

## MOTIVATION OF CZECH STUDENTS OF SECONDARY TECHNICAL SCHOOLS TO STUDY ENGINEERING

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**Abstract:** The main aim of the paper is to introduce the recent findings of the motivation of secondary technical schools' students in the field of engineering. Technological progress requires higher quality and quantity of human resources working in engineering field, however, the interest of youth in studying the field is falling steadily. A project "Education in engineering and its optimisation for the needs of the labour market" led by the Technical Agency of the Czech Republic (TAČR), which is implemented by the Faculty of Education at the University of Ostrava together with the National Engineering Cluster is focused on discovering the factors influencing the choice of these fields, students' satisfaction with their studies, study aspiration and manifestation of an in-depth interest in technical fields. The results of a pilot research confirm that almost one half of the students believe they possess aptitudes for engineering professions.

**Keywords:** aptitudes for profession, labour market, motivation, secondary education in engineering, engineering practice.

### 1 Introduction

Engineering generates a significant part of the gross domestic product in developed countries. It requires qualified labour force educated at secondary technical schools and universities specialised in engineering. These schools are not currently considered as adequately attractive and desirable by children and young people and thus do not produce enough graduates for professional practice. That is why pupils' motivation to study at secondary schools specialised in engineering is rightly an important research subject. This paper focuses on the analysis of factors influencing the choice of professional education and selected motivational factors for studying the field of engineering in one region of the Czech Republic.

#### 1.1 Motivation as a Dynamic Part of a Personality

Motivation is an essential psychological and pedagogical topic, as evidenced by a significant number of theoretical approaches (Madsen, 1972; Cofer, Appley, 1964). Motivation toward studies in current circumstances should be examined within the context of the recent view on the education of 21st-century children. It is possible to understand contemporary children via four topics and their subtopics, covering both the positive and negative sides of the heart of the recent childhood phenomenon. The topics include: physical health (Play and activities, Eating habits, Alcohol and drug consumption, Sleep), emotional well-being (Social/emotional skills, Stress, Anxiety and depression, Suicide), digital technologies (Digital divide, Information as power, social networks, Cyber risks) and families (Changing family values, Diverse families, Ageing parents, Role of peers) (OECD, 2019).

Motivation is recognized as a person's varied set of motives towards a particular activity, work, entertainment or effort. It is an intrapsychic process resulting in an internal state, motive (Nakonečný, 1996). Rousing interest in activity also affects school education. At schools, students are encouraged towards specific behaviour, attitude, experience, overcoming obstacles, but also reducing certain displays, which then leads to an independent performance and potential growth of activity, understanding or sharing of knowledge, experience, gain or challenges to get to know the unknown. Motivation can be understood as a set of momentums in activities, experience, behaviour and personality. It helps students to recognise their primary interest at school and can also influence their direction towards a selected profession.

It is necessary to regard motivation as a complex process which plays a vital role in all stages of a person's life-long education, work orientation and personal experience. There is a close link between the motivation of each person and social motivation, which reflects social aims, cultural, value and ethical potential, needs and certain stimuli resulting in impulses in the behaviour of individuals, groups, nations and higher social units.

Motivation is not an isolated element; it can be understood as a coherent and complex process instigated by an initial motivational state which reflects a particular deficit in the physical or social being of an individual. The removal of the deficit is then experienced as a satisfaction (Nakonečný, 1996). Motivated students are more likely to achieve their professional growth goals throughout their active participation in studying, interest in technology, communication with the professional public, interest in professionally oriented engineering activities, teamwork in solving problems, interest in specialised literature and interaction with new technologies.

An experiential professional education focusing on the development of critical thinking and functional literacy is a crucial motivational factor as well. Ježová (2013) observes that motivation is closely related to emotions as they stimulate one another during activity.

Motivation is also closely tied to performance, but not only in the sense of competing with other individuals. Performance motivation is also manifested in a person's attitude to study and work. Work motivation expresses a worker's general approach to performed activities through specific tasks, a position held in the organisation and related employee role. It is manifested by performance, interest and effort in the work activity (Štikar, Rymeš, Rieger & Hoskovec, 2003).

