

Successful Experience in Chemistry Teaching in the Czech Republic

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Abstract

The Czech education system has a long tradition, which is followed by changes and educational reforms. Czech society is changing and the educational system needs to respond these changes. The paper discusses innovative methods in science teaching and key competences and their development in chemistry teaching. This paper also deals with outcomes of the three/year process and it highlights the successful experience of its activities. Firstly, the project was focused on students' motivation, then on teachers training (pre-serving and lifelong learning) and the last year of the project was devoted to the examples of successful experience. Thanks to the activities a community of active science teachers who support and motivate their pupils/students to chemistry was created.

1. Introduction to the national situation

The society is changing and Czech teachers try to make the best to respond these changes. Many difficulties and problems connected with education were discussed in previous papers and national reports.

Czech educational tradition is slowly followed by new innovative teaching methods and trends. The main teaching form is still a frontal teaching of big group of students/pupils (25 and more). Some teachers still give information and let students be passive. Reportedly, the main reasons of that are the economic situation and workload of chemistry teachers and thus low teachers' motivation. In the frontal teaching form, innovative components could be successfully incorporated (brainstorming, mind maps, students argumentation and discussion as well as ICTs). Cooperative teaching (learning) is also considered as classic teaching method. This form leads students to share, cooperate and support each other. This helps to understand the curriculum.

It is not easy to find the most successful way. But it is important, that Czech system is changing with the changing Czech (European) society. Lifelong learning programmes, workshops, fairs and conferences inform about innovative teaching methods (each activity will be discussed below). Interesting and successful innovative methods will be discussed.

2. Innovative methods in science teaching

There are many innovative methods in science teaching. This paper deals with the most important of them (related to the science teaching).

- Inquiry-based teaching in the Czech Republic
European pedagogues are discovering inquiry-based science education (IBSE) in these days. Czech Republic also follows this trend (with a slight delay). IBSE approaches focus on student's inquiry as the driving force for learning. Teaching is organised via questions and problems in a highly student-centred inquiry process. In IBSE, students learn through and about scientific inquiry rather than by teachers presenting scientific content knowledge. We would like to mention a successful National conference SCIENTIX which was designed primarily for teachers of elementary and secondary schools who teach maths, science and technology, and also for professionals who are involved in innovation of the areas of mathematics, science and technical subjects. (<http://www.dzs.cz/cz/eun/narodni-konference-scientix/>) There were practical workshops, where



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the participants tested a variety of innovative teaching methods in practice. The main goal of this conference was that each teacher took particular inspiration for his teaching. The conference was organized by Association of European Schoolnet (EUN) in collaboration with the Centre for International Cooperation [1].

- **Project education form**
Project education form helps to motivate students to learn chemistry and to enhance competences like: cooperation, discussion, formulation of questions, problem solving, create and find information (competences necessary for laboratory work). [2]
- **Open education form**
Students cooperate together (the class premises are modified to support cooperation as well as frontal or individual form of teaching chemistry). Weekly schedule informs about compulsory work and what is voluntary. It is not limited to the borderline of the school. Students choose their work activity freely but they have to carry out the schedule. [3]
- **Chemistry teaching supported by ICTs.**
Information and communication technologies are becoming more and more involved as a teaching support in Czech schools (visualisation of information, communication between students, teachers, experts, support of cooperative teaching forms, support of experiments). The need of innovation and changes in chemistry teaching via new technologies is highlighted by a number of renowned authors [4]. Whiteboards are the ICT most widely used by Czech science teachers. They use it to present their powerpoint slides, or short videos of experiments, graphs, tables, virtual labs, and field trips. Information technology enables e-learning and promotes interdisciplinarity (ICTs, English). ICTs are also an integral part of the equipment for school laboratories. According to the declaration of the Czech state and the Agricultural Office, there is still not enough computers with high speed internet at Czech schools. Figure 1 shows number of computers per 100 pupils/students in 2010 [5].

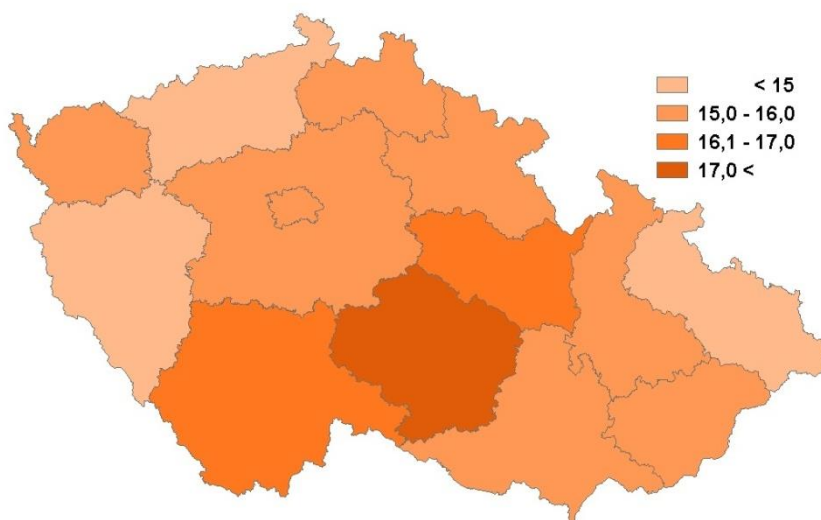


Fig. 1: Number of computers with high speed internet at schools (for 100 pupils/students), 2010. [5].

