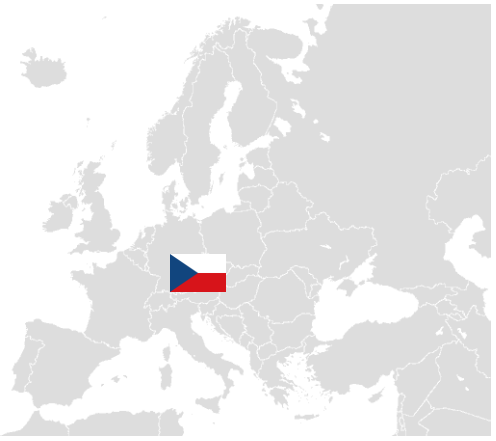
ICT PRAGUE

CHEMISTRY IS ALL AROUND NETWORK

518300-LLP-2011-IT-COMENIUS-CNW

Students' Motivation to Learn Chemistry in the Czech Republic



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Students' Motivation to Learn Chemistry in Czech Republic

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Abstract

This work focuses the issue of Czech pupils` and students` motivation to study chemistry. Various sources of this lack are reported and analyzed, from technical equipment and teaching methods to general opinion and unpopularity of chemistry. Possible ways to improve this state-of-the art are suggested, e.g. usage of new educational methods, electronic tools and ICT-based learning/teaching materials. However, this is limited by costs of new tools and time and effort necessary for change. Students` motivation can be increased also by popularization events as Lessons of modern chemistry, Chemistry fairs etc.
The concept of this work is the introduction, national trends in scientific subjects, than settings in promoting incentives in teaching chemistry. The whole idea of this work is the reasons for declining interest in science studies and related professions. Here is also rising demand for qualified researchers and technicians and concern that there may be a decline in innovation and, consequently, economic competitiveness.
What are the aims expressed in these strategies? The most common aims are to promote a positive image of science, to improve public knowledge of science, improve school-based science teaching and leasing, raise pupils' interest in science subjects and consequently increase uptake of science studies at upper secondary and tertiary education levels, strive for a better gender balance in MST studies and professions, provide employers with the skills they need and so help to maintain competitiveness.
We also present some ways how to repeat it. One of them is teachers' approach. Teachers would suggest more real life examples, teaching more about issues that are useful or even essential in daily life. They should avoid instructivistic approach with students` passivity. Instead, various teaching methods can be utilized, e.g. games, trans-subject project education, proper experiments. The teaching method is crucial for students, it is better if they learn non-violently, seemingly incidentally. This depends on the teacher's abilities and imagination.
ICT-based materials are also due to us very important instrument to increase students` motivation. Computers are well accepted by the students because they are mostly well skilled to work with it. Using computer, didactic possibilities are much wider.
Electronic learning tools are also good instrument. Several schools have been provided with modern electronic learning tools as interactive whiteboards, tablets etc. We assume that this could increase the attractiveness of learning for pupils and students. We will aslo consider the international students' exchange.
Even more could be done to increase students` motivation to learn chemistry.
The last one is popularization of chemistry, polularization events. Activities for basic and secondary schools organized and co-organized by ICT Prague are good example of it.

Introduction to the National Situation –causes of lack
There is no doubt that in the Czech Republic, there are significant problems with students` motivation to study chemistry. Chemistry is considered as difficult and unpopular at elementary and high schools, which causes that only few students choose chemistry as their field of study for higher

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education. The question to be answered is: What are the reasons for lack of students` motivation? If we analyze the problem we find that there reasons for lack of motivation come from several sources.
Countries support many individual programmes, like local programmes, but what about national…overall strategy….these strategies are rare. Nowadays few European countries have developed a broad strategic framework to raise the profile of science in education and wider society, also in the Czech Republic. A wide range of initiatives have been implemented in many countries. During last few years, there took place the relationship, school partnerships with science-related organisations are common across Europe but are very diverse with respect to the areas they cover, how they are organised and the partners involved. [1]
All these partnerships share one or more of the following aims: they try to promote scientific culture, knowledge and research among students; to improve students' understanding of what science is used for; to strengthen the teaching of science at school and, to increase recruitment to sciences like mathematics, science and technology. [1]
Science centres also share one or more of the aims mentioned above and contribute to improving science education by providing students with activities that go beyond what schools typically offer. [1]
Where broad strategies for the promotion of science do exist, science–oriented guidance for students
is usually an integral component. However, not many other countries have implemented specific guidance measures for science and very few countries have initiatives which focus on encouraging girls to choose science careers. Similarly, few countries have implemented specific programmes and projects to further develop gifted and talented pupils and students in the field of science. [1]

National education system focusing in scientific subjects

In our country, there is the main problem with the timing of learning scientific subjects. It is mostly at higher levels of education. Later we will see the structure of our educating system. It begans with nursery school, than the primary school, the secondary school and the university.But the main problem is that the education of science doesn't start in primary school, but secondary. The pupils are not so interested in these subjects because there is no big incentive for them as a very small child.
So this is a breaf schedule of general educating system. But now, we will focus on the educating system of scientific subjects. It starts at the level of primary school. But at the age of 10...11 years old children. It is very late to connect these children with scientific subjects. Better it will be at preschool. Children will create bigger connection with it.
Science education doesn't begin as one general integrated subject and isn't taught in this way almost everywhere throughout the entire period of primary education. But in many countries there isn't the same approach. It is continued for one or two years into lower secondary education. In the Czech republic by the end of lower secondary education, however, science teaching is usually split into the separate subjects of biology, chemistry and physics. [1]
At general upper secondary level,we as the vast majority of European countries adopt a separate subject approach, and science often forms one of the specialist branches or streams open to students at this level. As a consequence of this increased amount of choice, not all students are taught science at the same level of difficulty and/or study science subjects throughout all grades. [1]
It is generally known that it is recommended that science should be taught in context. Usually this involves teaching science in relation to contemporary societal issues. Environmental concerns and the application of scientific achievements to daily life are recommended for inclusion in science lessons in almost all countries. The more abstract issues relating to scientific method, the 'nature of science' or the production of scientific knowledge are more often linked to the curricula for separate science subjects which are usually taught in the later school years. [1]

