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## THE PROCESS OF NATURAL SCIENCE EDUCATION IN PRIMARY SCHOOL: THE IMPORTANCE OF CHEMISTRY COMPONENT

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### Abstract

It is obvious that science education is playing a crucial role in all countries. Quality-based natural science education is necessary for every human living in a modern world. In most of the cases, natural science education in school is not popular, inexactly correspond to the curricula and has no relevance to the learners' needs. The introduced situation is determined by several common and uncommon factors. The process of natural science education in comprehensive school is one of those not adequate for the present day and achievements in sciences. Generally speaking, all spheres of science education are important in our modern, technologically oriented society.

Chemistry – is the most important component in modern science education. The weak interest of the youth to natural sciences, and especially - to chemistry, is one of the most acute problems of the present education. There are many reasons for this unflavored situation and amongst these is the insufficient attention to a component of chemistry in the content of primary education. During the period of primary education pupils do not receive the basic initial knowledge of chemistry and research skills. On the other hand, teachers of primary classes are not prepared at a sufficient level in sphere of modern natural science education. The final point in this case is that we should strengthen chemistry component in primary school and analyse all possible chemistry teaching approaches for primary school students (Lamanauskas, 2009).

**Key words:** chemistry component, science education, primary school, curricula.

### Introduction

Teaching chemistry faces problems in the majority of countries. It can be maintained that an attitude towards learning chemistry at school is formed by various factors. The problems cannot be addressed only to the process of teaching chemistry. An evaluation of what propaedeutic knowledge of chemistry the schoolchildren obtain in primary school should be made. The component of chemistry formed at school is considered to be a complex question. One of the subject matter versions is inclusion of the most principal topics integrating them into the whole natural science education content of primary school (Lamanauskas, 2005).

Foreign countries have also increased their interest in the above introduced and discussed issues, for example, the Pilot Project: Chemistry for Primary Schools is running in Finland.<sup>2)</sup> The purpose of the R&D –pilot project is to find out how the primary school pupils explain some concepts of chemistry. Special manual on teaching chemistry in primary school has been recently published (Rees & Osborne, 2000). This book consists of three main parts: A) Grouping and Classifying Materials; B) Changing Materials; C) Separating Mixtures of Materials. Firstly, the book introduces research and scientific activity, as well as presents chemistry as a branch of natural sciences. Such publications are supposed to be highly important to both – a learner, and a teacher. The primary school teachers frequently show lack of competence in the field of natural science education. Suitable training aids and resources for learning, as well as teacher training in the field of natural science education are the crucial factors in order to reach, yet in primary school the learners could be familiar with the most common substances and would be able to understand changes and numerous natural phenomena. This pilot research focuses on how primary school-leavers (10-11 years old) understand such everyday phenomena as the influence

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of temperature on the movement of particles (diffusion), evaporation and condensation, material melting, combustion, air expansion and reduction caused by the change in temperature conditions. The propaedeutic knowledge is just the ground for successful studying natural sciences in basic school (Lamanauskas, Vilkonienė, Vilkonis, 2007).

## **The Chemistry Component of Natural Science Education in Primary School**

Why should we strengthen chemistry component in primary school? The question is not simple and a wide and deep discussion is possible here. First of all, referring to researches (Malinovskaya, 2002; Ševčiuk, 2005) we can claim that the interest of primary school pupils and of the 8<sup>th</sup> formers in chemistry as a subject is not only not weaker, but very often stronger. Children get very naturally a lot of information from surroundings (home surroundings, multi-media and so on). It is without doubt, that in primary school children can be introduced very widely to chemistry science propedeutics (e.g. the classification of the materials, different chemical combinations and so on). However, the worst situation is with modeling physics component. Physics component is also important ensuring a balanced natural science education in primary school, isn't it? In international practice excellent examples occur about how to strengthen natural science education in primary school. Modern ICT are particularly helpful for this. Various websites have been created where children as well as teachers can find a lot of valuable practical information. For example, ChemiCroc is a very interesting website, the purpose of which is to help children understand the world of chemistry. (<http://www.chemicroc.com/index.php?page=1>). In Finland the project Chemistry for Primary schools HEUREKA has been prepared and put into practice (Pilot Project: Chemistry for Primary Schools, [http://www.xplora.org/ww/en/pub/xplora/nucleus\\_home/pencil/heureka.htm](http://www.xplora.org/ww/en/pub/xplora/nucleus_home/pencil/heureka.htm)). A lot of valuable natural science material is given in Australian website (<http://www.primaryschool.com.au/science.php>).

