THE 5th INTERNATIONAL CONFERENCE
RESEARCH IN DIDACTICS OF THE SCIENCES

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ABSTRACTS

Analysis of the nursing practice problem solving in the context of a comprehensive solution of nursing problems using physical knowledge

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Background. Nursing is the multidisciplinary branch of science, which requires knowledge on the pedagogy, psychology, human biology and other related scientific disciplines. The ability of nurses to use medical instruments and technical equipment is very important for nursing practice. This requirement is inevitable due to the increasing use of advanced medical technologies in hospitals and increasing job opportunities in nursing abroad. Some foreign scientific studies show insufficient competency of graduated nurses to use medical equipment in nursing practice. (Pfeil, 2008, Paclova et al., 2009) ***Aim:*** The aim of our study was to determine the physical and technical literacy level of Slovak nurses and their ability to solve comprehensive problems in nursing practice.

Methods. The statistical sample was comprised of 266 respondents – students of the 1st and 2nd year of the Master study of Nursing – part time program. Respondents attend one of the three Slovak universities. Their average age was (33,62 ± 8,68) years. Respondents answered in written form to the question: *"Stethoscope seems to function correctly and you hear no breathing sounds. Indicate one reason at least."* All responses were categorized according to the formulated reason: a) stethoscope, b) methodology of examination, c) health status of the patient. The responses were analyzed in each category. We investigated whether both quality and quantity of respondents´ answers depend on the attended faculty.

Results. 24.81% respondents didn't answer the question. 60.15% respondents identified one reason for the unheard patient breathing sounds. 2 reasons were identified by 12.41% respondents and 3 reasons were identified only by 2.63% respondents. 41.35% of all answers were related to the stethoscope disfunction. 13.53% answers were targeted on examination methodology and 30.08% of all answers were targeted on health status of patients. Attended faculty shows no statistically significant influence on both the quantity and quality of answers.

Conclusion. We have found out, that nurses´ knowledge of physics, measurement theory, instrumentation and their application in nursing practice are insufficient. Low number of alternative answers of solving problem could inform us about nurses deficiencies in flexibility and ability to solve comprehensive nursing problems (one respondent specified only 1.18 answers on average). These deficiencies could be positively affected by activating teaching methods, problem solving teaching including project teaching in (bio)physics. (Kráľová, 2010)

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Key words: problem solving in nursing practice, (bio)physics in nursing, technical literacy of nurses, medical devices and equipment in nursing.

On Teaching And Learning Of Stoichiometry

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Numerous articles have been published that address problems encountered in teaching basic concepts of chemistry such as the atomic mass unit, Avogadro's number, and the mole. The origin of these problems is found in the concept definitions and excessive emphasizing of their historical evolution. If these definitions were adjusted for teaching purposes, understanding could be improved. In the present article, the definitions are discussed, and the following adjustments are suggested: (i) the feature that classifies carbon-12 for the definition as the standard be its abundance, (ii) Avogadro's number should refer directly to the standard nuclide sample, (iii) the definition of the mole be based on Avogadro's number, and (iv) the term amount of substance be replaced by the collection or ensemble of microentities. In this manner the internal inconsistency of currently accepted definition of mole would be eliminated, that is the term amount of substance would no longer be connected with the terms mole of electrons and mole of quanta.

I also propose that in teaching:

- it is exposed that Avogadro's number is equal to the quotient gram/atomic mass unit;
- the difference between Avogadro's number and the Avogadro constant is discussed;
- the definition of the mole is first presented for nuclides and then generalized for poly- isotopic elements and chemical compounds.

The more comprehensive discussion of the problems in question can be found in the in the articles [1–3].

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Key words: mole, Avogadro, a.m.u., learning, teaching.

Chemistry Education on Primary Schools in the Czech Republic: Target skills and Popularity of the Subject

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Background. As it has been shown (Budiš, 1996; Pavelková, 2010), chemistry in the Czech Republic has for a long time been one of the less popular subjects at primary schools. The goal of this article was first to check this situation during the ongoing educational reform in connection with its implementation into schools, second to find out how much correspond wishes of pupils (regarding their target chemical skills) with chemistry subject matter.

Methods. A questionnaire about popularity of chemistry was answered in the end of January 2010 by 866 primary school pupils (8th grades of study). The results were compared to an analogical research undertaken earlier by Budiš (1996). Then (May - June 2011), 984 upper primary schools pupils (and pupils of corresponding grades of eight-years high schools) answered a questionnaire looking into pupils` wishes about their target chemical skills.