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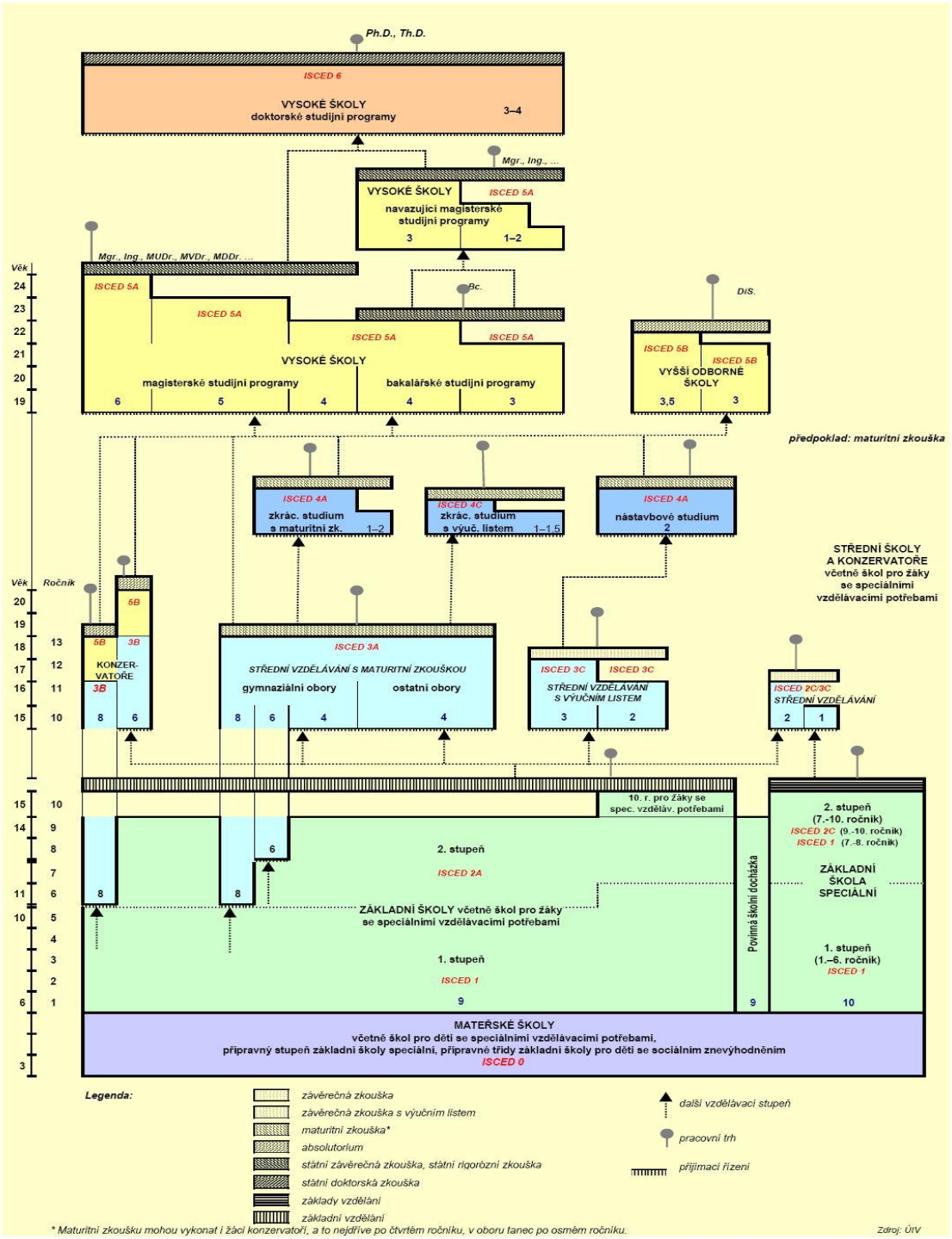

Source: Report on the Development of Education [2]

National trends

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In this chapter we will focus on national trends: the develepment of children, the development of the salary of teachers, because due to us, it is also very important reason for the lack.
As mentioned in previous chapters, there is low accent to educate very small children in scientific subjects. But if children choose the chemistry for example, these university schools are very good. Of course, you can not assume that all those who have a higher education research and development work or will ever work, but for this area represent potential resources and fundamentally participate in the creation of new knowledge and technologies. This chapter will discuss both the already existing number of persons with university education, as well as students and graduates of this degree study. [3]
In detail, it will focus on the natural and engineering sciences, which can be considered as key fields for research and development, as evidenced by the fact that in 2010, working in the fields of science 75% of employees research and development. [3]

Persons with university education

Number of people with university education is increasing every year. In 2010, the population persons over 25 years in the Czech Republic almost 1 million 111 thousand persons thus educated, amounting to 14.4% of the population of this age (the age category was chosen because it is a person, which are expected to have completed study). At the beginning of the period, in 2000, had completed a university degree approximately 714,000 people, which accounted for 10% of the population. Those with tertiary education predominated In 2005, men over women stronger than it is now. In 2000, the proportion of men and women 59% to 41% in 2010, the proportion of both sexes, more settled, when 100 persons with university education accounted for 54 men and 46 women. [3]

Graph 1 Persons who have has attained full higher education aged 25 years or more Source: ČSÚ, 2011 [4]

Among university-educated population outweigh long people with master's degrees in degree program. In 2010, 86% of such people, people with a bachelor's degree and the remaining 11% 3% of the population with university education was equipped with a doctoral degree. Over the years, there is a shift in the structure of tertiary educated persons by level of study for bachelor degree. This shift is caused by the change in composition of programs offered, when ten years ago it was possible to studyBachelor's program rarely and university study was possible in five predominantly Master's program. In the population with tertiary education have the highest concentration of people with degrees in fields of social science, business and law and engineering sciences, manufacturing and construction (both 25%), teacher education has 17% of university graduates and 8% are educated in the natural sciences. [3]
The highest proportion of college graduates in the year 2010 in the population aged 25-34 years, where thus educated persons represented 20% compared to 2005 and was an increase of 7 percentage points. The increase in the proportion of college graduates in the population occurred in the other age groups. Among persons aged 35-54 years in 2010, held a university educated about 15%, and forin post-age 10%. [3]

International comparisons

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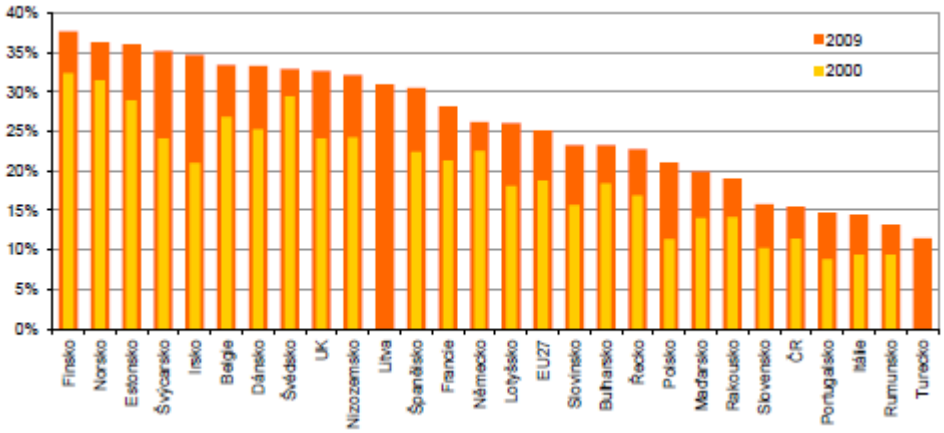
Czech Republic with the representation of people with tertiary education in the population is a long-term deep below the European average. In 2009 the population of the Czech Republic 15.5% of people with tertiary education, the EU27 average in the same year was 25% and the highest shares was then achieved in Finland, Norway and Estonia, where the population was represented by more than 35% of people with tertiary education. Since 2000, in all the countries to increase this proportion. Was most significant between the observed countries, an increase in the case of Ireland, where the proportion of tertiary graduates in the population increased by almost by 14 percentage points. Although the Czech Republic is among the countries with the lowest proportion of persons with tertiary education in the population, but if we focus on those who have at least secondary education, the situation is quite different. In 2009 the Czech Republic had at least secondary education, 91% of people. The same proportion was also achievedin Lithuania and the Slovak Republic. On average EU27 reached at least secondary education 72% of the population. [3]
Low proportions then occupy at least those with secondary education in Spain (52%), Italy (54%),Portugal (30%) and Turkey (28%), the last three as states have very small representationpersons with tertiary education (less than 15%). [3]



