

Educational Methods and Teaching Materials Used in Chemistry Teaching in Polish Schools

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Abstract

Contemporary schooling in Poland faces many obstacles with regards to teaching scientific subjects. Teachers have to be flexible in applying different methods and techniques in order to make students interested in learning and exploring technical issues. The author presents different ways and latest trends in Polish school in teaching chemistry. Starting from brief description of the educational system and how the chemistry is taught in a Polish school the author presents experiments, educational games and laboratory tasks; everything to facilitate students' progress.

Introduction

The process of teaching chemistry in Polish schools starts at the gymnasium and it lasts for 3 years at this educational level. After gymnasium, Polish students are taught chemistry in high school. Chemistry classes in high school last only for one year and it is at the basic level. However, all students have a possibility to choose the chemistry, as a subject that they want to study at the advanced level. If advanced level is chosen by the student, then chemistry lessons last for 3 years, with the average frequency of 4 hours per week. Therefore, the process of teaching chemistry in Polish schools may be grouped into three stages.

First one concerns education in gymnasium, where the teaching of chemistry is very extensive, including both inorganic as well as organic chemistry. During classes, students learn about physical and chemical properties of elements and chemical compounds. This is the most important stage, because during it, the students are discovering the world of chemistry for the first time. This first impression may have later significant influence on students' interests in chemistry and may affect their educational choices.

The second stage begins at the first year of high school, where chemistry is taught at the basic level. This stage aims students, who are not interested in possessing extensive chemistry knowledge because they are not going to need this knowledge during their future professional career. During the classes teachers are showing their students that the whole world around us is strictly related to chemistry and that the chemistry affects everyday life. Teacher may present some interesting facts from the field of chemistry and should answer student's questions about the applications of chemistry in pharmacy, medicine, sports, cosmetics, food, energy and genetics.

The third stage is the advanced chemistry classes. Chemistry lessons at this stage should prepare student for passing the matriculation examination from this subject, as well as provide the necessary knowledge of chemistry, that is required to study the chemistry related sciences in the future, such as medicine, pharmacy, biotechnology, dietetics, and many others.

As you can see, each stage should be discussed separately, because teacher's role and goals are different for each of them. In gymnasium, where students start to discover chemistry, so this is the most important stage of learning, chemistry classes should include many chemical experiments to help students learning new things in an effective way. Such experiments can be very supportive in the chemistry teacher's work. Student is able to observe the whole process of preparing the experiment, then he observes the results of the experiment, and finally he can determine his own conclusions. Such a form of classes helps to memorize properties of chemical compounds (colour, odour, state, reactivity).

Additionally, the experiment is exciting for the student; it can generate interest not only during the particular lesson, but generally for the whole subject of chemistry. Experiments at this stage of education are not hazardous and are easy to carry out. They do not require complicated procedures, or special chemicals. Often in such experiments, you can use the substances that may be found in every house.

Only basic laboratory glassware and indicator papers are needed. Of course not every school in Poland has access to chemical lab and suitable reagents, but in these simple experiments special chemical laboratory is not necessary. Instead, teacher can use the help of multimedia, such as educational videos and presentations, which are available at publishing houses websites, and also can be found on well known internet portal with movies: YouTube.

These educational movies present interesting chemical experiments. To be able to present such movie during the lesson we need a computer, OHP and a screen. Usually displaying educational movie takes only a short part of the lesson. After the movie end, teacher is explaining observed experiment to his students. It is very useful to draw a coloured scheme of the observed experiment in the students' copybook. Educational movies may be used not only to present chemical experiments, but also to show students some other chemistry connected issues. We need to remember that students in gymnasium are still at the beginning of their chemistry journey, so the movies should encourage them to discover chemistry. The most popular educational movies among Polish students concern the production of automotive fuels, manufacture and effects of medicines and cosmetics, and the sources of energy.

Another educational method that is proven to be helpful in chemistry teaching is various types of educational games. Most of them involve models of molecules, which need to be assembled manually by students. Such games are easily available on the Polish market and not very expensive. Typical game kit usually includes tiny colourful balls of different sizes, representing chemical molecules, and also pipes and sticks of different lengths representing chemical bonds.

These kinds of games help to understand the structure of molecules and functions of chemical bonds at the gymnasium level. Other educational games, that do not require additional materials, are word games, such as debates, competitions, crosswords, rebuses and others that can be performed in groups of various size or individually. Besides developing interest in chemistry, these educational games help to learn how to obtain needed information and also allow working in groups.

