

How Czech Institutions Overcome the Lack of Student's Motivation to Learn Chemistry

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Abstract

The paper 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.

1. Introduction

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 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.

2. Causes of motivation lack

2.1 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 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.

2.2 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.

3. Ways to increase students' motivation

3.1 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.

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.

3.2 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.

3.3 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.

3.4 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.

3.5 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 Běstvína, 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

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. (S)he should also correct the misleading facts that students have heard and reported.



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 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.

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