1.86	.839	2.03	.892
… I feel disappointed in my school performances	2.14	.942	2.60	1.105
… I feel close to and connected with my teachers and classmates.	3.27	.820	3.07	.973
… I feel insecure about my skills.	2.20	.878	2.51	.946
… I feel I can successfully complete difficult tasks.	3.45	.919	2.92	.961
… I have a good time with people who are important to me.	3.61	.748	3.30	.983
… I feel that my decisions reflect what I really want	3.15	.953	2.38	.961
… I feel obliged to do too many things.	3.04	.920	3.23	1.043
… I feel competent to achieve my goals.	3.39	.836	2.83	.919
… I feel insecure in relationships with some people who are important to me.	2.29	.953	2.39	.909
… I sometimes feel like a failure when I make mistakes.	2.17	.985	2.35	1.093
I am motivated for the subject chemistry because…				
… I am supposed to do this.	2.55	1.100	2.27	.998
... others (parents, friends, teachers...) force me to do this.	3.39	.913	2.26	.931
... others (parents, friends, teachers...) don’t get mad at me.	3.19	.966	3.40	1.059
... I will get in trouble if I don't.	3.44	.943	2.16	.874
... I want others (parents, friends, teachers...) to think I am wise.	3.52	1.000	2.17	.968
... I feel bad about myself when I don’t	2.70	1.248	2.88	1.197
... I would feel ashamed if I didn't.	2.85	1.169	2.65	1.092
... I want to give others (parents, friends, teachers...) the impression that I am a good student.	3.38	1.176	1.67	.766
... I want to learn new things.	2.69	1.012	2.47	1.044
... I find chemistry very important.	3.40	1.097	2.10	.956
... chemistry is important for what I want to do in the future.	3.32	.968	2.47	1.037
... it's important for me to do my best.	2.37	1.094	2.50	1.229
... studying chemistry interests me a lot.	2.09	.895	1.99	1.024
... studying chemistry is fun.	3.25	1.094	2.03	.938
... I find chemistry a fascinating subject.	3.47	1.000	2.72	1.067
... I find studying chemistry an enjoyable activity.	2.28	1.114	2.33	1.152

Appendix VI: Descriptive statistics for basic psychological needs and different forms of motivation for different schools and school levels

Table 9. Descriptive statistics for basic psychological needs and different forms of motivation for different schools.