Another type of educational games, available Polish market, is multimedia games in a form of computer software. They are produced mainly by educational publishing houses and can be downloaded from their websites. This type of game allows students to design a virtual chemical molecule. Unfortunately, such a form of modern education requires a computer for each student, which is rather rare in Polish schools. Therefore, these games are not very popular in Poland at the moment.

On the first year of high school, where chemistry is taught only on the basic level, the teaching of this subject also requires some teaching materials. At this stage, the best choice are educational movies. Majority of students, at this stage, are not interested in learning chemistry in future and that is why, we should try to realize them, that chemistry is strictly related to everyday life. Educational videos can be used to present such a relationship. In addition, these videos cover many topics that might be very interesting to students at this age.

For example they may concern such topics as: sports (muscles work, the role of protein supplements and isotonic drinks, textiles that are used in sport clothes, shoes, and sports equipment), health (medicines, vitamins), cosmetics, environment (recycling, waste segregation, environment contamination, biodegradable packaging), food (preservatives, food additives, packaging, healthy eating, diets, drinks), industry, construction, energy (renewable and non-renewable energy sources), genetics, and automotive (fuel, biofuels).

These videos, which are available on the websites of school textbooks publishers, can completely substitute some traditional lessons or support teacher in conducting lessons. After the movie projection, it is recommended to discuss it with students. Discussion allows teacher to find out about the students interests, which can be developed during next lessons. To be able to present a movie during the lesson we need a computer, a beamer and a screen. Many schools in Poland are also equipped with special multimedia rooms which are used to display such movies.

Obviously not every lesson can be replaced by the movie projection. Other lessons, at this stage, are conducted in the form of chats with students. Teachers can also conduct lessons in a form of didactic games, like debates. Within the chemistry lessons, it is also recommended to organize educational trips, for example, to sewage treatment plants, refineries or other sites that are related to chemistry and available near the city where the school is located.

If we take into the consideration the future perspectives of students, who consider to work in chemistry related professions after graduation, the third stage is the most important one. Similarly to gymnasium, in the third stage, chemistry teaching is also divided into two parts: inorganic chemistry and organic chemistry. This stage aims to prepare students for the matriculation examination and college education. At chemistry classes, students need to learn not only the physic-chemical properties of elements and compounds, but also need recognize formulas for chemical calculations. Students need to be able to prepare chemical solutions, conduct experiments and determine observations. They should be able to compare the chemicals or their groups, to design experiments and write equations of chemical processes and to solve calculation tasks. Within two years, students must acquire all the knowledge and skills that will help them to pass the matriculation examination well and let them study on a dreamed college.

Teaching methods, which can be used by teachers at this stage, are mainly chemical experiments, which are carried out in the presence of students or by themselves, as well as accurate description of these experiments results. To be able to perform experiments, school needs to be equipped with glasses and laboratory equipment, properly adapted chemical laboratory with the fume cupboard and chemicals burners, protective clothing for teachers and students, and protective gloves. Such laboratory need to be obligatory equipped with a fire extinguisher, fire blanket, and access to running water. Students need to learn the rules for safe work in chemical laboratory and the plan of proceedings in case of evacuation. Experiment conducted by the students themselves, in the presence of a teacher, is the best way to teach chemistry, especially the organic part.

Properly maintained student's notebook is also very important. Students should draw diagrams of chemical experiments and mark them with appropriate colours. The notepad should also include a verbal description of the experiments, equations of reactions, observations and conclusions. Making notes helps to learn the proper vocabulary and chemicals phrases.

At this stage, educational trips and movies are no longer recommended. However, some schools in Poland cannot afford to hold chemical laboratories, where experiments can be carried out safely. Such labs are expensive to maintain, and it is not always possible to arrange a lab in a school building due to technical issues. Therefore sometimes it is necessary to display short videos presenting particular chemical experiments, which are later precisely discussed by the teacher. These videos are available on the websites of school textbooks publishers and other matriculation examination's related websites, as well as on YouTube. After movie projection it is also recommended to note down experiment's description in a student's notebook.

However, at this stage, chemical experiments are very important part of learning and lack of chemical laboratory is really a huge problem. Videos, although professional and well discussed by the teachers, are useful, but they cannot fully replace experiments that are carried out by students or observed live. Therefore it is recommended to organize educational trips to specialized chemical laboratories, often in other schools or universities, where the staff or teachers with students can carry out the most important experiments. In Polish schools, it is very popular, and universities are keen to cooperate with teachers and high schools in this matter.