Graph 2 Persons with tertiary education aged 25-64 years (% of population 25-64 years)
Source: Eurostat 2011 [5]

Students and graduates of Master's Studies
In the last ten years, the number of university students (bachelor, master and doctorate) Czech steadily ever since 2001 there has been almost doubling their numbers to nearly 400,000 students in 2010. For steep rise can be described not only the absolute values but also evaluative indicators which is the representation of students in Master's Studies in the population aged 20-29. While in 2001 enrolled in college young population 12% of people in 2010 in this population occurred no more than 27% of college students. More significant than the number of students grew total number of female students. those were at the beginning of the period, in 2001, 98,000 in 2010 more than 221,000, and in all university students and held a share of 56%. Since 2001, when the students were 48% women and their representation among college students significantly increased. [3]
While the number of university students between 2001: 2010 almost doubled in the case of graduatestheir number in the same period increased by almost three times. In 2001 graduated from high school in the Czech Republic more than 30,000 students in 2010, there were nearly 88,000. The sharp increase in the number of graduates may be to some extent due to the fact that since 2001, the master's degree level training divided into two and a large part of the bachelor's degree graduates continues studying in the Master program. Representation of women among university graduates throughout the period more than 50%, with that in2001 women accounted for 51% of all graduates and 9 years later, in 2010, already 60%. The fact that it is long higher proportion of women among university graduates than among students could be deduced their higher success in completing university studies. [3]

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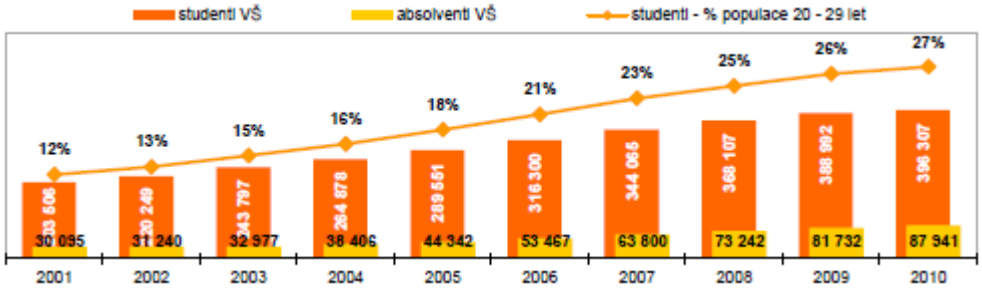
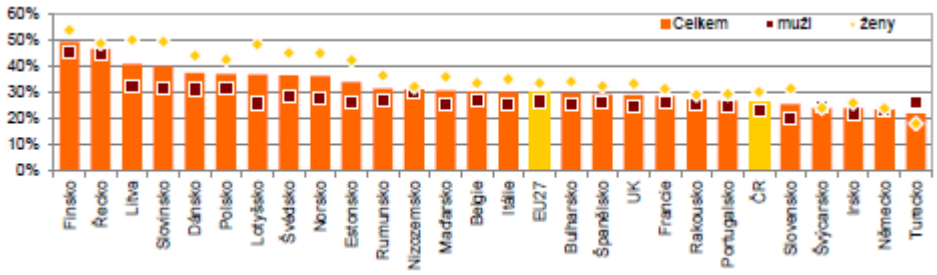


Graph 3Students and graduates from universities in the Czech Republic
Source: MŠMT, 2013 [3]

Long term among college students most interested in fields of social sciences, business and law, in 2010 enrolled more than 137,000 people and the total number of students participated in 34%. thisfield also are among those, which since 2001 has raised interest the most. Compared to 2001, it is currentlycurrently studying by about 160% more people and a similar increase was also recorded interest in the case of services and natural sciences. On the contrary, a negligible change in the number of students can be marked increase in the number of students technical sciences, when the number of students during the period increased by only 17%. in all years, most university students educated in the social sciences already mentioned, in 2001, however, these students took on the whole 26%. In contrast, the second most studied field of technical sciences, to all students participated in 2001, 24% in 2010 has only 15% (59,000). The most popular fields of doctoral degrees include natural sciences, mathematics and computer science, which in 2010, studied more than 7,000 postgraduates and engineering sciences, manufacturing and construction, with more than Five thousand students. Among college students favorite social sciences, business and law were in the case of doctoral students is 4.5 thousand students in the third place of the chart. [3]

International comparisons

Due to the availability of data for international comparisons reported for students in tertiary study, ie. not only for college students but also for students of higher vocational schools. Supreme representationtertiary students in the population 20-29 years was observed in Finland in 2008 (49%), Greece (46%),Lithuania (41%), or Slovenia (40%). Czech Republic with 26% of the value indicators located deepbelow the EU27 average, which was 30%. Generally it can be said that among the surveyed states are more students tertiary study in a population of women aged 20-29 years than in the population follows the old men in Latvia is among even 48% of women university students between men and only 26% of university students. The only exceptions are Germany and Switzerland, where the representation of students of tertiary study among men and women identical, and Turkey with 26% of students between men and only 18% of female students among women. [3]



Graph 4 Students in tertiary study, 2008 (% of population 20-29)
Source: Eurostat 2011 [5]

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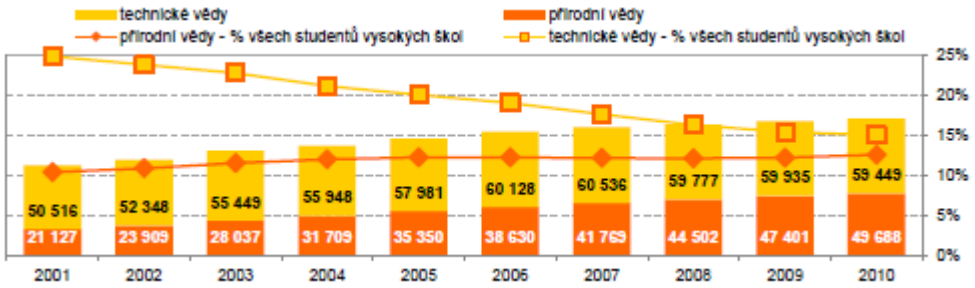
Students and graduates of Master's Studies in fields of science and engineering

In the narrowest basis for measurement of human resources are considered highly educated people in the fields of natural and technical sciences, and therefore it is necessary to take a closer look at students in just these fields. In 2010 there were studying in the Czech university in the fields of technical and natural sciences about 109,000 students. Since 2001 when these fields studied 71,000 college students are seeing steady growth their number. [3]