Results. We find out that the school subject chemistry is now more popular than in the year 1996. It might be (as follows from the comparison of chemistry subject matter in both periods) due to using more chemical experiments at schools nowadays. Moreover, we found that although the wishes of upper primary schools pupils rather change with their age, the main demand remains the same: experimental work and application of school chemical knowledge in everyday life. Astonishingly, many young pupils wish to get theoretical sills (nomenclature, ability to estimate the reactivity of substances). Unlike them, many of the older pupils want to be able to use their knowledge and skills to protect the environment.

Conclusions. The attitude of upper primary schools pupils to chemistry improved during last 14 years, maybe due to using more chemical experiments at school. It agrees with results received by the 2nd questionnaire from which it follows that pupils want first of all to be able to do chemical experiments and to be able to use their school knowledge and skills in real life.

The research was supported by grant project GAČR č. P407/10/0514.

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Key words: chemistry, education, skills, research, questionnaire

Drug prevention in the education system and monitoring at universities

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This article deals with drug prevention in the education system and find out the awareness, attitudes or experiences with drug use among students of faculties of education - future teachers.

Attention should be focused on the development of quality educational environment, development and implementation of prevention programs and educational activities, raising awareness and improving support services. The education should be paid more attention to the theme drugs and drug prevention and the state education program (ISCED). This is particularly the subjects of chemistry and biology, which have this topic in their standards, but according to the monitoring of university students (former students of elementary and secondary schools) very little or almost no attention are devoted to this subject. Within the school curriculum it is the subject included in such subjects: ethics and psychology, but only just at some schools. It is certainly more efficient to pay attention on this topic - especially on the permanent prevention not only by one-time lectures, discussions with invited experts.

We did an analysis of individual subjects for inclusion of these topics in the ISCED and we compared it with the reality of university students by questionnaire method. Monitoring is concerned not only their sources of information, but also their attitudes and experiences with drugs. Monitoring results for the theme of drugs at the regional level was compared with a nationwide (and European) monitoring ESPAD - European School Survey Project on Alcohol and Drugs (measurement NMCD or EMCDDA).

The implementation of the National Drug Strategy (NPDS) is involved in a number of institutions, bodies and organizations. The key is the education sector, which should be particularly focused on achieving the main objective of NPDS by primary form of prevention - reducing demand for drugs.

In accordance with new developments and trends in drug use and associated with new patterns of behaviour of young people we should focus our attention on the preparation and implementation of innovative approaches in information on the adverse effects of drugs (in terms of health and behaviour of individuals) without underestimate drug prevention at all levels of the education system.

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Keywords: drugs, prevention, education program, monitoring

Use of multimedia for preparation of particular classes of natural sciences subjects

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The use of ICT in teaching has broad application. It changes the traditional form of teaching, from a passive acquisition of information to an active one. The teacher ceases to be just the broker of knowledge; he/she becomes a manager of the learning process of pupils.

Currently, Slovak schools use the system *Planet of knowledge*. It is an interactive teaching tool with a professionally processed digital content and simple operating tools for teachers and pupils. It contains a number of multimedia presentations, animations, attractive simulations, interactive exercises and activities, which can be included in any phase of the teaching process.

The planet of knowledge will enable the teacher to make his/her preparation for class an easier enterprise. It is important to teach the future teachers of natural sciences to create their own teaching subjects modules, which will be efficient, motivational and inspiring. When teaching didactics of natural sciences, we try to create cognitive competences of pupils, which mean acquiring competences associated with the preparation for teaching, with teaching itself, with assessment of learning, with problem solving, and with the development of critical thinking and creativity. The future teachers should benefit from these materials during the preparation of a quality class, which will be adjusted to the abilities of the pupils.

The aim of the paper is to point out the possibilities of the inclusion of ICT in the teaching process within the preparation of university students for their future profession, and to teach them to apply these technologies in their preparation for the class.

Key words: ICT in teaching, Planet of knowledge, quality class

Experimental Activities as Part of TPCK in Pre-graduate Chemistry Teachers Education

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Currently, the society requires more from each individual than in previous years. Adjusting to new situations, replying to them adequately, solving new problems, e.g. finding new jobs if previous ones are not required any more – these are the strongest challenges. Work structures with firmly defined roles are steadily missing being replaced by positions and professions from new fields and specializations. The flexible, active, creatively thinking individuals who can be relied in this uncertain environment are strongly required. This is the challenge for the current educational system, especially for the teachers and their new roles within it.