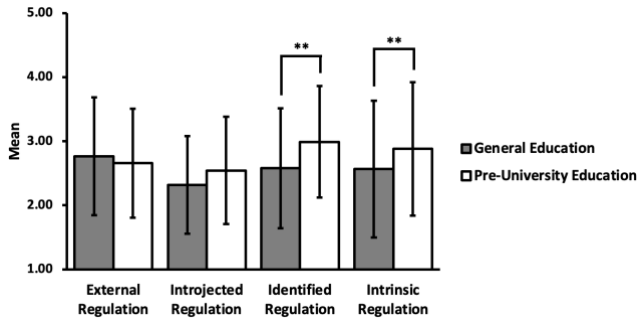
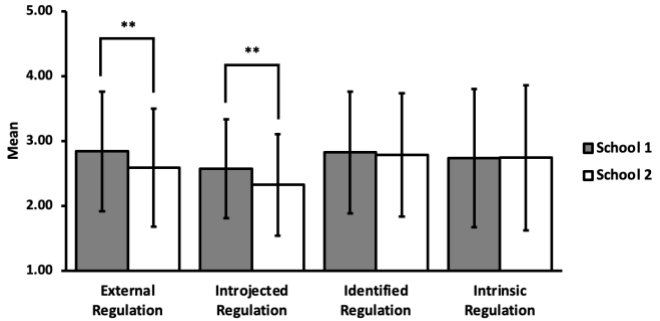
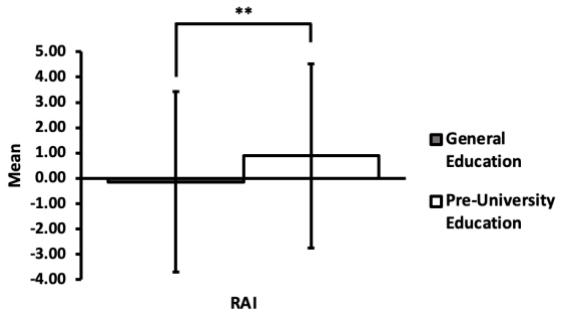
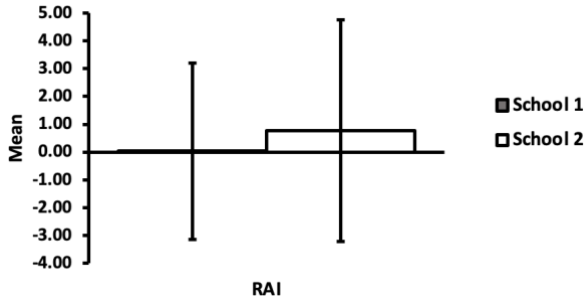
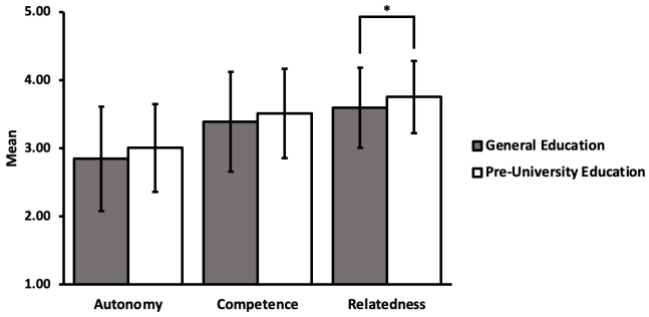
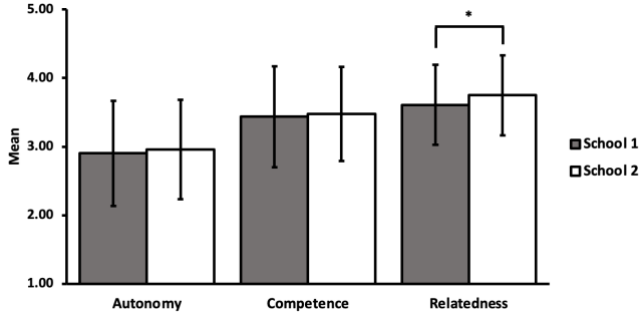
		Autonomy	Competence	Relatedness	External Regulation	Introjected Regulation	Identified Regulation	Intrinsic Regulation	RAI
School 1	Mean	2.9033	3.4351	3.6069	2.8378	2.5725	2.8225	2.7328	0.0401
	N	131	131	131	131	131	131	131	131
	Std. Deviation	0.68996	0.70516	0.52586	0.83948	0.82187	0.88768	0.99865	3.17015
	Median	3	3.5	3.6667	3	2.5	3	2.75	0
	Minimum	1.17	1.67	2.17	1	1	1	1	-9
	Maximum	4.17	4.83	4.67	5	5	5	5	9.25
School 2	Mean	2.9563	3.477	3.7483	2.5914	2.3224	2.7845	2.7414	0.7621
	N	145	145	145	145	145	145	145	145
	Std. Deviation	0.72409	0.68398	0.5837	0.90992	0.78501	0.95499	1.12013	3.98841
	Median	3	3.6667	3.8333	2.5	2.25	2.75	2.75	0.25
	Minimum	1	1	1	1	1	1	1	-8.5
	Maximum	4.67	5	5	4.75	5	4.75	5	10.75

Table 10. Descriptive statistics for basic psychological needs and different forms of motivation for different school levels.

		Autonomy	Competence	Relatedness	External Regulation	Introjected Regulation	Identified Regulation	Intrinsic Regulation	RAI
General Education	Mean	2.8439	3.3902	3.5952	2.7679	2.3194	2.5794	2.5675	-0.1409
	N	126	126	126	126	126	126	126	126
	Std. Deviation	0.76761	0.73278	0.58364	0.92042	0.76396	0.93683	1.06743	3.5656
	Median	2.8333	3.5	3.6667	2.75	2.25	2.5	2.5	-0.25
	Minimum	1	1	1	1	1	1	1	-8.5
	Maximum	4.17	5	4.67	5	4	5	5	10.75
Pre-University Education	Mean	3.0044	3.5133	3.7533	2.6583	2.5433	2.99	2.88	0.89
	N	150	150	150	150	150	150	150	150
	Std. Deviation	0.64591	0.65525	0.53153	0.85256	0.83733	0.86935	1.04018	3.63711
	Median	3	3.6667	3.8333	2.5	2.5	3	3	0.5
	Minimum	1.17	1.83	2.33	1	1	1	1	-9
	Maximum	4.67	5	5	4.75	5	4.75	5	10.25

Appendix VII: Differences in means of variables between different schools and different school levels

Table 11. Differences in means of variables between different schools and different school levels

	Level of education	Schools
Motivational Profiles		
RAI		
Basic Psychological Needs		

Appendix VIII: Frequency table of focus group interviews per school

Figure 10. Frequency of mentioned quotes (N = 158) within a category (Autonomy-, Competence- and Relatedness satisfaction (A+, C+, and R+) and frustration (A-, C-, R-), Autonomous motivation (AM), Controlled motivation (CM), Suggestions for improvement (S)) during each focus group interview.