

# PUPILS' ATTITUDES TOWARDS NATURAL SCIENCES AND THE DECISION-MAKING PROCESS WHEN SELECTING A FIELD OF STUDY AT UNIVERSITY

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## Abstract

*The text yields the results of research which was concentrated on the perception of natural sciences by pupils of basic schools and students at secondary schools in one of the regions of the Czech Republic. The first part of the research focused on basic school pupils' and secondary school students' attitudes towards natural sciences, while the second focused on the understanding of social reality by students of grammar schools who are in the process of selecting their future fields of study at universities. We addressed the issue of how they take decisions and the factors that influence the decision-making process. To identify basic school pupils' and secondary school students' attitudes we utilized the statistics-quantitative method. In the second phase we built on the previous findings and utilized the quantitative method (focus group). The quantitative part of the research demonstrated that pupils consider natural sciences interesting but very challenging. Having taken into account the risks involved when studying natural sciences, most of them rated natural sciences positively. Also, the interest to study nat. sciences is not negligible, however, the occupation of a scientist is little attractive. The interpretation of social participants in science, stereotyping and popularization, the differentiation of three kinds of science – they all have an impact on the decision-making process whose result is university studies. The so-called “school science” influences the decision to study general science. Popularization should aim to bridge the enormous gap between the reality of a scientist and the reality of everyday life. School is the place where the popularization of general science ought to begin. School science should present not only the results of scientific research but also scientists with regard to their everyday life. In pupils' eyes the most important people popularizing science are the teacher and the scientist. It is their approach to science that determines how they present and make science look attractive. The popularization of science should become more systematic and a part of curriculum. It should also be included in the university study programme of future teachers. Pupils need to gain awareness of how they can apply such skills in real/professional life.*

**Key words:** *focus group, natural sciences, popularization of science, pupils' attitudes, school science.*

## Introduction

The results which we present here have come from the MedVed project organized by Palacky University in Olomouc. The project aims to improve the popularization of science, research and study of natural sciences in the Czech Republic. The results of our research should aid in the identification of new and non-traditional forms the popularization of natural sciences. They are to be used to help students understand how to perceive natural sciences as well as the basis for the formulation of appropriate interventions and programmes in the area of education.

The research consists of two parts. In the first part we sought to identify basic school pupils'

and secondary school students' attitudes towards natural sciences in the region of Olomouc<sup>1</sup>. Our goal was to identify how pupils perceive natural sciences and take into account how the school as well as out-of-school environment affect their perception.

In the second part we present the social reality of secondary school (grammar school) students who now have to take the decision where to study at university. Our goal was to find out how aware they are of their situation, how they interpret natural sciences within the framework of their social reality and which factors influence their decisions to study natural sciences. Their preferences to study certain fields of study demonstrated how they perceive natural sciences and what impact their perception has on the decision to study natural sciences. Although we used two completely different methods, we kept to the principles of the integrative approach which is based on the combination of quantitative and qualitative methods.

We believe that our research has practical consequences. Our intentions were motivated by the findings of social participants in natural sciences (not only scientists) who had in recent years been drawing attention to the declining attractiveness of natural sciences and thus the interest in the study of natural science fields at universities. The declining interest is demonstrated by low numbers of students enrolling in universities which offer such education as well as persons wishing to work in natural science related occupations, even though their chances to find employment are positively high in the Czech Republic (Stupnytskyy & Kotíková & Michalička, 2007).

The decline in the interest in natural sciences is caused by several factors. It is connected with the general loss of scientists' authority, the loss of scientists' credit for rationality and the growing criticism of the consequences of science (Beck, 1992), which has resulted in the declining legitimacy of teaching natural sciences at schools – so called “school science”. The findings of our research cannot be interpreted independently of the changing importance of natural sciences within the context of post-modern societies. The offer of different forms of education is constantly expanding and individualizing, while students have more and more choices with regards to academic field selection, especially in the area of non-exact sciences. The teaching of “school science” at basic and secondary schools faces numerous obstacles. The doubting of legitimacy of natural science education is criticized by all participants of the educational process. Peter J. Fensham sees the reasons for the failure of natural sciences in the one-way transmission of knowledge – teacher/book to student – without giving space for the individual development of own ideas. Furthermore, the syllabus is often uninteresting to the point of being boring and it is quite demanding (Fensham, 2006).