Another important aspect of primary natural science education is to make children observe, investigate nature, learn to discern the link between facts and phenomena, feel the integrity of the surrounding world. Children not only like this activity but the activity itself stimulates their interest in nature and surroundings. Foreign researchers often emphasize this: (English - *pupils want a more hands-on approach*). Nature research based on scientific methods and nature research results are linked by the process of *research* – from simple observation to primitive data-processing. Research activities are extremely invaluable for pupils. Moreover, schoolchildren have already got some rudimentary knowledge about natural science from the previous studies at school. According to professor Šapokienė, exploration is “a form of the organization of the educational process, when pupils become familiar with the basic methods of research, learn easily comprehensible elements of research methodology, obtain knowledge and skills to individually investigate phenomena of natural and environmental life” (Šapokienė, 1994). If it is possible, not complicated experiments, tests are carried out: planting and growing, dissolving, steaming, weighing and measuring. Pupils are taught and they learn consequent research method: observation- analysis- hypothesis- checking it- conclusion. In primary school the teacher tries to make children observe, investigate nature, try to discern the link between facts and phenomena, their interrelationship, feel the integrity of the world. As Rauckienė states (1994), subjective factors play a great role in the child's cognition of nature: his willingness to find out, his mood and his concrete activity. Observations, demonstrating, tests, laboratory works and other practical research work enrich children's sensual knowledge and cause the creation of image system (Šlekienė, 1999). Later on, problem situations can be created in order pupils could more or less perform the process independently from abstract to concrete and vice versa.

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Researches show that children's investigation of nature and its phenomena during the organized, inspired and independent activity is dynamic but directly depends on every child's interests,

ways to find out, investigate, experiment and share the experiences of the acquired results and their changes (Plytnykienė, 2001). Children like research activities.

Chemistry component in the content of primary education is especially important for developing the competence of children's knowledge. The competence of knowledge could be developed by solving different problems, analysing different materials, investigating natural surroundings, accumulating research data, analysing them and evaluating. Such activities teach to draw conclusions and present them to others. Of course, it is necessary to consider, that in many countries natural science education in primary schools is already integrated, for example, science is taught as integrated subject in Ireland, Estonia, Cyprus, Spain, Belgium, Italy, Latvia etc. Nevertheless, every country has its own peculiarities, for example, in Italy science is not a definite subject, but is included as general knowledge, with emphasis on technology (ECTN survey, 2009). More information is available on the FACE project website (<http://www.face.net.tc/>).

It is understandable that at the primary school level integrated chemistry knowledge can only be propaedeutic. Otherwise, it does not prevent the strengthen of primary school curriculum by the aspect of chemistry subject. Nowadays it is obvious that in the majority educational curriculums of this level the knowledge of biology sphere prevails. In our opinion it would be purposeful in the primary school natural science education content to reflect exhaustively such topics of chemistry sphere:

- Solids and substances. Chemical substances in mode of life;
- Molecules. Movements of molecules. Diffusion.
- States of substances. Physical properties;
- Basic units of measurement (length, mass, temperature, time etc.);
- Atoms. Chemical elements. Compounds. Mixtures;
- Mono-substances and multiple substances;
- Organic and non-organic substances;
- Chemical formulas of substances;
- Chemical reactions;
- Water – the most widespread substance in the nature;
- Water as universal solvent;
- The composition of air and its characteristics;
- Oxygen and combustion;
- Pollution of environment by chemical substances;

Realizing chemistry component it is very important to organize effective teaching (learning) process and ensure suitable educational environment. In general, in natural science education the life experience of children is extremely significant. It should be gradually broadened, giving children opportunities to return to the same things every time getting acquainted with environment, different objects and phenomenons at a higher level.

Organizing such teaching (learning), the lessons of „Scientific discoveries and research“ should become the most important form. It is obvious that suitably integrated chemistry component stimulates schoolchildren's desire to experiment, research and be the experts of the nature.