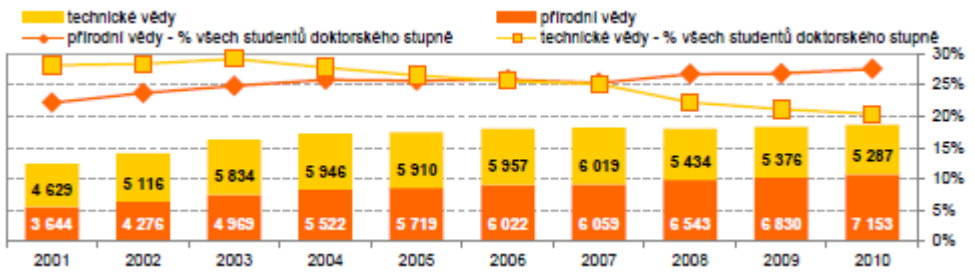
Significantly faster growth rate, however, over the whole period, the natural sciences. Number of students in technical sciences in recent years was as stagnation. Since 2001, when studiedscience 21 000 students to present their number increased by 135% to nearly 50,000. In contrast, The number of students in technical sciences during the same period increased by only 17% from about 50,000 in 2001 on 59 000 2010.[3]



Graph 5 University students in the fields of science and engineering
Source: Institute for Information on Education 2011

In 2010, the college enrolled in the fields of natural sciences, mathematics and computer science more than 49,000 students, among whom prevalence of men a share of 64%. These subjects were enrolled in 2010 also 12% are foreigners. Among college students of science, mathematics and computing has long been the greatest interest informatics, which in 2010, 45% of students studying natural sciences. Physical science studied 26% live and 21% of all students in the natural sciences. On the contrary, among the branches of natural sciences, which are of college students are least interested in mathematics and statistics with a share of 9%. [3]

Technical sciences at the university in 2010, studied more than 59,000 people, among which greatlyprevalence of men, which was 75%. Foreigners on engineering students held a share of 7%. Betweenuniversity students of engineering sciences, manufacturing and construction is the biggest long-term interest the technique in 2010, 55% of students studying engineering, architecture and construction32% of students studying science and engineering to manufacturing and processing are left 13%.In 2010 enrolled doctoral level education in the fields of natural sciences and more than 12,000persons and all doctoral degree students participated in 48%. Since 2001 the representation of studentsthese two disciplines at all doctoral students decreased by 2 percentage points. Womendoctoral degrees to students of natural sciences accounted for 42% of doctoral degrees in engineering sciences accounted for 23%. In the case of doctoral science programs is a higher proportion of women than iswith all study programs in this field, viz. above.[3]



Graph 6Students of doctoral study programs in the fields of science and engineering

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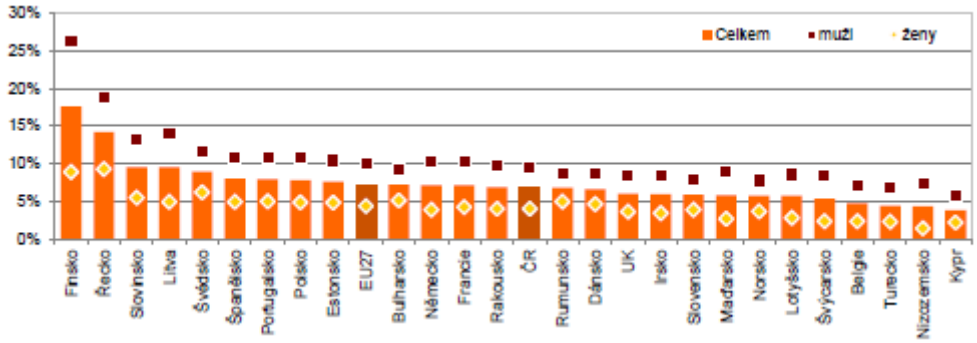
Source: Institute for Information on Education 2011 [6]

International comparsion

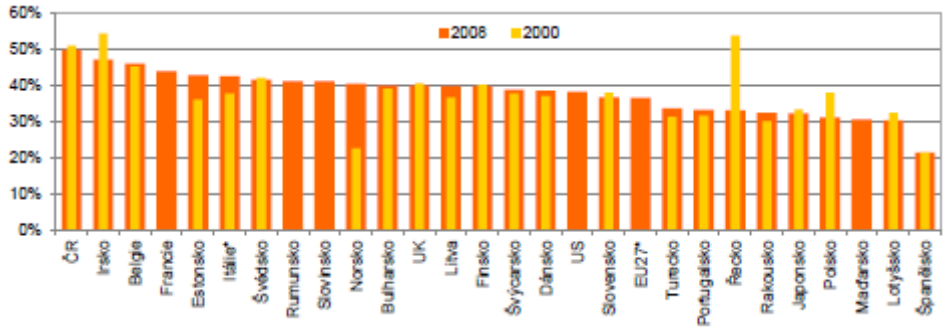
In Finland in 2008, tertiary education in the fields of natural sciences and engineering studied 18%people of the population 20-29, thereby Finland reached in comparison with other investigated States supreme in this indicator. Relatively high representation in the population 20-29 years of these students held a fields in Greece (14%), Lithuania (10%) and Slovenia (10%). On average EU27 studied natural and technicalScience 7% of the population 20-29. As mentioned above, the representation of students of tertiary studieshigher among women than among men. In case of technical and natural areas, however, this argument is not valid. In all countries surveyed, the higher proportion of students in these fields among men than among women. The most significant was the difference between the sexes in Finland, where the population of men studied natural and technical Science 26% of the female population and only 9%. [3]



Graph 7 Students in tertiary studies in natural sciences and engineering, 2008 (% of population 20-29)
Source: Eurostat, 2011 [5]

Among doctoral students held, in 2008 students of natural and technical sciences highest proportion in CR (50%), Ireland (47%) and Belgium (46%). On the contrary, a small representation of nature should sciences and engineering doctoral students between Hungary (31%), Latvia (30%) and Spain (21%). [3]

On average across the EU27 doctoral degree students studying in the fields of natural sciences and engineering 36% Students of this degree. Compared to 2000, between the observed states the highest increase of interest in the case of Norway, when this year studying disciplines mentioned 22% of doctoral students and seven years later, 40%. The biggest drop in this indicator was recorded in Greece, and itvalues from 54% in 2000 to 33% in 2008. [3]



Graph 8 Students of doctoral degree programs in the field of natural and technical sciences (% of alldoctoral program)
Source: Eurostat, 2011 [5]

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1. Setting up of the Network

At first it is very important to realize that there are more than one….two…three things which are the main obstacles. There is big number of reasons.

Strategic aims and actions
The reasons commonly expressed as the driving force for developing strategies to improve science education are, in most cases, a:

- declining interest in science studies and related professions;
- rising demand for qualified researchers and technicians;
- concern that there may be a decline in innovation and, consequently, economic
- competitiveness. [1]

The aims expressed in these strategies are, in many cases, linked to broader educational goals for society as a whole. The most common aims are to:

- promote a positive image of science;
- improve public knowledge of science;
- improve school-based science teaching and learning;
- raise pupils' interest in science subjects and consequently increase uptake of science studies
- at upper secondary and tertiary education levels;
- strive for a better gender balance in MST studies and professions;
- provide employers with the skills they need and so help to maintain competitiveness. [1]

Areas usually considered important and in need of improvement at the level of school education are curricula, teacher education (both initial and continuing) and teaching methods.
Governments are trying to achieve these aims through measures, such as:

- implementing curriculum reforms;
- creating partnerships between schools and companies, scientists and research centres;
- setting up science centres and other organisations;
- providing particular guidance measures to encourage more young people, particularly girls, to
- choose scientific careers;
- cooperating with universities to improve initial teacher education;
- initialising projects focusing on continuing professional development.