The provided analyses focus on approaches to increasing teachers information literacy, mainly in the general chemistry education, in relation to the subject taught, which is in the newly defined didactic terminology called "TPCK – Technological Pedagogical Content Knowledge". For this purpose the group of lecturers was monitored for 18 months, when teaching the course "The ICT in chemistry instruction" which was held within the "State Information Policy in Education Project" (SIPVZ). We analysed the study materials which they prepared for the course with the aim to optimize the content and forms of the further teacher education in this field. A set of the ICT-supported lectures with the topic of ICT supported teaching chemistry as the general education subject at lower secondary schools was designed, and methodology and technical recommendations for their practical realization were tested.

The monitoring of lecturers´ activities within the course focused on following fields:

1. The analysis of the learning content plans within "The ICT in chemistry instruction" course.
2. The analysis of the ICT-supported teaching units (prepared as lecturers´ attestation work).
3. The questionnaire mapping the lecturers´ activities one year after receiving the lecturer´s certificate.
4. The lecturers´ recommendations for running "The ICT in chemistry instruction" course efficiently.

The analyses proved several crucial results which to large extent influenced the TPCK content of the pre-gradual preparation and further education of chemistry teachers under the Czech conditions which is currently provided by various organizations without the SIPVZ co-ordination.

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Key words: ICT in Chemistry Education; Models of Instruction Supported by Internet; Chemistry Teachers Training.

The systems of representation in early sciences

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Considering the increasing interest, both internationally and in Brazil, for the research on the teaching of science in the early years of education, this study aimed to discuss the implications of the contributions of Jerome Bruner on the children's cognitive development in the teaching and learning process of science in early childhood from a sociocultural perspective of education. Based on a qualitative research design, this study consisted of the analysis of the activities accomplished throughout the 2010 school year by a class of the first grade of Elementary School (5-6 years old) comprised by 18 children, in a school in the city of Sao Paulo, from the interdisciplinary project called „Solar System". With the aim of understanding how children in this specific group age construct their meanings on scientific culture, we analyzed a set of activities in order to consider the three systems of representation proposed by Bruner (2007, 2008) on the cognitive development of children (iconic, enactive and symbolic representations). These data indicate that the allocation of scientific meanings by children occurs through the combination of the studied concepts and the everyday elements that comprise their concern or interest. It was also learned that the process of meaning is not restricted to the classroom, but it occurs constantly, in different contexts of everyday life for children, through the articulated use of three kinds of representation systems. This finding reinforces the need to offer first grade students experiences that lead them to reflect on science issues and its consequences for the society, providing opportunities to construct the scientific knowledge through the use of three modes of representation, that is, through the use images, the manipulation of objects and movements of the body, as well as the use of oral and written languages. The obtained results reinforce the core role of the teacher in mediating the construction of scientific knowledge, since it is up to him the complex task of recognizing the focus of interest of the children, considering them as the starting point for activities that enable not only the connection of the aforementioned issues with the curriculum, but also the use of different modes of representation.

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Key words: Early sciences, systems of representation, childhood

Researches into the causes of choosing the extended matriculation examination in chemistry among secondary school pupils of biological and chemical profile

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The study was conducted in selected secondary schools of Poznan. They concerned students preparing for the matriculation examination and implementing expanded teaching of chemistry. In participated in the study schools teach active and outstanding teachers. They take part in inter alia innovative process of education for AMU students of Chemistry faculty, being tutors of subject and methodological practices in the innovative project: „A good school, better practice, an excellent teacher. Preparing schools and practices of tutors for effective collaboration with students of chemistry." The students taking the chemistry exam and those who did not choose chemistry as a subject of matriculation examination have answered the question. The study provided an answer to the question of what motives guided the selection of chemistry on the matriculation examination at the advanced level or for what reason they did not decide to choose chemistry. Studies have shown that in the evaluation of a large number of students chemistry is an interesting subject, funny to learn because the messages are structured and logical. However, students perceive chemistry as a difficult subject. An interesting result is that the school mark has little impact on plans of secondary education students and that Mark does not guide students in making life decisions. You can assume that the function and importance of marks are therefore overestimated by teachers. It turned out that the most important are interest in the subject and its understanding, assessment of their own intellectual capabilities in natural sciences, and above all the plans for a future field of study. Surveyed students were asked to identify up to three concerned fields of study. In this way, we determine popular fields of study among future scientists. Pupils were asked also about the exam result which would be satisfactory to them and the minimum score, which are sure to achieve. Selected results were compared with annual marks of students and the results obtained by them in matriculation examination.