That is why we differentiate between two levels of science. The first we call “school science”, which is science that is anchored in curricula and is taught at basic and secondary schools. When we mention “science” or “natural science” without any attributes, we have in mind “science” which corresponds to the concept of normal paradigmatic science which is created by scientists and whose results are taken for granted by the community of scientists.

## Methodology of Research

The research was drawn up to be integrative. In the first part we tried to identify pupils' and students' attitudes by using the statistics-quantitative method. In the second part we built on previous results and extended their interpretive framework by the qualitative method.

### *Quantitative methodology in the first part of the research*

The qualitative part enabled us to see how pupils/students perceive the personality of a scientist and nature in general. We focused on the identification of actual attitudes of pupils towards natural sciences, the presentation of a wholesome picture of how natural sciences are viewed by pupils/students and the finding of variables, which lead to the preferring or rejecting of natural sciences.

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<sup>1</sup> The Olomouc region is one of 14 regions of the Czech Republic. The region lies on the area of Central Moravia. Olomouc is the most important centre with Palacky University. The region covers an area of 5 000 square kilometres which constitutes 6, 7% of the whole area of the Czech Republic and has a population of about 630 000 inhabitants.

We designed a set of working hypotheses which we consequently verified. They mainly concerned the form of the teaching process and the teaching methods used to teach “school science”; the preferences of other fields of knowledge; little attractiveness of natural sciences; pupils'/students perception of scientists; the transmission of cultural capital among generations; the relationships among science the natural environment and engineering; changes taking place in modern society; imagination – association with regard to the relationship between natural sciences and scientists; gender perceptions, attitudes to natural sciences; extracurricular influences, the popularization of science; future professions and careers and the motivation to study natural sciences.

The research was statistics-quantitative and we received data from pupils/students via questionnaires. It was necessary that the questionnaires meet the criteria appropriate for the scrutinized populace. The research took place in basic and secondary schools in the Olomouc region. When selecting the respondents we had to take into account the system of the curricula and the pupils /students' familiarity with natural sciences. Therefore we focused on pupils /students attending the last two grades of their respective educational institutions. It was necessary to be cognizant of the percentile representation of pupils /students in the former districts of the Olomouc region and thus determine the numbers of pupils /students to be addressed. Randomly, we selected a total of 28 classes in basic schools and 2 classes in secondary schools.

A total of 1 250 questionnaires were returned. We analyzed 1 173 due to the fact that 77 questionnaires were either incomplete or contained unreliable data – those had mainly been completed by basic school pupils. Basic school pupils constituted 42% of those questioned. 8-year grammar school students constituted 26%, specialized secondary school students 22% and 10% represented students of 4 year grammar schools. Students attending vocational schools and 6-year grammar schools represented insignificant numbers. 52% of those addressed attended the last two years of basic school and 48% attended secondary schools. Girls were the more common respondents with 53%. The same rate (53%) was more or less evident in all individual grades. A noticeable difference between genders was observed between educational institutions with 47% of girls at specialized schools and almost 65% at both types of grammar schools.

