

# MOTIVATIONAL STRUCTURE OF YOUNG CHEMISTS

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## ABSTRACT

**Aim.** The goal of this study is to investigate the motivational structure of participants of Chemistry Olympiad summer camps. The participants are young students who achieved the best results in chemistry olympiads. Chemistry is one of the least popular subjects among Czech students and therefore it is important to understand what motivates extraordinary, or gifted students, to learn.

**Methods.** Participants (N=38) completed a combination of qualitative and/or quantitative questionnaires. The primary questionnaire, known as the Motivational Induction Method (MIM), is a quality-quantitative questionnaire that uses the principle of open-ended questions. This method can provide a deep understanding of participants' plans, desires and wishes but also fears, inhibitions or problems. Other questionnaires used were: The Learning Motivation questionnaire and the Achievement Motivation questionnaire which measure the sources of motivation and proportion of achievement needs, respectively.

**Result.** The MIM questionnaire, providing qualitative-quantitative analysis, showed that participants' motivation was mainly focused on self (identity) and contact with others (social motivation). The Learning Motivation questionnaires revealed that the two most important motivational sources for learning chemistry were: One, the acquisition of a good profession in the future (instrumental motivation); and two, cognitive motivation, or simply the positive feeling one experiences from learning something new. The Achievement Motivational questionnaires revealed that participants' need to avoid failure was lower in comparison to general pupils.

**Key words:** Academic Olympiad, scientifically talented students, future time perspective, achievement motivation

## INTRODUCTION

The Chemistry Olympiad is a competition for gifted young students who are interested in chemistry. Joseph Renzulli (1977), who is an expert in the theme of psychology of giftedness, suggested that there are three factors in development of giftedness: a) ability, b) creativity and c) commitment. Partici-



pants of Chemistry Olympiad summer camps are certainly very capable; getting that far into the olympiad requires a deep understanding of chemistry and high aptitude in general. Although gifted students have higher than average cognitive abilities (measured by IQ tests) by between 15% and 50% (Reis, 1998; Ross, 1993; Richert, 1991; Pendarvis, Howley, A. & Howley, C., 1990 in Morisano and Shore, 2010), some of them actually achieved significantly below their intellectual and creative potential level in academic and work-related domains of their lives.

According to Detlef Urhahne, Lok Hang Ho, Ilka Parchmann & Sabine Nick (2012), motivation (except causal attribution) of olympiad participants is not studied systematically, therefore they used the *expectancy-value of achievement motivation* of Eccles, et al. (1983), and found a number of factors in achieving success in competitions including: positive parental influences, intelligence, prior achievement, school grades, motivation and emotions of the participants. The authors understood motivation in this model as setting short and long term goals, hope of success and fear of failure. In conclusion, it is possible to say that success requires not only a higher than average understanding of chemistry, but also a high level of motivation.

Motivation of gifted students in the Czech Republic is an area investigated by Jiří Mudrák. Mudrák (2012) found out that participants of Talnet<sup>1</sup> summer camps were motivated to work in Talnet because they gained new knowledge. Talnet is a project that offers educational, research and communication activities in various fields of physics, mathematics, chemistry, biology, geography, and technical disciplines for gifted students and their teachers. Gifted students might be in problematic situation in Czech schools because they have special education needs that are not addressed at some schools. This thirst for knowledge was also proved in the research carried out during science (chemistry, biology, physics and physical geography) olympiad summer camps by Vanda Janštová, Radka Dvořáková and Martin Jáč (2016). Janštová, Dvořáková and Jáč (2016) found that participating in chemistry olympiad summer camps positively influenced taking part in the chemistry olympiad the following year.

David McClelland, one of the most famous motivational psychologists suggested that "Motivation includes choosing some goals and not others, starting work towards a goal, and persevering in that work" (Clinkenbeard, 2012, p. 622). It can be seen that in McClelland's theory choosing the goals is one of the most important moments: if one does not have a goal, they can not start working towards it to have anything to achieve. Also, when people think about their goals, wishes and plans, they think about the future.