#### 1.2 Sources and Causes of Motivation

According to biological theory, the primary sources of the motivation of human behaviour are instincts which significantly influence personality both physically and mentally. However, not all students are motivated by them to perform activities with the same momentum, with the same intensity in the school environment, at home and in the after-school environment in a broader context. "Motivation is related to human needs, time, hope, aims, performance, self-respect, interest in an activity, and searching for causes of success and failure" (Mareš, 2013). Needs and motives are internal mental states. A need is a state of psyche, which can influence, e.g. a student's decision whether they will finish their studies or not. A need expresses an initial motivational state, which, through experience, finds a particular activity and thus a behaviour pattern. A motive expresses the content of satisfaction. Students are encouraged to finish their studies so that they are happy with themselves.

The need to know is characterised by a hunger for knowledge, a desire to broaden mental horizons. It is occasionally called a cognitive or intellectual need. It is closely linked to the overall level of intelligence. It is a desire to learn and educate oneself. The need for knowledge is also connected with the need for manipulation, play, experimenting and work activity (Kohoutek, 2002).

Generally, there are several motives that influence one another. Motivation sources can be external agents (family, school, club, place of residence, set of economic, political, cultural circumstances) and internal agents (interests, aims, knowledge, abilities, perseverance, responsibility and health status, which are manifested during a game, work, learning process and hobbies) (Čáp & Mareš, 2001). Except for motivation sources, people are also interested in causes of motivation, that may be physiological processes happening in the brain and body, as well

as cultural and social interactions with individuals in our environment (Nolen-Hoeksema, 2012).

### 1.3 Research of Factors Influencing Students' Motivation to Study

McClelland (1975), who studied performance motivation, presented his respondents with pictures with ambiguous interpretation and asked for a narrative reaction via story. He discovered that stories from individuals with high performance motivation contained motives related to a specific effort, success etc. On the other hand, the narrations from individuals with lower performance motivation contained motives of boredom, speculative behaviour, lies. The research on the intensity of motivational incentives for an activity in Czech, English, Japanese, German, New Zealand and Scottish students (the research sample consisted of 1 256 students, 360 of which were Czech) showed that students' motivation sources statistically differed to a significant degree, and Czech students demonstrated a higher intensity of motivation sources (except fear of failure). They expressed their motivation to study regularly using the following statements: "I want teachers to like me, I want to be better than others, the things I learn interest me, I know that learning is my duty, I feel well when I learn something well, I want to have a good job (profession) in the future, my parents want me to do well at school" (Pavelková, Hrabal & Hrabal, 2010).

The examination of students' motives to study has been discussed by Šebestíková (2013). She compared motives to study in Year 4 students (graduation year) at two technical secondary schools; one specialised in engineering and the other in design. She discovered that more than half of the respondents (57%) were not happy with their choice of a secondary school and would instead select a different field at a different school. It is also worth noting that more than half of the respondents would like to study at university other than technical and that important motivation agents influencing the choice of a school can be students' interest in technical specialisation and proximity of the school to their home.

Svatoňová (2016) analysed motivation to learn in lower-secondary schools' pupils (aged 11-15) in the Czech Republic. She asked which subjects are their favourite and which are not and to what extent the motivation to learn is related to pupils' boredom at school. She states that pupils prefer organised activation learning which prevents boredom. External and internal motivation to study is almost even by the respondents (49.9%). She regarded the following pupils' statements about the internal motivation factors to study: "I enjoy it, I want to learn new information, I want to make my parents happy, I want to make my teacher happy, I am happy with good results, I want to be the best in class, I like the subject". She regarded the following pupils' statements as the external motivation factors to study: "I have to study because of my parents, teachers, I want to get to university, to get a good job, education is important in our society, I want to equal my parents".

In her research, Polom (2018) identified relations between the locus of control and motivation for success in students. She discovered that the increase in the motivation for success corresponds with a more internal locus of control and vice versa, the more external the locus of control, the lower the motivation for success. In other words, the more people are persuaded that they are able to control the results of their activity, the more they are motivated to succeed.