The basic goals are:

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- To educate schoolchildren`s understanding about the variety of materials (substances);
- To help schoolchildren perceive that different chemical materials (substances) could be not only useful but also very dangerous;
- To teach schoolchildren behave cautiously with every chemical substance;
- To stimulate schoolchildren`s wish to care of their personal and other people`s security;
- To teach schoolchildren assort (classify) different substances according to their basic indications: state, colour, smell, form and etc.;
- To form such concepts as raw material, pollution, waste, chemical pollution, organic and non-organic materials, filtration, diffusion, solvent, indicator, combustion, evaporation, condensation and etc.;
- To educate research work (initial investigational activities) abilities;
- To educate schoolchildren`s understanding that everything, surrounding us, is made of different chemical substances;
- To stimulate schoolchildren`s curiosity to experiment and independently elucidate different problems; also realize children`s wish to research and find out;
- To develop common attitude towards chemistry;
- To develop abilities to process and visualize information;
- To develop abilities to use simple devices and instruments (for example, a thermometer, scales, measuring cylinders, pipettes, test-tubes and etc.);

As it was said before, every country, despite the similarities, distinctively solves the issues of natural science education in primary school. For example, in Lithuania in the year 2008 the General educational programmes were looked over. On the basis of that programme separate schools, teachers can prepare detailed curriculum. The given table presents the fragment of the schedule of schoolchildren`s abilities according to the centres of the school forms.

**Table 1. Abilities of schoolchildren according to the centres of the school forms (General educational programmes, 2009)**

<b>Sphere of activity</b>	<b>1-2 forms</b>	<b>3-4 forms</b>
Man and inanimate nature	To perform simple observation and carry out tests. To indicate that materials (substances) can be of different states (hard, liquid, gaseous). To compare materials (substances), found in everyday life environment, detecting them by sensations. To indicate what means of everyday life usage pollute water. To give examples of using energy in everyday life. To recognize where energy is being wasted and offer simple ways how to save it.	To plan and independently perform simple observations and present the results in oral or written form, in tables or simple diagrams. To give examples of changing reversible and non-reversible materials (substances). To investigate the characteristics of materials (substances), found in everyday life environment, carry out tests, related with changes of materials (substances). To point out the main sources of air and water pollution and their influence over environment. To indicate energy sources. To give examples of usage of the sun-power and wind-power. To investigate and define the main characteristics of light, sound, warmth and electricity.

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It is obvious that schoolchildren in primary school have to perform simple observations and carry out tests, draw conclusions, know, how to use simple units of measurement of length, time and temperature. They have also to be able to apply method of scientific research by observing, analysing natural phenomenons, processes and be able to gather information, use it and etc. Anyway, it is possible to claim that chemistry sphere component still remains poorly expressed. People do not know, how properly to use even simple (in private life) devices of measurement.

The analysis of different empirical observations and carried out tests allow us to make such general concluding remarks:

- not only in primary but also in higher forms, pupils have difficulties in relating knowledge of natural science with the knowledge of other spheres, for example, mathematics;
- schoolchildren can not properly use even simple devices of measurement, for example, those, which are used in everyday life environment;
- pupils can hardly perceive the concepts; transformation of the units of measurement remains urgent problem not only in primary, but also in higher school forms, even during university studies;
- schoolchildren of primary forms indicate that lessons of natural science education are frequently boring, during them is mostly spoken or read (verbal teaching prevails). The consequence of this is that majority of schoolchildren lose the motivation for learning natural science subjects even in the primary school and it is impossible to revive and strengthen that motivation later on.
- chemistry component in the content of primary school education has to be closely linked with the physics component;

## **Summing-up**

In 2008 in Lithuania renewed General educational programmes of primary and basic education were confirmed. Natural science and social education are further closely linked amongst themselves. This correlation is realized during the „World cognition“ lessons. There are two main components, which express natural science education in primary school: a) man and animate nature; b) man and inanimate nature. World cognition is integrated educational sphere, assigned to develop child's social and natural science competence (General programmes, 2008). It is obvious that chemistry component should be best expressed realizing the second part of educational process – man and inanimate nature. So it is purposefully to review in essence not only teaching (learning) content but also to adapt practical activities of schoolchildren. It is advisable broadly apply game elements (learning by playing), elements of research activities (inquiry-based learning), elements of practical activities (learning by doing). Automatic transferring the material of natural science education into educational content is frequently noticed, forgetting that it is necessary to take into consideration children's mental and psychical development. The changes in content and competence of teachers are not enough. It is important to complete the design of equipment and supporting materials for chemistry at the primary school level. The issue of education of natural science teachers still remains problematic. The curriculums of university studies practically do not pay necessary attention to such an urgent matter.

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