Joseph Nuttin (1985) understands the psychological future as a primary motivational space where all goal objects exist. These goal objects (wishes, plans, etc.) that lie in the future are anticipated in the present. For example, if someone is a fourteen year old student who wants to become a chemist and work in a laboratory, they have to focus on mastering chemistry and gain the knowledge and understanding that is needed to become a scientist. Nuttin

1 More information available at <http://www.talnet.cz>

(1985) calls this ability future time perspective: Willy Lens (who was Nuttin's colleague) and his colleagues (Lens, Paixão, Herrera & Grobler, 2012, p. 322) define future time perspective as "present anticipation of goals in the near and/or distant future."

Future perspective theory claims that setting goals in the future has a motivational impact on the present. From previous correlation studies it is well known that extended future time perspective predicts motivation and academic performance at school (Vansteenkiste, Simons, Soenens & Lens, 2004). Students with a longer future time perspective perceive school work as more valuable (de Bilde, Vansteenkiste & Lens, 2011). Philip Zimbardo and John Boyd (1999) found out that students with profound future time perspective have better grades. These suggestions were supported by a newer study (de Bilde, Vansteenkiste & Lens, 2011) where the authors claim that students with future time perspective have a more positive attitude towards school and have an easier time when dealing with school related problems.

Future time perspective can be defined "as an acquired personality characteristic that results from motivational goal setting" (Nuttin & Lens, 1985; Nuttin, 1964, 1980) which is formed by motivational goals that are in the near or distant future.

## PARTICIPANTS

The research was conducted during the Chemistry Olympiad summer camps<sup>2</sup>. The Chemistry Olympiad has a long tradition in the Czech Republic; the 55th cyclus is being held in 2018/2019. Participants of the Chemistry Olympiad, category D for youngest students (13-15 years), with the best results are invited to attend a two week long summer camp. These summer camps function as a reward and also as motivation for attending further rounds of the Chemistry Olympiad.

All participants were asked to collaborate on the research project, of which 38 agreed. Questionnaires were filled by 21 males and 17 females of an average age of 14 years, 9 months.

## METHODS

### Three different methods were used:

MIM developed by Nuttin (1980), which requires the participant to complete thirty sentences. The beginnings of these sentences are called inductors and are written in the first person singular. Their goal is to induce objects that are present in the participants' minds at the given moment. Inductors are positive (I plan... I desire...) and negative (I am afraid that... I would not be glad if... I fear...) and differ in emotional intensity. Filled answers can provide great

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2 <https://bestvinka.vscht.cz/>

insight into the motivational structure of participants. Motivational structure can be analysed in two ways: one, as motivational content; and two, as spatio-temporal localisation.

**Motivational content.** The structure of content analysis was taken by Nuttin (1980), who identifies 10 main categories. Some of the categories were adjusted for adolescent population by the author of this article (High, 2017). In the current version all answers can be classified into 9 main categories:

- Self - motivational objects that thematise the self or the personality;
- School - all motivational objects that are connected to education and school;
- Work - answers related to job and work;
- Contact - social contact with others;
- Exploration and knowledge - the desire to want to know more information and gain more knowledge;
- Transcendancy - religious or existential beliefs;
- Possessions - answers expressing the need to possess something;
- Leisure - free time and hobbies;
- Test - answers that refers to the test.

All categories have subcategories.

Time analysis divides answers into two main domains: short term and long term goals. Both categories can also be divided further.

**Spatio-temporal localization (time analysis).** Time analysis localises motivational goals into time periods when they are going to be realised. There are two main categories: calendar periods and social time periods.

Calendar period is the time that is measured by clocks or calendars: the moment when the questionnaire is taken, day(s), week(s), month(s) or year(s) (maximum of two).

Social time periods are beyond measurable and it is assumed that motivational goals are going to happen depending on the culture to which the participants belong. Social time periods contain the following periods: educational (basic school, high school, university), adult life (first half of working/professional life and second half of working/professional life) and old age (retirement).