### 1.4 Research of Motivation Factors in Secondary Engineering Schools' Students

Selected factors of motivation to study in secondary technical engineering school students, or more precisely, factors influencing the choice of such a school or starting this type of profession, comprised the research subject. The main aim was to pilot authors' research tool usable for broader research and, at the same time, to collect primary data for the analysis of relevant

curricular documents and vocational and consultancy activities carried out in other schools specialised in the same field.

### 1.5 Research Methodology

A questionnaire used for data collection consisted of 29 items, (20 items were closed and nine open or half-open). For the purpose of this study, seven items were selected, and their phrasing is presented together with the results. The collection of data was carried out in April 2019 on a purposely selected sample of 79 students from Year 4 (graduation year) at the end of their secondary school education. The results are presented in a descriptive form as well as in the form of statistically assessed relations of selected variables.

### 1.6 Results of the Descriptive Analysis

*Question 1: Was the secondary school you study at your first choice on the application form? (yes/no)*

The first (dichotomous) item was examining whether the secondary technical engineering school completed by a school-leaving exam (maturita exam) students are currently finishing their studies at was their first choice.

It is apparent from the graph below that for 53 respondents (67.09%) the secondary technical engineering school they are currently finishing their studies at was their first choice on the application form. On the other hand, for 26 respondents (32.91%), the secondary technical engineering school was not their first choice on the application form. In other words, a greater number of respondents were first decided to study at a secondary technical engineering school completed by a school-leaving exam (maturita exam) which is specialised in computer technology and offers opportunities to work in the automotive industry.

*Question 2: Do you think that you have the aptitudes for the given profession? (yes/no)*

The second (dichotomous) item of the questionnaire was examining whether the secondary technical engineering school completed by a school-leaving exam (maturita exam) students think they have aptitudes for the chosen profession.

The graph below shows that 39 respondents (49.40%) stated that they think they have aptitudes for the chosen profession, and 40 respondents (50.63%) stated that they do not think they have aptitudes for the chosen profession. Half of the respondents are convinced that they have aptitudes to perform a profession specialising in engineering in the future.

*Question 3: Do you want to continue studying engineering at university after finishing the secondary school? (yes/no)*

The third (dichotomous) item of the questionnaire aimed to find out whether secondary technical engineering school students want to continue studying engineering at university.

44 respondents (55.70%) want to continue studying engineering at university after finishing their secondary school, and 35 respondents (44.30%) are not interested in studying engineering at university, and they can thus represent a staff potential for engineering companies and organisations.

*Question 4: In your free time, are you interested in engineering, e.g. machines, cars, technology? (yes/no)*

The fourth (dichotomous) item of the questionnaire was formulated to find out whether students are interested in engineering, e.g. machines, cars or technology in their free time.

It is apparent from the summation of respondents' answers that 52 of them (65.80%) are interested in engineering, e.g. machines, cars or technology in their free time and 27 respondents (34.20%) stated that they are not interested in engineering, e.g. machines, cars or technology in their free time. It can be noted that school and after-school activities of the significant share of the research sample are related to the studied field and, in the future, can become an aptitude for the engineering profession.

**Question 5:** In technical subjects, do you figure out certain information:

on your own / only from the teacher's lecture? (yes/no)

The fifth (dichotomous) item was examining whether secondary engineering technical school students figure out information from technical subjects on their own (individual work or self-study) or only by listening to teacher's explanation in the class. This question was answered positively by 35 respondents (44.30%), that means they figure out certain information in technical subjects by self-study activities. Forty-four respondents (55,00%) stated that they learn information from technical subjects only by listening to a teacher's lecture.

**Question 6:** Do the studies at the secondary school correspond with the ideas you had before entering the school? (yes/no)

The sixth (dichotomous) item provided data about whether the studies at the secondary school correspond with ideas students had before entering the school.