This is very breaf look at this problem. But let us see it in more details. [1]

1.1. Ways to increase students` motivation

Teachers` approach
It is a matter of endless disputes how to increase students` motivation to study chemistry. Teachers would suggest more real life examples, teaching more about issues that are useful or even essential in daily life. They should avoid instructivistic approach with students` passivity. Instead, various teaching methods can be utilized, e.g. games, trans-subject project education, proper experiments. The teaching method is crucial for students, it is better if they learn non-violently, seemingly incidentally. This depends on the teacher's abilities and imagination.

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However, the curriculum and teaching methods cannot be changed overnight. Czech teachers are very busy and besides teaching, they have to maintain discipline, solve educational problems and do lots of paperwork and thus have almost no time for innovation of teaching which desires great portion of enthusiasm. Although some teachers try to change their style of teaching, they have to prepare new teaching and learning materials in their free time, sometimes without chance to be rewarded.

a) ICT-based materials

Usage of computers can increase students` motivation. Computers are well accepted by the students because they are mostly well skilled to work with it. Using computer, didactic possibilities are much wider. We can visualize even relatively complex phenomena via pictures, video or applications. These would be hardly explained with words or static pictures. PCs can be used in almost every field of chemistry. To create teaching materials, many kinds of software are available, even free of charge. Nevertheless, as mentioned above, the same problem arises with lack of teachers` time.

Of course, many ICT-based teaching and learning materials are available online; however we found they differ a lot in topic, quality, extent, target group and purpose. It is not easy to find material suitable for particular class. Hence it is necessary to review and assess the materials, which is one of the aims of CIAA NETWORK project in the framework of which this paper has been produced. We have found that there are only a few suitable online-available materials in Czech language. The offer in English is much wider; however not every Czech chemistry teacher masters his English so much that (s)he could translate the materials for his/her students. Automatic translators are not suitable because they are not able to translate the text clearly and correctly since Czech is a very complicated language. We have to say the teachers are very busy (as we reported above) and there is a problem to motivate some of them for more work with reviewing the materials.

b) Electronic learning tools

Several schools have been provided with modern electronic learning tools as interactive whiteboards, tablets etc. We assume that this could increase the attractiveness of learning for pupils and students. Of course, these technical innovations cannot help without quality software and newly created or adopted teaching and learning resources. Although some of the devices have been already equipped with the resources by the producer. Usage of electronic tools has also numerous advantages. As we mentioned above, experiments in laboratory have to be limited at primary and secondary schools. At this time, laboratory simulations are very useful. For instance, pupils and students can simulate some chemical reactions without risk of injury.

c) International students' exchange

Even more could be done to increase students` motivation to learn chemistry. We mean that international exchange of students should be also extended. This can apply also for secondary schools; however student exchanges are more common during university studies. We assume every hardworking university student should have a chance to experience study in a foreign country.

d) Popularization events

Students' motivation can be also enhanced by popularization events. Activities for basic and secondary schools organized and co-organized by ICT Prague can serve as an example:

- Lessons of Modern Chemistry, Lessons of Modern Natural Science
- Laboratory for Secondary Schools
- Summer camp Běstvina, Summer Scientific camp
- Summer School and Workshops for Secondary School Teachers
- Scientific Trades (Open-air fairs)
- Excursions to various industrial plants, scientific organizations and science museums
- Natural science competitions (Chemistry Olympiad, Chemquest)
- Science in Ring, Workshops for journalists and scientists
- Preparation of popularization scientific materials.

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The activities are usually free of charge and some of them are described in detail in other papers. According to our experience, it is desirable to focus mainly on teenagers attending last grades of basic schools or lower grades of upper secondary schools, i.e. at the age of 13 to 16 because this is the age when most of the teenagers form their ideas of future career. At the last two grades of upper secondary schools, they are already decided upon their future career.
It is necessary to mention that not every piece of popularization of science is desirable. Mainly in some particular media, the popularization turns to yellow journalism. The sensation events are highlighted instead of serious ones. Therefore the educator has to choose carefully the material for teaching. They should also correct the misleading facts that students have heard and reported.

Many national initiatives to help improve teachers' skills

As past evaluations of science promotion strategies have shown, strengthening teacher competences
is a particularly important concern. Countries which have a strategic framework for the promotion of science education normally include the improvement of science teacher education as one of their objectives. School partnerships, science centres and similar institutions all contribute to teachers' informal learning and may provide valuable advice. Science centres in several countries also deliver formal CPD activities for teachers.
Almost all countries report that their educational authorities include specific CPD activities in their official training programmes for in-service science teachers. Less common, however, are national initiatives focusing on the initial education of science teachers. [1]
Creating a rich spectrum of teaching situations' and applying a variety of teaching techniques, are usually mentioned as 'part of a specific course' in teacher education programmes; collaborative or project-based learning and inquiry- or problem-based learning are also frequently addressed. However, dealing with diversity, i.e. teaching a diverse range of students, taking into account the different interests of boys and girls, and avoiding gender stereotypes when interacting with students, is addressed less often in teacher education programmes. Obviously, the survey results only provide indications about teachers' preparedness to teach, as their actual knowledge and ability to teach cannot be directly inferred from the content of teacher education programmes.[1]
Nowadays one of the ways to increase interest in scientific subjects is the Foundation's Scientific Culture and Innovation Program included three main elements in 2010. [1]

- The promotion of scientific culture and innovation. This element includes projects for the dissemination and communication of general scientific topics as well as projects to promote scientific vocations to young people. However, some of its actions are directly related to school education, teachers and non-university students.
- Promoting network operations including projects for the dissemination of science and innovation coordinated by specific Communication and Innovation Units of the Autonomous Communities.
- The launch of new networks including projects aimed at promoting good practice in companies or other organisations which have successfully incorporated new innovations and an entrepreneurial culture.

Information on participants of this idea

In the Czech republic, there are involved five schools. Three of them are in Prague, two another are from Mikulov, Moravské Budoějovice. According the position of these schools, it can be told that it include the whole area of republic. Here are the names of these schools. Gymnázium Moravské Budějovice Tyršova 365; Gymnázium Na Zatlance 11, Praha 5; Gymnázium, střední odborná škola a Střední odborné učiliště Mikulov, Komenského 7; Masaryk Secondary School of Chemistry, Křemencova 12,Prague 1; PORG, Gymnázium a základní škola, o.p.s., Lindnerova 3, Praha 8; SPŠ sdělovací techniky, Panská 3, Praha 1.
These institutions are average institutions in education sector.
We also included few experts in this area. Alexandra Hroncová is Science communicator & Marketing Specialist. Jitka Svatošová is Project Manager. Michaela Žaludová is Project Manager and

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Science Communicator, Petr Holzhauser is Teacher Trainer, and the last is Petr Klusoň, which is UniversityProfessor.Main obstacles to Students' Motivation to learn Chemistry

The main reasons of students to learn chemistry

Main factors associated with science performance are almost everything around us. There are lots of surveys explore factors associated with science performance on several levels: characteristics of individual students and their families, teachers and schools, and education systems. [1]

For example the first motivation for students to study scientific subjects and chemismy in particular is home environment and individual student characteristics.