There are some special codes as well: past (motivational objects that happened in the past), open present, life as a whole and humanitarian objects.

The Learning Motivation Questionnaire (Pavelková & Hrabal, 2010) measures the source of motivation and consists of 8 statements rated on the classic 5-point Likert scale from 1=completely disagree to 5=completely agree. The more points participants get, the higher their motivation is. The questionnaire captures the following motivational structures of the individual and motives for school activity (Hrabal & Pavelková, 2010, p. 128): one, positive relationship with the teacher; two, the need of prestige; three, knowledge motivation; four, moral motivation; five, successful performance; six, the fear of failure; seven, instrumental motivation; eight, motivational pressure.

The Achievement Motivational Questionnaire (Hrabal & Pavelková, 2011) is based on Atkinson's theory of achievement motivation and measures two

achievement needs. It consists of 12 questions, 6 of which identify the motive to achieve and another 6 which identify the motive to avoid failure. The task is to select one of the offered options for which it is possible to get from 1 to 5 points, with the maximum possible value of both needs being 30 points. Examples of questions: I try to do my best at school: a) almost always, b) often, c) sometimes, d) mostly not, e) almost never; I have a fear of school failures: a) almost always, b) often, c) sometimes, d) mostly not, e) almost never.

MIM was used as the main method because, due to its nature, it provides a deeper understanding of participants' motivation content. The latter two methods were used as control models in order to validate or invalidate the results.

## RESEARCH ETHIC

Prior to research, parents (or other legal representatives) of participants signed an informative agreement. Parents and participants were informed about the aim of the study, methods and the length of the study. All participants and their parents were assured that their names would not be used in the study.

Participants took part in the study freely. Also, any participant could withdraw from the study at any time without needing to provide a reason why or being questioned by those conducting the study. Two participants used this option and ended their participation in the initial stage.

## RESEARCH QUESTIONS

This study has three research questions: 1. What is the students' relationship to the future? 2. What are the motivational sources for learning? 3. What is the achievement motivation of the participants?