- **The Institute for Support of Innovative Education**
The Institute for Support of Innovative Education is focused on supports innovative methods and trends, mediates information, initiatives for teachers, experts and schools. The institute is focused on Montessori School, Waldorf School, intercultural schools, intuitive education etc. It provides an online portal with a list of successful schools which involved innovative teaching in their daily practice [4].

- Innovative training of future teachers of chemistry
It has been indicated that the education is going through changes and reforms. The efforts of innovative methods are visible. The Project "Innovation of professional preparation of prospective chemistry teachers" at Palacký University in Olomouc can serve as an example. This project has been co-financed by the European Social Fund and the state budget of the Czech Republic. The aim is to allow prospective chemistry teachers to be in a close contact with pupils at primary and secondary schools through management of students' projects directly in chemistry lessons, tutoring laboratory lessons, organizing Chemistry Olympiad at schools and excursions to laboratories for pupils, chemistry consultations for talented secondary school pupils, preparation of natural science competitions and popularizing events [6].
The focus on preparation of prospective chemistry teachers has become a priority even during the International Year of Chemistry, where international student's conference *Project teaching in chemistry and related subjects* took place, organised by Faculty of Education, Charles University (Chemistry and Chemistry methodology department)[7].

3. Key competences and their development in chemistry education

In line with the new curricular policy principles outlined in the National Education Development Programme for the Czech Republic (the so-called "White Paper") and enshrined in the Education Act (on Pre-school, Basic, Secondary, Tertiary Professional and Other Education), a new curricular system for pupils and students from 3 to 19 years of age was introduced into the Czech education system. Curricular documents were developed at two levels: the national level and the school level. The national level in the curricular documents system comprises the National Education Programme and Framework Educational Programmes. The content of basic education within the education framework is divided into nine, roughly defined educational areas. Each educational area comprises one or more interlinked *educational fields*. Chemistry is included in area Humans and Nature (Physics, Chemistry, Natural Sciences, Geography)[8].

Pupils and students often learn the curriculum from outdated textbooks that do not correspond with current knowledge. We would like to mention two successful textbooks: Chemistry for 8th grade of primary school by Škoda and Doulík. [9] It is a modern textbook (2006) that works with whiteboards and other ICT technologies. The second example of a successful textbook is Chemistry for high schools by Honza and Mareček (2008). [10]

The main competence developed on primary schools (ISCED 1 and 2) are: learning competence, competence to solve problems, competence for communication, social and personal competence, civic competence, working competence. ISCED 1 education does not include chemistry (In the *Man and his world* some workshops could be involved supporting science fields - framework educational programs support interdisciplinarity). Pupils have first chemistry education at 7th or 8th grade. The main goal of chemistry teaching at primary schools is to build complex attitude to the world of chemistry. Students get basic knowledge of major chemical industries.

School educational program (chemistry) ISCED 3 builds on the skills acquired in ISCED 2. Students are supported to take part in national and international contests, extending the particular issues and broadening the knowledge and competence.

Children at kindergarten do not learn science (it is not included in the Framework educational programs), but it is necessary to start with small children (for example through an interdisciplinary teaching) to motivate them to be inquisitive and observe the world (chemistry including) as well as own skills. There are some successful activities supporting science teaching for small children, but it is still not enough.

Successful activities supporting the motivations of students and helps to develop their chemistry skills are:

The Young Chemist contests

- Successful journals and books
- Successful conferences and programmes of lifelong learning
- Successful projects and portals
- Successful science teachers and school, experts who communicate with students

4. Successful outcomes of the Chemistry is all around us - network project

- Workshop for science teachers organized by ICT Prague (with CIAAN): The workshops helped to create collaboration between teachers and experts in the field of chemistry proceeded. Workshops helped to science teachers to get to know new results of some actual scientific research carried out at ICT Prague. ICT Prague will stay in contact with associated schools, teachers and experts.
- Teaching resources on the CIAAN portal: There was created an extensive database of teaching resources (some of them are in Czech). Teachers and experts commented them and discussed some topics. It was uploaded more than 90 comments from Czech teachers and experts during the three years. This helped to make the database more interactive and more useful. The resources were also tested by teachers.
- International conferences: Members of the CIAAN team of ICT Prague took a part in international conferences. This helped to spread information about an actual European situation in chemistry teaching to associated Czech teachers. One of these international conferences was held in Prague (2012).

There were organized more activities. Main idea was to encourage teachers to lifelong learning, and to discuss their opinions, successful experience and barriers in chemistry teaching to increase students' motivation to chemistry.

5. Conclusion

The paper dealt with examples of good practice in the teaching of chemistry in the Czech Republic, as well as with innovative methods in science teaching and key competences and their development in chemistry education. Outcomes of the CIAAN project were discussed too.

The paper highlighted that children in kindergarten do not learn chemistry (it is not included in the Framework educational programs), but it is necessary to start with small children to motivate them to be inquisitive and to be able to observe the world (chemistry including) as well own skills.

Three years of the CIAAN project helped to create a lot of activities for teachers and their students. Workshops for the teachers were the most popular for them. Teachers also actively commented the resources uploaded on the CIAAN portal. The portal will be available after the end of the project. ICT Prague will stay in contact with associated partners, teachers, experts and schools in the future.

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