#### *Qualitative methodology in the second part of research*

The qualitative method did not enable us to interpret and explain all obtained data. Questions such as: “why do pupils/students perceive scientists as... and not differently” had been asked. Since statistics could not yield satisfactory answers, we resorted to the qualitative method. We based our research on the premise that pupils/students' perception of natural sciences influences their decision to either study natural sciences at university or study humanities. We had opted for the qualitative method in order to be able to understand how pupils/students perceive natural sciences when they are under considerable pressure to choose a field of study at a particular university. We focused on a very important moment when students decide on their future studies and careers. The qualitative method enabled us to understand factors influencing the decision-making process, which is for many as we observed during interviews, quite stressful. We had the opportunity to find out how students understand the situation and how they interpret natural sciences within the framework of their real and construed social reality. The way they perceive and interpret their social reality has an impact on their behaviour and the decision-making process. In other words, if a student considers natural sciences as difficult and indecipherable, he/she will most likely refrain from studying them at university. The same could be said to be valid if the situation is reversed.

When selecting an appropriate methodology, we decided to use one of qualitative methods – the method of focus group. The method of focus group is based on a group discussion, which is different from an ordinary interview between a questioner and a questioned. It relies on interaction among group members which is stimulated by presented topics. The interaction is initiated and to some extent controlled by a moderator. The chosen method helped us to understand certain attitudes towards natural sciences. It also served as a source of understanding of the selected topics.

We were inspired by advice put forth by the sociologist R.K. Merton, who had set four criteria for conducting interviews: covering the whole spectrum of relevant questions; placing emphasis on participants' clarification of their experiences; support of interaction and taking into account the

personal contexts of statements (Merton, 1990). We arranged for the group discussions, moderators, ensured that we had participants and drew up a set of questions. The discussions were then transcribed and analyzed.

It was our intention to find three focus groups at three grammar schools. Each group had a different approach to natural sciences – there were those who rejected them, those who were ambivalent to them and those who had a positive approach. Approximately 50 students took part in the discussions.

## Results of Research

### *The results of the quantitative part of research*

In this section we present selected conclusions. In the first part of our research we learnt that if parents are educated in natural sciences, it is likely that their children will dedicate themselves to a scientific field. The selection of an educational institution is closely linked to cultural capital. Children of parents, who are educated in natural sciences and are professionally, engaged in them, show slightly better study results in natural sciences. The cultural capital of a family has a great influence on the interest of pupils/students in natural sciences, their perception of science related subjects as highly attractive as well as their study results. Children, whose parents have scientific background, often tend to study natural sciences, are interested in them and achieve good study results.

It was surprising to learn that pupils/students consider natural sciences as interesting. This opinion is shared by pupils/students at all types of schools and grades. Almost 60% of those questioned responded they found natural sciences interesting, which is a very good result. One third of respondents ranked physics, mathematics and chemistry among the least favourite subjects. On the other hand informatics and optional science related subjects were among those favoured. Approximately two thirds of respondents had taken a liking to natural history, geography, biology and ecology. The enthusiasm for individual natural sciences varies according to gender of respondents. Unlike boys, girls seem to prefer subjects about living things (natural history, biology, ecology) and seem to dislike mathematics and especially physics. More than 80% of pupils/students are of the opinion that natural sciences are interesting and beneficial. Approximately, two thirds of pupils/students stated that natural sciences had helped them to understand nature and made them realise how important natural sciences were for life. They believe that they will find natural sciences useful in life; however, they consider them to be difficult. More than half of respondents thought that their teachers presented school science in an interesting way which stimulated their interest to understand inexplicable things. Pupils/students are aware that being educated in natural sciences helps people find employment. The most common source of information about natural sciences is teachers, television and the internet. Their interest in traditional sources of information (books, radio) is on the decline.

To summarize, we should say that pupils/students consider natural sciences to be interesting, yet not well-liked. Their answers demonstrate that their attitude towards natural sciences is mainly positive. Although pupils/students consider them to be a very important tool for the development of society, they are aware of their limits as well as their negative effects. Almost 40% of respondents plan to study natural sciences in the future, i.e. (31% of basic school pupils and 47% students of secondary schools). The representatives of natural sciences were not so positively assessed. How do pupils/students view scientists? They attribute the two following characteristics to them: intelligence and diligence. Scientists are perceived as not sociable and not neat in appearance, which is fairly stereotypical. They are crazy, untidy and undesirable beings to be around, closed off from the outside world by the walls of their laboratories.