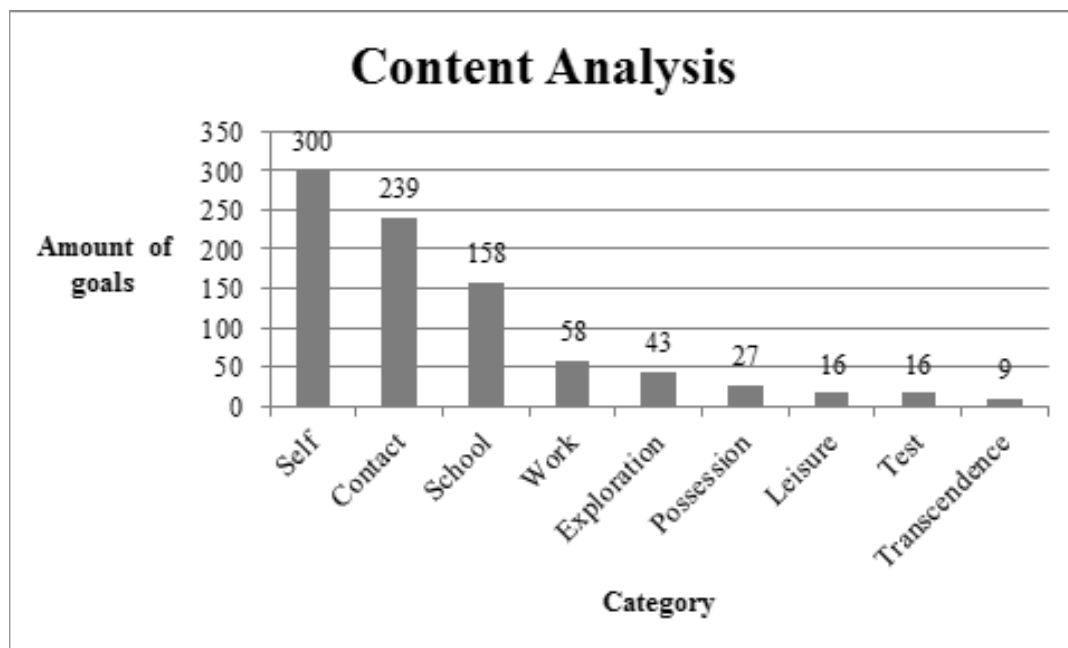
## RESULTS

Results are presented by the order of used measurement. The first part, Future as a Motivational Source, was measured by MIM.

### FUTURE AS A MOTIVATIONAL SOURCE

As already mentioned in the method description, it is possible to have a content and time analysis. First, the content analysis is examined.

All 39 participants answered the MIM questionnaire and these answers were categorized into 940 codes. All these answers and their codes are quantified in Figure 1 (below).



**Figure 1.**

Content Analysis of MIM

Source: author's research

The section below describes the categories and the particular answers of the participants. Categories and subcategories are sorted from those that occurred the most to those that occurred the least.

### *The Self*

The most used category was 'self' with 300 answers with the frequency of almost 35%. Self is a category with 10 subcategories. The main category (without closer specification) contained the answers that were too general: "be happy," "to have a nice life," "be fine." One participant wrote about "good future" and one about "calm life."

The most used subcategory was self-realisation, with 67 goals. It is usually connected with plans: planning to make dreams to come true or fear that these plans would not be realised in the future; for example, "do as much as possible for my dreams," "accomplish my biggest dreams," "dreams about personal and work life come true."

The second most used subcategory was self-preservation. Participants wrote a lot about their wishes to live or have a "calm life," "life without problems," "to get rid of conflicts" and "not to be stressed." They were afraid that something would happen to them. Wishes were also about their physical health: "not to be ill" or "be healthy."

Self aptitudes is a subcategory used especially for learning languages ("to know as many languages as possible," "to learn Spanish"). Participants wanted to gain a new strength: "to memorize things faster," "understand whatever I want to," "to get better in some areas."

The fourth most used subcategory was self content, the perception one has of oneself. Most answers were about the wish to be a normal and good person, for example: "to live like a normal good person"; some participants wanted to be a better person. On the other hand, there was also a group that wanted something else than to be average: they wanted "to be the best," "to reach the perfection." One girl explicitly said that she does "not want to be average."

Participants were at the age where they start to get closer to groups of other adolescents, the family becoming of secondary importance. It is possible to see this in the MIM questionnaire with 21 goals thematising self autonomy. Some goals in this subcategory were general ("to be autonomous," "not to be dependable"), some were more specific ("to live alone," "to be able to take care of my future family").

Self character are goals that represent personality traits. Participants wanted to be "empathetic," "nice and friendly," "to have higher volition." There were also three fears: participants were afraid that they are not smart enough.

It was possible to find eight answers that were in the category self and thematically connected with communication. Most of them were in the subcategory self: egocentric communication. These goals represented answers with the wish to be "indispensable," "to create something huge that everyone remembers."

### *Contact*

The second most used category is connected with 239 answers. Contact with others is very important for adolescents. They are at a crucial stage of their life where they establish a social identity. Although this category has also a lot of subcategories, most answers were coded as in a general contact. Participants wrote mostly about meeting new or interesting people with similar interests and having a positive relationship with the people around them. They wrote about their fear connected to contact: "that I will stay alone," "nobody will talk to me." They do not want to be in contact with people who do not understand them; conversely, they would like to find more people with whom they can be themselves.

Family related answers were in the research 38 times. Participants wrote about family in general: "to have a happy family," "to have a good relationship with my family." They also expressed concerns about the current family they live with: "my parents would be together again," "to work on relationship with my mother," "have a better relationship with my older sister." However, they also wrote about their future family: "I will have children one day," "have a son."