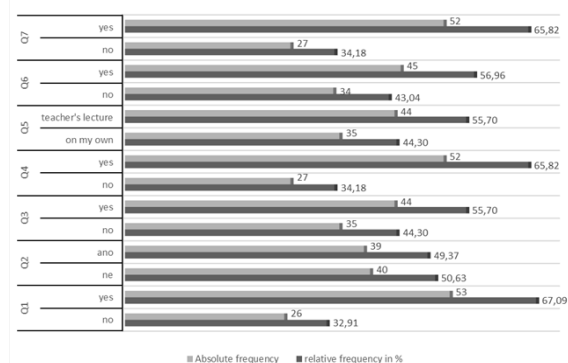
A larger number of respondents (45; 56.96%) stated that studies at the school correspond with ideas they had before entering the school. On the other hand, 34 respondents (43.04%) stated that studies at the school do not correspond with the ideas they had before entering the school.

**Question 7:** Do you want to be successful at school? (yes/no)

The seventh (dichotomous) item aimed to examine whether of the secondary technical engineering school students are motivated by achieving success in their studies.

Two-thirds of respondents (52, that is 65.82%) stated that they want to be successful at school. On the other hand, 27 respondents (34.18%) stated that they do not want to be successful at school. The analysis of other items of the questionnaire will examine which other sources of motivation worked and supported students in their efforts to finish their studies at the secondary school.

Graph 1: Frequency of answers to Question 1-7



**1.7 Results of the Statistical Analysis**

The research survey was also focused on discovering a possible link between selected variables. Hypotheses and results of their verification are mentioned below.

**Hypothesis 1:** Students who think they have aptitudes for their chosen profession want to be successful at school more frequently than students who do not think so.

Tab. 1: Detected and expected frequencies related to H1

Pearson's chi-square = 9.0173 = 1 significance p= 0.002674		degree of freedom = 1	
Question 2	Question 7 (yes)	Question 7 (no)	Line totals
yes	32 (25.671)	7 (13.329)	39
no	20 (26.329)	20 (13.671)	40
Column totals	52	27	79

Given that the calculated value of chi-squared is higher than the value of the test criterion and the value of significance is lower than the chosen significance level of 0.05, it has been proved that there is a statistically significant relationship between answers to both questions.

Hypothesis H1 "Students who think they have aptitudes for their chosen profession want to be successful at school more often than students who do not think so" has been confirmed.

**Hypothesis 2:** Students who indicated the secondary school they are studying at as their first choice on the application form state that they will continue studying engineering at university more frequently than students who did not indicate this secondary school as their first choice.

Tab. 2: Detected and expected frequencies related to H2

Pearson's chi-square = 0.53607 = 1 significance p= 0.46407		degree of freedom = 1	
Question 1	Question 3 (yes)	Question 3 (no)	Line totals
yes	28 (29.519)	25 (23.481)	53
no	16 (14.481)	10 (11.519)	26
Column totals	44	35	79

Given that the calculated value of chi-squared is smaller than the value of the test criterion and the value of significance is higher than the chosen significance level 0.05, it has not been proved that there is a statistically significant relationship between answers to both questions.

Hypothesis H2 "Students who indicated the secondary school they are studying at as their first choice on the application form state that they will continue studying engineering at university more frequently than students who did not indicate this secondary school as their first choice" has not been confirmed.

**Hypothesis 3:** Students who are interested in technology in their free time report that they want to continue their studies at a technical university after graduating from high school more frequently than students who are not interested in technology in their free time.

Tab. 3: Detected and expected frequencies related to H3

Pearson's chi-square = 5.6238 = 1 significance p= 0.017726		degree of freedom = 1	
Question 4	Question 3 (yes)	Question 3 (no)	Line totals
yes	42 (37.519)	10 (14.481)	52
no	15 (19.481)	12 (7.519)	27
Column totals	57	22	79

Given that the calculated value of chi-squared is higher than the value of the test criterion and the value of significance is lower than the chosen significance level of 0.05, it has been proved that there is a statistically significant relationship between answers to both questions.

Hypothesis H3 "Students who are interested in technology in their free time report that they want to continue their studies at a technical college after graduating from high school more often than students who are not interested in technology in their free time" has been confirmed.

**Hypothesis 4:** Students who think that teachers of vocational subjects lead them to think about a technical problem report that

the school deepens their interest in the field of study more often than students who do not think so.