### *The results of the qualitative part of research*

The second part of our research focused on the social reality of grammar school students, who

are now in the process of selecting a field of study at universities. Their preferences for individual study programmes demonstrated how they perceive natural sciences and how this perception influences their decision-making process. We were interested in the following areas: their perception of a scientist; the role of natural sciences; the attractiveness of natural sciences and their decision-making process with regard to university studies.

Science is viewed as an exclusive activity, characterized by contemplation, exploration and the discovery of new things. It opens the door to the unknown, is beneficial in various forms and simplifies life or prevents people from suffering caused to natural catastrophes. Science symbolizes progress, will to explain the unknown and the understanding of near as well as distant objects which surround us. In spite of all the aforementioned, science is perceived as an exclusive and creative activity which is carried out by people who are creative with exceptional intelligence and diligence.

Pupils/students view science via three important participants – ordinary people, students and scientists. All interpretations are based on two opposing poles. One extreme is an ordinary person, the other a scientist. The first is a consumer of what the second produces. A student is the third participant finding him/herself somewhere in between.

Individual social participants behave in their own ways, use different practices and have different lifestyles. A student aspires to unravel the secrets of science and is a “melting pot” of the science reality and everyday reality. He/she endeavours to strike a balance between the two, draws comparisons and thus prefers one of the two. The dichotomy between the two realities is rephrased from the students' point of view. When students reflect upon their attitude towards a scientist, they do so via school science. School represents science, however, as students anticipate, school science is different from scientific science. Students accept science as long as it discovers something new and is beneficial to humankind. They hesitate between the two alternatives and it is to be expected that they are hesitant and are inclined to feel closer to the reality of an ordinary person.

An ordinary person lives an everyday life and from their points of view the behaviour of scientists is not practical, it is remote from the spontaneity of everyday life. On the other hand, an ordinary person is practically oriented, promotes utility and usefulness, and is interested in luxury and survival. They pay attention to the world surrounding them - hobbies, people, and family. The world is incomprehensible and unnecessarily difficult to them – they can participate in scientific achievements without having contributed anything. They are not uncharacteristically intelligent or talented; however, unlike scientists they have natural social intelligence.

On the contrary, a scientist – producer is a discoverer who fully concentrates on science. He/she is totally absorbed by work. The more he is absorbed, the more he becomes isolated, closes himself off from the world of ordinary people. He exerts enormous effort, sacrifices himself not to his own advantage but for science. He turns into an asocial human who is difficult to understand by others. His being different deepens as he is increasingly devoured by science. His behaviour, although acceptable in the scientific community, becomes too extraordinary within the community of ordinary people so much so that he is often referred to as erratic. There exist numerous stereotypes surrounding scientists; however, not all scientists separate themselves from society. There are those who fit the description of a normal human being.

The interpretation of the difference between the reality of a scientist and the reality of an ordinary person demonstrates how important it is to explore the principle of differentiation, which separates the two realities. We call the principle of differentiation – habitus – a unified style of scientists' activities and properties. Scientists' habitus consists of two components – outer characteristics (body and the environment) and inner dispositions (being systematic, being a-social, sacrifice, talent, ponderousness, effort and relationship). There is a relationship between outer characteristics and inner dispositions. The character of a scientist's work excludes him from everyday reality. Concentration on work and research leads to his being absorbed into the world of science and they lose interest in everyday life. They no longer comprehend everyday life and it becomes an obstacle to their job. They stop caring about their appearance which disqualifies them in the eyes of ordinary people.

The habitus of a scientist, its components, demonstrate that scientists are interpreted as beings with a great degree of talent and intelligence. Their social status and popularity are on a low

level according to how young people feel on the issue. Scientists are viewed as the chosen ones, however, no so superstars.