Home background is very important for school achievement. There is very strong relationship between pupils' science achievement and student background, measured by the amount of books at home or speaking the language of the test at home [7]. It is also generaly known that home background, measured on an index summarising each student's economic, social and cultural status, remains one of the most powerful factors influencing performance. However, poor performance in school does not automatically follow from a disadvantaged home background. Many disadvantaged students spent less time studying science in school than their more advantaged peers. They often ended up in tracks, streams or schools where there is very little choice and no opportunity to take science courses. Therefore, learning time at school should be considered when designing policies to improve performance among disadvantaged students [8]. [1]

We also can see that interest in science appears to be influenced by student background.

Students with a more advantaged socio-economic background or those who had a parent in a science-related career were more likely to show a general interest in science and to identify how science may be useful to them in the future [9]. [1]

Gender differences in average science performance are rather small compared with other basic skills assessed by international surveys (i.e. reading and mathematics) Yet, it is important to take into account that overall gender averages are influenced by male and female student distribution across different streams or tracks (school programmes). In most countries, more females attend higher performing, academically-oriented tracks and schools than do males. As a result, in many countries, gender differences in science were substantial within schools or programmes, even if they appeared small overall [9]. In addition, there were tender differences regarding scientific competences and certain attitudes. On average females were stronger in identifying scientific issues, while males were stronger at explaining phenomena scientifically. Males also performed substantially better than females when answering physics questions [9]. The largest gender difference was observed in students' selfconcept in science. On average, girls had lower levels of belief in their scientific abilities than boys in all European countries. Boys also had higher level of confidence in tackling specific scientific tasks. In most other aspects of self-reported attitudes towards science there were no consistent tender differences. Both boys and girls had similar levels of interest in science and there was no overall difference in boys' and girls' inclination to use science in future studies or jobs [10]. [1]

There i salso clear link between enjoyment of learing science and science achievement.

Students' belief in whether they could handle tasks effectively and overcome difficulties (self-efficacy in science) was particularly closely related to performance. While this does not indicate a causal link, the results suggest that students with greater interest in science are more willing to invest the effort needed to do well [9]. It is also reported a link between the level of self-confidence in learning science and achievement in the subject [7]. Attitudes towards science differ between grades and different science subjects. According to the Index of Students' Positive Attitudes towards Science, fourth grade students generally had positive attitudes. At the eighth grade, a general index of attitudes was

constructed only for countries teaching science as a single, integrated subject. In three out of four European countries where the comparison of attitudes was possible, eighth grade students had considerably worse attitudes towards science than fourth grade students. This was especially pronounced in Italy, where 78 % of fourth grade students and only 47 % of eighth grade students had positive attitudes towards science [7]. In countries teaching science as separate subjects, eighth grade students' attitudes to biology were the most positive, but slightly less positive to earth science and, in particular, to chemistry and physics. [1]

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For example European commision present the international survey ROSE [1] – the Relevance of Science Education (2003-2005) : which analyses the views and attitudes to science of pupils towards the end of secondary school (age 15). This survey views positive attitudes towards science and technology as important leasing goals in themselves [Sjøberg and Schreiner, 2010]. Interests influence future career choices; moreover, attitudes to science acquired in school might determine a person's relationship to science and technology in adult life. Unfortunately, the results of the survey have to be interpreted with caution as not all participating countries managed to achieve representative samples. The ROSE results show that attitudes to science and technology among young people were mainly positive, but students were more sceptical towards school science. The results showed some variation across countries. Students in northern European countries seemed to show less interest in science and science careers than students in southern European countries. The least interesting topics for 15 year-olds were plants (flora), chemicals and basic physics topics (such as atoms and waves). Interestingly, contextual topics were also among the least interesting, for example 'famous scientists and their lives'. ROSE results seem to indicate several differences between the attitudes of boys and
girls. Boys tended to be interested in the technical, mechanical, electrical, spectacular, violent or explosive aspects of science. Conversely, girls tended to show more interest in health and medicine, the human body, ethics, aesthetics, and paranormal issues. Environmental issues were important for all, but girls were more inclined to agree that each individual can make a difference. Based on these findings, the ROSE research team suggests that the gender differences in interests and motivation should be taken into account when teaching science in schools. [1]

The second main reason to study science subjects or second impact on the motivation is the schools and education system.

School features contributing to higher student achievement vary from country to country to a great degree and their effects need to be interpreted by taking national cultures and education systems into
account. The variation in student achievement observed within schools or between schools differs greatly across countries. Other possible causes might be: differences in the socio-economic and cultural background of students entering the school; geographical disparities (such as those between regions, provinces or states in federal systems, or between rural and urban areas); and differences in the quality or effectiveness of science instruction in different schools. The advantage resulting from attendance of a school where many students have favourable home backgrounds relates to a variety of factors, including peer-group influences, a positive climate for learning, teacher expectations, and differences in the resources or quality of schools. [1]

Causes of motivation lack: the view of general audience

Teaching methods

The main obstacle is that teaching is mostly conducted in too abstract terms so that most of the students are unable to imagine in reality what is the teacher talking about. The students try to remember the facts by heart without understanding them. They copy the formulae and equations written on the board without thinking of their meaning. The main problem is that the education in chemistry classes consists in too much theoretical lecturing instead of presentation of real life examples. The textbooks are often old and contain abstract plain text without simple explanation.

Theory is preferred to practice for several reasons. Firstly, the allocation for chemistry is often low, one to two lessons per week. Secondly, at some schools there may be a lack of teachers who want to teach chemistry by different way. Although we are sure that generally there are many teachers enthusiastic to change the way of teaching but they are limited by various laws and regulations. Many chemicals which students commonly used to work with in the past are considered harmful now (more or less rightfully) and even the teacher is not allowed to neither use nor store them in the school. Moreover, many schools cannot afford to buy expensive chemicals and equipment to perform experiments. Should there is a time for laboratory experiments at chemistry lessons, the number of possible experiment is limited. In addition, teachers have to follow the curriculum and prepare pupils or students for leaving exam or admission exam to higher degree of education, so

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they must teach what is expected to teach. Learning drill is often practiced (e.g. many theoretical calculations or numbering of equations) followed by boring descriptions of industrial processes (typically manufacture of steel or ammonia). Pupils and students are not only unsuccessful in chemistry but also gradually become disgusted by it and prefer other subjects for their following study and professional career.
According to results of some particular research projects, it was found out that chemistry and physics are the least popular subjects at different types of primary and secondary schools. There is also close connection between difficulty and popularity of subjects: An easy subject is also favorite and vice versa. Hence informatics, physical and art education are the most favorite subjects while biology lies in the middle. However it is complicated to assess the popularity of the individual subjects because the students` response strongly depends on how the questions are asked. Sometimes the students assess the teacher and his/her enthusiasm for teaching while at some other time they judge popularity of teaching method or the actual topic. Therefore international standardized research methods should be used.
Nowadays, mainly instructivistic educational approach is characterized by still prevailing dominant role of the teacher and receptive passivity of the pupils. Scientific facts are obtained by such way that almost excludes their later application and utilization. Pupils are not able to use their knowledge in concrete situations because they cannot recognize their relation to reality. They are not able to transform their abstract facts to the real situation.[Paper]