To sum up, three stages of chemistry teaching in Polish schools are significantly different, but educational methods and teaching materials are very and mainly based on chemical experiments, presented in various ways. Each stage aims to encourage students to learn chemistry by showing that it is an essential part of our lives and that it is strictly linked with other fields of sciences. All described stages differ in both, the type and level of chemical knowledge. Also students, in each stage, are considerably older. Teacher need to take all of these differences into the consideration. In addition, he must know what the objectives are that should be achieved on chemistry classes for a particular stage.

However all stages are open for new proposals to improve the chemistry lessons, for example using computers and Internet resources to teach chemistry.

References

- [1] R. M. Janiuk, E. Samonek-Miciuk, W. Stawiński and A. Walosik [2002] Raport o stanie dydaktyki przedmiotów przyrodniczych w Polsce.)
- [2] E. Samonek-Miciuk M. Pedryc-Wrona [2001] Przygotowanie nauczycieli biologii do funkcjonowania w zreformowanej szkole in: Nauczyciel 2000 plus. Modernizacja kształcenia nauczycieli przyrody , biologii i ochrony środowiska, Warszawa , Instytut Badań Edukacyjnych
- [3] Burewicz A., Gulińska H. (red), Dydaktyka chemii, Wyd. NaukoweUAM, Poznań 1993
- [4] Czupiał K., Sprawdzanie i ocenianie osiągnięć dydaktycznych z chemii, Wyd. Nowik, Opole 1993
- [5] Dziennik Ustaw nr 61/2001, Podstawa programowa kształcenia ogólnego dla liceów profilowanych, Chemia, Załącznik nr 4, poz.625
- [6] Galska-Krajewska A., Pazdro K., Dydaktyka chemii, PWN,Warszawa 1990
- [7] Institute of Chemistry Didactics – Jagiellonian University Cracow – website address – qualifications of chemistry teacher http://www.zmnch.pl/index.php?option=com_content&view=article&id=98&Itemid=92
- [8] Rules of students practice – Jagiellonian University website address – qualifications of chemistry teacher <http://www.zmnch.pl/images/pliki/regulaminy%20praktyk.pdf>
- [9] Aleksandra Smejda-Krzewicka; 2013; Chemistry education in polish schools; Gabrovo project conference
- [10] Kulawik T., Litwin M.: Chemia Nowej Ery. Program nauczania chemii w gimnazjum: www.mrat.pl
- [11] Dz. U. z 6.02.2012 Nr 0, poz. 131.
- [12] Batorycka B.: Program nauczania chemii w gimnazjum: www.profesor.pl
- [13] Hejwowska S., Marcinkowski R.: Chemia. Program nauczania dla liceum ogólnokształcącego (w zakresach podstawowym i rozszerzonym), liceum profilowanego i technikum (w zakresie podstawowym), 2001, Wydawnictwo Pedagogiczne OPERON, Rumia; ISBN: 83-87518-43-3.
- [14] Kulig J., Bednarczyk J.: Rola doświadczeń w procesie nauczania chemii. Wybrane doświadczenia chemiczne dla licealistów, Aparatura Badawcza i Dydaktyczna, Vol. VIII, No. 4, 2003, p. 313.
- [15] Kulig J., Bednarczyk J.: Doświadczenia chemiczne, Forum Nauczycieli Liceum 2, 45.50, 2003.
- [16] www.gazetaprawna.pl, www.britamer.pl
- [17] [KMB] K. M. Błaszczak, „Wszzechobecna chemia”, konkurs „Wdrożenie podstawy programowej kształcenia ogólnego w poszczególnych typach szkół ze szczególnym uwzględnieniem II i IV etapu edukacyjnego”, ORE 2012
- [18] [MM] M. Molzahn, Chemical Engineering Education in Europe - Trends and Challenges, Institution of Chemical Engineers Trans IChemE, Part A, December 2004
- [19] [CECDE] M. Cooke, L. Gros, M. Horz, W. Zeller (editors) Chemical Education for a Competitive and Dynamic Europe, Components of a „European House of Chemical Education“: Situation - Good Practice – Recommendations, FACE - A Leonardo da Vinci Network Project, 2004
- [20] [GS] M. Ciecwerski, „Golden Submarine/PKN Orlen. Poczuj chemię!”, Marketing w praktyce, 12/2013