Students, who perceive science mainly via school science, place scientists into a closed off world- scientists' reality, which is efficient, however, devours and deforms the scientist's personality. The gap between science and everyday life is insurmountable. Those who choose a scientific career risk the fate of a social outcast. On the other hand, students who have met a scientist in person and have a better understanding of their work confirm the validity of such stereotypes to some extent; however, they are aware that a scientist is also an ordinary human being.

Three social participants represent three types of science. Each type of science evokes a certain image. It is noteworthy that the connection between scientific science and school science is very weak, almost non-existent. Students are not cognizant of the relationship between the two dimensions of science and interpret school science as a form created by curriculum and teacher (the executor of curriculum). School science is attractive only when it is demonstrative, appropriately presented and practical. Teachers as people popularizing natural sciences find themselves in a complicated position – on one hand they are limited by the set curricula, on the other they may lose motivation for their work.

The interpretation of social participants in science, stereotyping, popularization and the differentiation of the types of science influence the decision-making process when a field of study is being selected. Students' perception can be interpreted as a limiting factor in the selection process. School science plays an important role in deciding what field of study is to be preferred. Those with a negative attitude towards natural sciences and related subjects tend to prefer the study of humanities. Has school science been at times instrumental in discouraging potential scientists from the career of a scientist? Students are hesitant on this issue. School science does not fulfil the role of a popularizing agent and students find it difficult to see science as attractive which turns them away from natural sciences. The weak connection between school science and scientific science serves to strengthen certain stereotypes which separate the reality of science from the reality of everyday life. We have identified areas for improvement in the way natural sciences are taught (it is to be noted on this point that students also mentioned inspiring examples of). The derivative, which school science is, still plays the main role in the decision-making process. That is why we believe that popularizing components need to be included in school science as well as other elements which will help to find common ground with the real scientific science.

## Conclusion

It is now time to offer recommendations to those popularizing natural sciences. The results of the first quantitative and the second qualitative parts are convergent; they are in agreement in their aims and together provide a deeper understanding of the researched phenomenon. Although the findings are linked to one region in the Czech Republic, they are applicable within a much larger framework. The quantitative part of the research demonstrated that students perceive natural sciences as interesting, however, quite demanding. Aware of certain risks, they assess natural science positively. Also, the interest to study natural sciences is not negligible. In spite of that, the occupation of a scientist is of little attractiveness. The explanation why was arrived at in the qualitative part of the research.

The popularization of natural sciences should aim to bridge the enormous gap between the reality of a scientist and the reality of everyday life. Students make decisions to study at universities based on the satisfaction they expect to get as well as their employability after having graduated. Unfortunately, they do not have a clear understanding of how employable they will be having studied natural sciences. Those who have had direct contact with science seem to be the only ones with concrete vision with regard to the study of natural sciences. Finding employment in humanities seems easier and that is why more often than not students choose to study socio-scientific fields of study.

The popularization of science aims to overcome the stereotype of a crazy and impractical scientist whose reputation is generated by school science. Students who have had the chance to

come to terms with the science reality tend to be sensitive towards these stereotypes. School is the place where the popularization of natural sciences ought to begin. School science should present the results of science as well as scientists with regard to everyday life. The most important entities popularizing natural sciences are the teacher and the scientist. It is their attitude that dictates how they present science and how they can make it interesting. School science should become closer to real science via popularization. Popularization needs a more systematic approach and ought to become part of the curriculum at school as well as the curriculum of students preparing to teach natural sciences. It is necessary to show students how employable they will be with the aid of individual counselling. By no means will the popularization of natural sciences affect a decrease in the interest in the study of natural sciences. As we have explained in the introduction, what we have dealt with is a complex issue. Despite the complexity, the popularization of natural sciences can help students to make the right decisions with regard to their future studies.

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