Unpopularity of chemistry
Another problem is that pursuing a career in chemistry does not appear to be “in style” for the youth. This seems to be transnational problem. Nowadays, mainly the tertiary sector of the economy, i.e. the service sector speeds up economics as for example traveling service, tourism, transport, entertainment. Heavy industry which prevailed for decades has receded for several reasons: The Czech Republic, as many other countries of Central and East Europe, experienced turnover in political and economical development in 1990s. Then the chemical production fell down. The other decrease was caused by demand to lower harmful emissions and by restrictions originated in EU that has committed to reduce the emissions of carbon dioxide. In addition, there have been pressures from ecologic organizations including self-styled populist ones which defame chemistry and chemical industry without justification.
More and more young people do not consider chemistry (and other technical branches of science as well) interesting and perspective but dirty or even harmful. They prefer humanistic branches as sociology, political science, laws etc. Humanistic faculties of universities have to select from vast amount of prospective students, however many of their graduates are confronted with employment problems. Nevertheless, there is no doubt chemistry is not only necessary for our lives, but it is also a perspective field of science. People should realize that chemistry is versatile and ubiquitous. Many things we use every day are products of chemical industry, e.g. food, clothes, detergents, plastics, drugs etc. The mankind would be paralyzed without chemistry and chemical industry because so called bio-products cannot be produced in amounts sufficient to satisfy human needs. It is to be said that chemistry and ecology are not opposites but they are closely connected. Chemical industry will not disappear, just its orientation may change and new, more sophisticated and specific manufactures will be opened. So chemistry can be also a good choice for career.
Here we can summarize these obstacles. Integrated science teaching occurs mostly at higher level of education. So it can not deeply influence children. But in recent few years, there is the tendency to repeat it. For example with lots of reforms.Naturally, these reforms have also affected science curricula. The main motivation for these reforms was the desire to adopt the European key competences approach.
But the strongest obstacle is no specific support measures for low achievers in science.There is no specific support policy for low achievers in science subjects. Help for low achievers is usually provided as part of the general framework of support for students with difficulties in any subject. Few countries have launched nation-wide programmes for tackling low achievement at school. In most countries, support measures are decided at school level.
Another obstacle is that traditional assessment methods still prevail. Guidelines on student assessment generally include recommendations on techniques to be used by teachers. Traditional

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written/oral examinations, assessment of students' performance in class as well as assessment of their project-based work are the techniques most commonly recommended. It is also interesting to note that no clear distinction can be made between the specific guidelines for science assessment and the general guidelines that apply to all curriculum subjects; the techniques recommended are similar in both.

2. Analysis of Teaching Resources

The task of partner schools, which were mentioned in previous chapter, is also to evaluate the resources of chemistry portals. we evaluated 20 portals. for example: amazing chemistry teaching resources
zazijchemii, world of teaching, výukovémateriály.eu, teachable, studiumchemie: portal supporting education in chemistry, science kids – chemistry, rsc – advancing the chemical sciences, michael canov, merlot chemistry portal, khan academy, hands-on chemistry activities with real-life applications: easy-to –use labs and demonstrations for grades 8-12, free – federal resources for educational excellence, eso – electronic study supports, effective learning by reformation of education at gymnasiums (grammer schools), educa – education for modern school staff in ustecko region creative chemistry.
In their reports, there was the point for prerequisities for the portal, the aims, the content, task description or how to use it in class. It also included points of strength, weakness. Few of them were incerdibely funny, lots of them were in traditional view.
The prerequisities were about what it is all about. Whether you are a teacher, doing chemistry at school, or are simply just interested in chemistry, Creative Chemistry has lots for you.There are full-colour worksheets and teaching notes for fun activities suitable for a chemistry club, and around three hundred pages of question sheets and practical guides for GCSE and A Level Chemistry. You will also find fun chemistry puzzles, interactive revision quizzes and molecular models. Choose from the featured selection below, use the Search facility, or enjoy just browsing.
The contents were in general Fun practical activities, Interactive Crosswords, GCSE worksheets and practical guides, Wordsearches, Concentration game. Pupils are to solve tasks and answer basic questions as well as provide results. Themes are very interesting, connected to real life and nature. All items can be demonstrated on real life examples.
The aim was in general to ensure the safety of students, work to a ratio of one teacher to every eight students, and have the help of capable sixth form chemistry students. In every activity, the students wear safety glasses, smocks and gloves.
Task description seem sometimes quite long, but it is necessary because the experiments could be conducted at home, therefore the pupils must understand everything very well. For that matter the instructions are quite clear and straightforward. Points, received from work appears as a good source of motivation.
How to use it in class: As written on the website: it can be used in experimental/ practical lessons, but it can also be solved as homework. I think, students like home projects, they can work in groups or they can compare different results and discuss them.
As points of strength are very often used words as very interesting themes, properly written instructions and tasks, feedback. Provide for cooperation between teachers, pupils and parents, Knowledge received by actually conducting experiments is much larger than by watching experiments on TV or video. For example: Aluminium can be anodised fairly easily, and dyed permanently using fabric dyes or fountain pen ink. Used drinks cans form an inexpensive source of aluminium sheet, though you could splash out on new sheeting if you felt like it. Our students have been very creative with anodised aluminium, producing jewellery, badges - even a Klingon dagger!
Points of weakness: Pupils must sometimes work without help; there should be cooperation between teachers and parents of pupils. Instruction are sometimes very long although pupils prefer shorter descriptions, they don´t like to read long articles, but if working at home, it is necessary to provide these long descriptions.

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Very important is the scientific reliability. I think, all is perfectly explained and students are led to make the best results. After every task should follow a session where everyone discusses the results and teacher corrects the mistakes.
And at the end of this chapter the last main point - Pedagogic value. The pedagogic value is large.Students that are sick can work on experiments at home and without everyday consultation with the teacher. Every teacher can use this web site and teachers can consult results together. The materials are very useful.