Intimate contact was a subcategory with 25 answers. These answers were mostly about finding a partner. Some participants were only vague and probably in the near future wanted: "to have a girlfriend," "to find a boyfriend," "be in love." I also found a number of answers that gave a little bit more information: "to marry a boyfriend who meets my standards," "do everything for my girlfriend."

Twenty-three answers were coded as humanity contact. It means that participants were concerned about humanity in general. They did not want to have wars, they did not want "people to destroy the planet," and were afraid that "people were going to destroy themselves." One reply was more proactive, stating they wanted to "to fight for freedom and fairness."

Seventeen answers were categorized into altruistic contact that described a willingness to help to help those close to the participants or society in general. The same number of answers were classified as contact with friends.

### *School*

School activities were found in 158 answers. The biggest number of goals regarded the subject which the participants wanted to study ("understand chemistry," "get better in other subjects," "study medicine"). They expressed wishes where they wanted to "study abroad," "study at the University of Chemistry and Technology," "study in Brno." These goals were usually in the further future. There were some fears about not being good at school and general statements as "I want to study."

Thirty three goals were about the Chemistry Olympiad. Most of these answers emphasised being good or winning the Chemistry Olympiad ("I want to win the Chemistry Olympiad," "to participate again in the Chemistry Olympiad" and "to attend Běstvinka again").

Thirty answers talked about graduation, most of them (18) explicitly wrote about graduating at the university level. Others used vague statements like "to finish school" which could have meant high school or university.

The beginning of school was mentioned 11 times. Typical answers were "to get in university" or "to pass entrance exams into Charles University."

Grades were important for 9 participants, the general statement being "to have good grades" or "I don't want to have bad grades."

There was a subcategory contact at school with seven goals. These goals thematise teachers "to have the same teachers next year," "not to have mrs. 'x' or 'y' teacher next year."

Only four statements were in the subcategory exams. All four of them were wishes for passing the maturity exam.

### *Work*

Only 58 codes were categorised into work and work related activities. Most of the goals were dedicated to having a good stable job. Another description of future job was: "happy job," "job with a good relationship with colleagues," or "successful job." Some participants were afraid that they are not going to find such a job. Some participants wrote exact jobs that they want to have in the future: six chemists, five scientists, four doctors, three teachers, one biologist, one mathematician ; moreover, one female wanted to become an architect and one male wanted to work for Google.



### *Knowledge and exploration*

Forty three goals were coded in this category, seven of which were general information, such as “to gain more knowledge” or “to learn a lot of things.”

More than half of the goals were connected to world exploration. This subcategory is based on gaining knowledge about the world itself: visiting countries and learning about their culture, “to get to know other countries,” “to visit Athens” and “to travel the world.” Cultural knowledge is also included in this subcategory, for example “to read ‘1984’,” “to play the guitar” and “to go to a mineral museum.”

Six answers thematised new experience in life: “to experience new things”, “get new experience.”

Five responses were categorised as knowing the self: “to know myself better,” “to know who I want to be.”

### *Possessions*

Possessions is a category with 27 codes. Most answers were about money and being rich or driving in beautiful sports cars. Two participants wanted to get pets, one wanted a new microscope and one wanted a new accordion.

On the 7th place there are 2 categories, both with 16 goals:

#### *Leisure*

Almost half of the goals were coded as physical leisure encompassing all sorts of sport activities: parkour, aikido, cycling, table tennis. Others were about having free time and more hobbies.

#### *Test*

There were positive or neutral comments: “I want to finish this test,” “to write the best answers for this questionnaire” and one negative comment, “I regret that I am a part of this research.”

### *Transcendence*

The answers that were connected with thinking about the meaning of life or the afterlife were categorized as as existential tendencies. This category involved seven goals, such as “to find the sense of life” and “to be remembered after my death.”

Two answers thematised religion, both showed negative attitudes: “I wish there was no religion.”

### *Time Analysis*

This part analyses localisation of motivational goals, i.e. when the goals, plans or wishes are supposed to happen in the minds of participants. Time categories are presented from most to least used according to figure No 2.