Tab. 4: Detected and expected frequencies related to H4

Pearson's chi-square = 7.2880 = 1		degree of freedom significance p= 0.006942	
Question 8	Question 9 (yes)	Question 9 (no)	Line totals
yes	42 (37.595)	24 (28.405)	66
no	3 (7.405)	10 (5.595)	13
Column totals	45	34	79

Given that the calculated value of chi-squared is higher than the value of the test criterion and the value of significance is lower than the chosen significance level of 0.05, it has been proved that there is a statistically significant relationship between answers to both questions.

Hypothesis H4 "Students who think that teachers of vocational subjects lead them to think about a technical problem report that the school deepens their interest in the field of study more often than students who do not think so" has been confirmed.

Main conclusions of the research survey are:

1. For two-thirds of the respondents, i.e. 53 (67.09%) the secondary school specialising in engineering was their first choice.
2. Half of the respondents, i.e. 39 (49.37%), think they have aptitudes for the chosen engineering profession.
3. The interest to continue studying engineering at university after the secondary school was expressed by 44 (55.70%) respondents.
4. Two-thirds of the respondents (52 in total, i.e. 65.80%) stated they are interested in engineering, for instance, machines, cars or technology in their free time.
5. More than half of the respondents (35 in total, i.e. 44.30%) figure out certain information through independent learning activities in the class.
6. More students in the research sample stated that the studies at the secondary school specialising in engineering corresponds with their ideas they had before entering secondary school.
7. Almost two-thirds of the students (52 in total, i.e. 65.82%) said that they want to be successful at school.
8. The validity of the hypothesis that "students who think they have aptitudes for the chosen profession want to be successful at school more often than students who do not think so" has been confirmed.
9. The validity of the hypothesis that "students who indicated the secondary school where they are studying as their first choice on the application form state that they will continue studying engineering at university more often than students who did not indicate this secondary school as their first choice" has not been confirmed.
10. The validity of the hypothesis that "Students who are interested in technology in their free time report that they want to continue their studies at a technical college after graduating from high school more often than students who are not interested in technology in their free time" has been confirmed.
11. The validity of the hypothesis that "Students who think that teachers of vocational subjects lead them to think about a technical problem report that the school deepens their interest in the field of study more often than students who do not think so" has been confirmed.

## 2 Discussion and Conclusion

The problem of students' motivation to the study of technical engineering fields at high schools was analysed using questions focused on discovering the circumstances of the choice of these fields, the more in-depth interest in the field, the compliance of the study reality with the previous idea and the further study perspective of students. In a thematically related study (Ondrejkoř, Křemenová, Malý, Krajča, 2017), the authors have focused on the comparison of answers of two groups of technical engineering fields – schools finished with vocational certificate and schools finished with school-leaving exam. The authors analysed reasons behind the choice of the field, satisfaction with the choice, the intention to apply in the field after graduation or seeking employment in another field.

However, distinct differences in the questions do not allow to directly compare acquired data except one area represented by the question concerning the comparison of compliance of study reality with the previous idea of the student, and the question of satisfaction with the choice of the field in the other research, which results are presented negatively as the students are dissatisfied with the study field. Almost 57% of respondents of our research confirm the compliance of the studies with the idea. In the other research, the most frequent reasons for the dissatisfaction are the low share of practical training (mentioned by 18% of respondents), loss of interest in the field (13%) and low quality of preparation in the field (10%). Assuming that every pupil would state one reason for dissatisfaction, the summation of 41% of respondents would almost comply with our discovery. Question about whether the field was a first choice for the students was positively answered by 67% of our respondents and 78% of Czech students participating in EUROSTUDENT VI research (Fischer, Vltavská et al., 2016).

In the next phase of the research, which will build on the presented pilot research survey, a collection of data will be carried out on a sample of students from six secondary technical engineering schools in the Moravian-Silesian Region in the Czech Republic. It will contribute to higher reliability and relevance of the discoveries and will allow formulating more general statements about the chosen aspects of students' motivation for the choice of professional training. At the same time, the school will be provided with materials reflecting the motivation level of their students, a level which crucially influences the results of their studies or more precisely their stay in the studies and possibility to commence the professional practice in the field.

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