3. Workshop

Let us briefly describe the workshop. This is the best example of results. At the beginning of the workshop, there was presented the programme of the day. It was composed of seven parts. The first part was focused on different views of chemistry. There were presented very interesting topics like Chemistry of fragrances, Chemistry of cosmetics, Nanotechnology. The second part of workshop was devoted to Mikuláš Duda, the spokesperson of UNIPETROL Company, who presented the new websites of the project. The third part was dedicated toCIAA Network, presented by Zdeněk Hrdlička. The part number four was about problems of motivation into chemistry. What are the causes? What are the results? Than the director of MSŠCH Křemencova presented the proposals of changes, which were focused on the process of school-leaving examinations at vocational schools. This part was followed by discussion of participants about previous topics. At the end of the workshop there was the time for questions, answers, and for the proposals of professors to improve interest in chemistry.
As already mentioned above, the first part was focused on chemistry in different views. The aim of professors was to show chemistry in common life, with no formulas needed. This is the one of few ways to increase motivation of students to study chemistry. There were seven presentations: Chemistry of fragrances presented by L. Červený, which showed that everything around us is connected with substances and chemicals; presentation Quality, safety and authenticity of food by J. Hajšlová: food is also closely connected with chemistry, every day food analysed, if it satisfies the conditions required by law. Very interesting was also the presentation by Moravcová, Saccharide code or how to cells plotting; presentation Cosmetics, nature or chemistry by Šmidrkal : if there weren't any chemists, there wouldn't be any cosmetics products. This claim was extended to food production by R. Ševčík who presented a lecture "Harmful Es or significant part of traditional quality food". Very positively evaluated by audience was the presentation of L. Joska about: "Metallic biomaterials in medicine". Chemistry is very important part of medicine, they seem to be like twins. They help together. The last presentation aimed to show chemistry in the world of nanotechnology. It had also very good response by audience.
This part was specially made for students. It presented chemistry in other view. It was the attempt, if the students evaluate it. If this is the right way, which will improve the interest in Chemistry. It had to involve as much as possible branches of chemistry.
The next part, second part, was consisted in the presentation of Mikuláš Duda, the spokesperson of the Unipetrol Company. It was the first time when he introduced new web site project www.zazijchemii.cz, a new way which can improve interest in chemistry in the Czech Republic. Unipetrol is the oil company so it is closely connected with chemistry. This web site is very clear, it contributes experiments, crosswords, quiz. It can serve as the scheme of chemistry lesson. It demonstrates experiment in pc version. Lots of professors were excited. The presentation had really great response by audience.
The third part of the workshop was devoted to presenting the CIAA NET project - Chemistry is all around network. Zdeněk Hrdlička, assistant professor at ICT Prague. He presented what is the aim of the project – to stimulate students in studying chemistry. He also showed that this project is international with lots of partners from eleven countries of Europe. He introduced the coordinator of the project, Maria Maddalena Carnasciali, from the University of Genoa in Italy. During his speech he talked about database of educational materials in the areas of chemistry, about networking and sharing of knowledge between experts, teachers, and also about removing existing barriers in chemistry area. He pointed out the importance of organization transnational conferences to share lessons, information. Part of his presentation was dedicated to the way of funding. He informed that

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the project is financed by European Commission as a part of Lifelong Learning Programme. It takes 36 months. Very interesting information was the amount of money provided on it. The European Commission provided the amount € 445 706 of the total budget € 594 275. For Czech Republic is allocated the amount € 25 545 and the remaining money € 8 515 will be provided by the Institute of Chemistry Technology Prague.
As a part of his contribution he presented the expected results of the project. The results would be the creation of network of cooperating teachers and experts at the transnational level, which would evaluate resources for teaching chemistry, and also creation of comprehensive database of teaching materials in field of chemistry.
At the end of his part he presented the invitation to International Conference on Innovative Learning in Chemistry in December 5th. This conference is aimed at addressing the issue of education in chemistry and of motivation of students to study chemistry. The key part of the conference will be the presentation of results of national reports on student's motivation.
The fourth part of the workshop was the topic: Problems with the motivation of students in chemistry at gymnasium, grammar schools. This part was presented by Marie Vlková from Gymnázium Havlíčkův Brod. There is no doubt that there currently exist significant problems surrounding student motivation towards the study of chemistry in the Czech Republic. She also stressed that pursuing a career in chemistry does not seem to be among the top choices for the youth but also studying chemistry at school seems to be unpopular. It seems that the main obstacle is that teaching is mostly conducted in too abstract terms so that most of the students are unable to imagine in reality what is the teacher talking about. The main problems appears to be too little real life examples in classrooms, too much theoretical technical lecturing, old textbooks with abstract plain text without simple explanation and no possibility of at home studying as most of the teachers do not use any textbook and just teach "their own materials".
These problems or obstacles were confirmed by lots of professors at the workshop.
The fifth part of the workshop was led by Jiří Zajíček, the head of Masaryk Secondary School of Chemistry. He had the presentation: The proposals of changes focused on process of school-leaving examination at vocational schools. He stressed that it is a matter of endless disputes how to increase student motivation towards the study of chemistry and it is dependent on many factors. For example he suggested more real life examples, teaching more about issues that can be useful and helpful in daily life and/or to provide materials to study at home for those who do not understand it in class. Another issue to be further researched is why is there lack of students wanting to pursue career in chemistry. It seems one of the main reasons is the fact that pursuing career in chemistry does not appear to be "in style" and also there still seems to be a gender issue within technical disciplines.
The end of the workshop was reserved for discussion of participants, questions and answers, proposals of professors to improve interest in chemistry. A few professors proposed that there is no general overview of legislation. The legislation of chemistry is very fragmented, and it is very difficult to have clear view in this. So professors suggested the necessity to make an overview of chemical legislation. Another opportunity to make chemistry branch clear is the creation of overview of marks. Which liquid has to have which signification, which designation.
Lots of primary and secondary school professors and also students participated in the workshop. The new very interesting and actual topics were discussed, new ideas also arose to improve this area.
During this agenda, profesors had lots of questions. Mainly on the law of chemistry field, decree concerning the rules governing rules for handling chemicals, practice with chemicals. There is no yet a single document that would contain everything. This was the main obstacle from the workshop.
Lots of profesors also see the main problem in money as a reward for helping with questionaires, they do it for free, in their time. So it is not a good incentive for them to do it.

4. Conclusions

In the Czech Republic, as well as in other countries, there exist problems with pupils` and students` motivation to learn chemistry. Many students consider chemistry difficult and not interesting for future career. The reasons of this lack are of different origin, from obsolete teaching methods and tools to general unpopularity of chemistry. This state can be improved by employment of new teaching

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methods and equipment; however this is limited by costs of new tools and time and effort necessary for change. There are many ICT-based teaching materials; available reviews of them can help the teacher to choose the proper one. Students` motivation can be also enhanced by various popularization events performed by universities and other scientific institutes.

Countries support many separate iniciatives but overall strategies to improve science education are rare. School science partnerships exist in many countries and may come under the umbrella of broker strategies or they may be stand-alone initiatives; in either case their organisation differs between European countries. Partners may vary and range from government agencies and higher education institutions to science associations and private companies. Although some partnerships focus on one specific topic, the vast majority embrace various aspects of science education. Nevertheless, very few partnerships seem to focus their attention on raising girls' interest in science. All the partnerships reported have one or more of the following aims in common: to promote scientific culture, knowledge and research by familiarising pupils and students with scientific procedures; to enable students to understand how science is used, particularly through contacts with applied science in companies; to strengthen science education by enhancing and supporting the implementation of the science curriculum; providing teachers with continuing professional development opportunities focused on practical work and inquiry-based learning; and supporting science activities for pupils and students; to increase recruitment to MST professions by encouraging talented pupils and inspiring more

students to choose MST careers by making science more work-relevant.

Traditional assessment methods still prevail. The main aim of assessment guidelines is to ensure that students' knowledge and skills are assessed in accordance with the objectives and/or learning outcomes defined in the curriculum. In half of the Eurydice countries or regions, there are specific assessment guidelines for science. These guidelines generally contain recommendations on the techniques to be used by teachers hen assessing student progress. Traditional written/oral examinations and assessment of students' performance in class as well as their project work are the most frequently recommended methods. It is also interesting to highlight that no distinction can be made between specific science assessment guidelines and those which apply to all curriculum subjects; the techniques recommended are simile in both. Overall, official guidance material to help teachers assess students' science-specific skills is sparse.

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