Calendar periods, study time and adult time have subcategories that are also presented in this article.

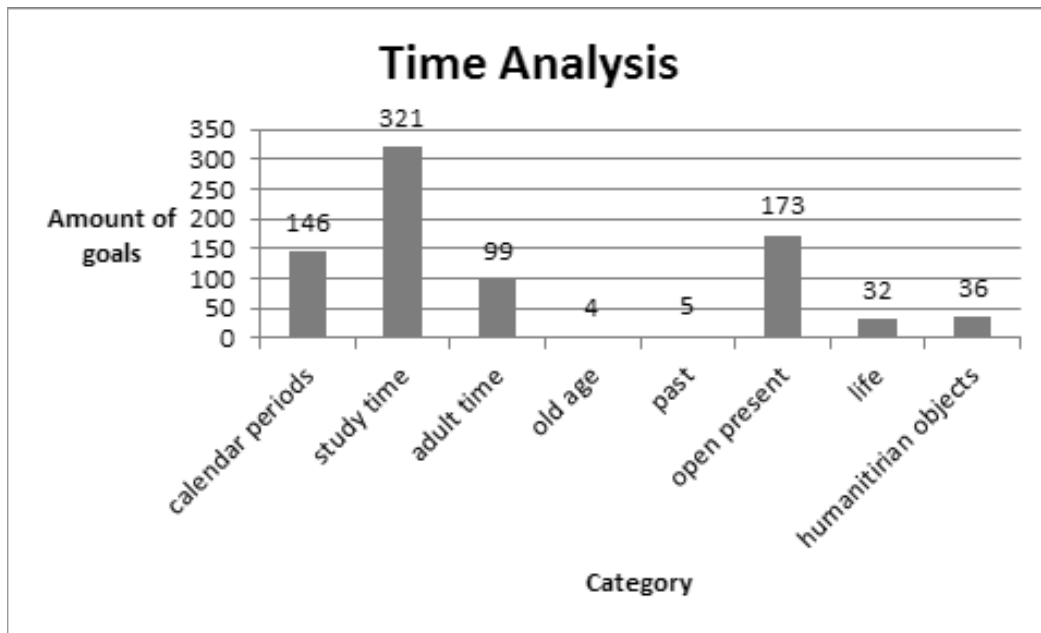


Figure 2.  
Time Analysis of MIM  
Source: author's research

### *Study time*

As can be seen in the figure 2.25% of goals were in the study time period. Some goals were coded only in the general period of study time. These were the goals that could be reached in that time, for example "to be a good student," "study well" or "finish school."

It was no surprise that most of the goals (23%) were in study time: basic school, that is the moment in time in which the participants were. Some of the answers regarded school, school subjects or classmates/teachers. Some examples are: "that chemistry is awesome, magnificent" and "to get better in some subjects."

Thirty five goals were coded as study time - high school. Participants mostly wrote about school related plans ("to finish high school" and "I hope that it is not going to be a problem with studying at high school") and about contact ("to gain truthful friends" and "to be in contact with my classmates when I'm in high school").

The least frequent subcategory was study time at university with 30 goals. Most of goals thematised studying at university ("to study chemistry" and "to get accepted to medicine"), or finishing it ("to get a title at University of Chemistry and Technology in Prague").

### *Open present*

The category open present had a frequency of 21%. A lot of answers had a vague time code with positive answers: "to be happy," "to be satisfied" and "to reach my goals" as well as negative answers (full of fear) - "not to have problems" and "to avoid conflicts."

There were motivational goals regarding one's personality: "to be smart," "to have self confidence" or "I am bashful."

*Calendar periods*

Almost 18% of all goals can be reached in calendar period: year.. Some of the goals were related to next year's chemistry olympiad, for example "to win the next round of of the chemistry olympiad," or "to be at the camp again." Some participants conceptualised their getting into their dream school: "go to my dream high school." There are also goals of intimate nature: "to find a good girlfriend."

4.5% of the answers could be reached in a calendar period - month(s). A lot of goals were about obtaining material possessions: phones, computers, microscopes, etc.

It was possible to find 18 answers about the current moment, i.e. the questionnaire. Most of them were positive ("I feel bad that I can't fill out more," "I hope that this test will help.")

Seventeen goals were in the category of week and days. Most of them regarded the situation at the camps: "to go out," or "to be with my group again."

*Adult time (adulthood)*

Twelve percent of answers thematised goals that were going to happen in the future when participants are adult. These 12% were divided into the general category of adult time (6%) and first half of adulthood (6%). In adulthood the goals are motivational or general and it is not possible to say when exactly in the adult life they are going to happen, for example "to live in a big city" or "to have a good future."

The first half of adult goals were coded regarding family: "to start a family," "to find my future wife" and work, such as "to work as a scientist," "to find a good job," or "to be a teacher."

*Humanitarian objects*

These 36 goals are very similar to the ones in humanity contact in content analysis: however, here, goals that thematised politics were added.

*Life*

In this category there are motivational goals that have the word life explicitly. For example: "to live a happy life," "to be happy my whole life," or "live a good life."

*Past*

There were 5 answers that had their motivational time-spacious setting in the past: "to change something I did in the past," or "I regret that I'm not little anymore."

*Old age*

The least numerous answers were coded as the last stage of life. It is reasonable that such young people have the least motivational goals reaching very far into the future. Typical answers were: "to have grandkids," "to be old," or "to be old and die in peace."

## MOTIVATIONAL SOURCES OF LEARNING

As shown in Table 1, participants were motivated by instrumental motivation (4.49 out of 5). This means they are oriented towards the future and learn because they want to have a specific job or to get into a higher level of school (usually university).

The second highest motivation is the need for successful performance (3.98). In the case of the participants in this experiment, another approach can be taken to interpret these results. Perhaps, the participants want to succeed in the next round of chemistry olympiad and/or in the international one.

The third source is knowledge motivation (3.78). In other words, having a good feeling when they learn something new motivates them. It makes sense because participants spent two weeks of their holidays being at a camp where the main goal is to learn new information.

It was not a surprise that our participants were least motivated by the fear of failure since indeed they are students with the best results in chemistry olympiad in the Czech Republic.

In the last column of the chart the norm is shown. Unfortunately only the norms that are valid for students from grammar schools are available. It means that researchers gained the norm from slightly older students. Therefore, the comparison of the results of this research and the norm is just approximate. The most interesting thing is the difference between norm (2.9) and results in this research (3.78) in need of prestige. Participants are much more motivated by prestige since they want to be better than others. It only makes sense that these students participated in academic olympiads. A big difference is present between the norm of moral motivation (4.1) and the results of this research (3.4). Isabella Pavelková and Irena Dvořáková (2015) understand moral motivation as a need to learn because students feel obligated to. However, this research has shown that our participants learn not because they have to but for a variety of other reasons.

**Table 1.**

Motivational source

Motivational source	Average	Standard deviation	Norm
positive relationship to teacher	2.59	1.13	3.1
need of prestige	3.78	1.10	2.9
knowledge motivation	3.91	1.02	3.5
moral motivation	3.40	1.41	4.1
successful performance	3.98	1.29	4.3
fear of failure	2.46	1.24	2.7
instrumental motivation	4.49	1.08	4.8
motivational pressure	3.43	1.31	4.3

Source: author's research

## ACHIEVEMENT MOTIVATION

The Achievement Motivational Questionnaire used in this study is standardised to basic school and high school population. If this group of participants is considered to be a class<sup>3</sup>, this standardised norm can be used. The results of the questionnaire are presented in Table 2.

The raw score of motive to achieve is 22.69, that is standard score 3. According to Hrabal and Pavelková (2011) it is an average result that has 40% of classes. The raw score of motive to avoid failure is 15, that is standard score 1 (very low). This low motive to avoid failure has only 10% of classes and about 11.6% of students (Vladimír Hrabal & Pavelková, 2011). Hrabal & Pavelková (2011) claim that this group of participants would be a class with no specific achievement orientation. This was a surprise for the author of the article. It was expected that these participants would have high achievement motivation.

**Table 2.**  
Achievement Motivation

	motive to achieve	motive to avoid failure
Average	22.69	15.22
Standard deviation	5.68	4.88

Source: author's research

## CONCLUSIONS

This study had 3 research questions that structure the discussion.

### **What are the students' relationships to the future?**

MIM showed that almost 36% of motivational goals regarded participants' self. At the time of questioning, participants were of adolescent age. According to Erik Erikson (1998), this is the time when identity is the main theme. The category of self can be seen as an identity so this result is not surprising. If this category is examined further, it can be seen that participants want to self realize. They are at the stage of life when they start to think about their future and future possibilities.

These results are consistent with the author's previous research (High, 2017) and bachelor theses where the author was a supervisor. It is a change from previous studies carried out by Pavelková (2002) where her participants had the highest frequency of motivational goals in contact, especially the wish for having an intimate relationship. The self was at the third place. In the longitudinal study by Pavelková (Pavelková, 1990 in Pavelková, 2002) it was found that students were most motivated by school. It is necessary to note that all these studies were done on the general student population, not the gifted.

<sup>3</sup> The author of this article is aware of the fact that this group is not a classical school class, therefore these results are only approximate.

Motivational goals that were connected to school had a frequency of 18%. These can be compared to Herreea (2010 in Lens, Paixão, Herrera & Grobler, 2012) who used MIM in her Peruvian research with students from high schools and universities and found out that between 23% and 30% of written goals were connected to self-realisation. Students from secondary schools wrote about finishing university surprisingly more (8.22% of all goals) than was expected (Herrera, 2010 in Lens, Paixão, Herrera & Grobler, 2012). Maria Paixão (1996 in Lens, Paixão, Herrera & Grobler, 2012) found that adolescents with high academic achievement had more goals in the self and self-realisation category than those adolescents with low academic achievement.

A different study (Herrera, Martinez & Matos, 2015) used MIM and measured the content of future time perspective in 202 Costa Rican, 217 Peruvian and 229 American university students. They found out that the frequency of educational goals in Peruvian adolescents is 23.04% and 24.08% in Costa Rican adolescents. American adolescents had lower frequency of educational goals (18.64%).

Time analysis showed that 25% of goals were in study time category. That is quite good news for educators because Nuttin (1980) understands this category as a long-term one.

#### **What were the motivational sources for learning?**

The highest motivational source was instrumental motivation. Pavelková and Dvořáková (2015) carried out research with 202 students from high schools and found that the most common motivational source was also instrumental motivation. The same result was also proven in the author's dissertation (High, 2017).

Michael De Volder and Lens (1982) found that students who attached more value to long-term goals and attached more instrumental value to their school work for achieving these goals were more motivated for their school work and had better academic results.

More recent experimental work indicates that experimentally increasing the perception of instrumentality causes a change in optimal learning rather than merely accompanying it (Simons, Dewitte & Lens, 2003 in de Bilde, Vansteenkiste & Lens, 2011).

#### **How is the achievement motivation of the participants?**

Motive to achieve is not as high as was expected. On the other hand, motive to avoid failure was extremely low. These participants were not afraid of failure. Pavelková and Dvořáková (2015), in research already cited, found that their participants scored 21.15. And it is necessary to re-emphasise that their participants were older than the ones in this research. In the author's dissertation participants of the same age scored 21.65 in motive to achieve and 20.49 in motive to avoid failure.

To briefly summarise, although there are differences among what participants want, plan or wish and what they actually achieve, participants of chemistry summer science camps have a positive motivational structure. Future rese-

arch should include longitudinal research to discover if participants achieve their motivational goals.

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