key words: matriculation examination, diagnostic survey, curriculum, high school

Educational Projects as Method for Developing Inquiry Attitudes and Skills

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Developing inquiry attitudes and skills of students is the leading theme of both numerous European projects, such as: PROFILES, SAILS, STEAM, FIBONACCI, as well as the new binding Polish core curriculum. Participating in the project within the scope of the European Commission's Seventh Framework Programme called ESTABLISH (http://www.establish-fp7.eu), the Department of Chemistry Education JU was often faced with concerns - how to implement activities planned together with foreign partners in the Polish school. The current educational project implemented in high schools is one of solutions. According to the Ministry of Education guidelines, projects should be primarily of research and interdisciplinary character [1]. Within the framework of a summer school financed from the ESTABLISH project, participants were asked to prepare posters, and subsequently also articles [2] on implemented projects and works with inquiry-based methods.

Methods. A comparative analysis of articles prepared by teachers was carried out with a purpose to assess compliance with Inquiry Based Science Education methodology.

Conclusions. Many teachers have remarkably innovative ideas and implement projects on a large scale not only in lower-secondary schools, but also in upper-secondary schools. Projects relate to subjects attractive to students, such as diets or modern applications of polymers. During implementation of these projects variety of skills, such as video recording, are being exploited and developed.

Notwithstanding, some examples of scenarios of classes performed with practical methods relate only to lower levels of the scale - so called *Guided Discovery* or *Guided inquiry*. Only one example (from a school with the International Baccalaureate Diploma Programme) could be assessed as the *Open inquiry*, which is the highest level. The most common deviation from the IBSE methodology and the project-based method was giving specified subjects for tasks or even provisions for specific experiments by teachers, as well as the lack of quantitative approach and discussions on results of experiments (e.g. comparison of results between groups).

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Key words: IBSE, educational projects, inquiry skills

Experiments with Nature-based Colours

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Project "Experiments with Nature-based Colours" is focused on pupils at the elementary school. Activity target is to introduce pupils to chemical and physic characteristics of colours. The practice is effectively connected with theory. Pupils will obtain new communication, professional and problem-solving competencies in this one-week project.

This project is based on the Framework Education Programme for Elementary Education and supports relations among subjects in educational content "Man and Nature" and cross-curricular subject "Environmental Education".

The main goal of this project is to introduce pupils to the physical and chemical properties of pigments (i.e. separation of nature pigment mixtures, application of natural indicators, food colouring using natural pigments, mixing the colours and colour filters). Biological part of project is focused on plant's pigments and their reactions in acid or basic environment.

Project outcomes are work-sheets, posters and PowerPoint presentations. All kind of outcomes can be used for repetition and proper understanding of basic subject matter. Pupils will organise the meeting with other pupils from the school or public and the eye-catching multimedia presentations containing photo documentation or other attractive points from the project will be prepared by the pupils.

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Key words: Colour, Experiment, Elementary Education, Chemistry, Science

The Representative Levels in Chemical Education

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The use of visual representations in teaching chemistry is not new; the use of models to represent chemistry properties and elements has been done for years. Nevertheless, recent studies have been realized with the intention of categorize the types of representation: macroscopic level or macrochemistry; microscopic level or submicrochemistry; symbolic level or representational chemistry (Johnstone, 1993; Nakhled, Krajcik, 1994; Treagust, Chittleborough, Mamiala, 2003).

The study of chemistry is distinguished since it presents its components not just at the visible level, at the macroscopic level, but at the invisible or microscopic level too. These components are represented in a symbolic way using symbols and schemes. However the biggest difficulties faced by students are the understanding of chemistry at the three representative levels, as well as at the transition between them.

The competence of transitions between the different representative levels is an essential tool for a full assessment of the natural phenomena. The acquisition of this ability is a big challenge that still exists at the teaching-learning of chemistry, since this kind of work involves representation and visualization skills.

In the school, the teacher is the responsible for introductions of activities using visual tools and, thus, his practice will determine the student capacity of understand, see and move between the representative levels.

In this work, is proposed a review about the difficulties faced by students and chemical professionals at the teaching-learning of chemistry using the representative levels.

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Keywords: Chemistry education, visualization, visual tools.

Motivational Secondary Science Education: A Requirement for Promoting Tertiary Education

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Background, framework and purpose. Students arrive at university less and less prepared and motivated towards learning. For example, a Friedel-Maloney (1995) questionnaire proposed during first lessons for students enrolled in the first year of an engineering university course typically leads to poor results (less than 50% correct on any question). According to Osborne and Wittrock (1983) "pupils are unable to construct meaning from the problem statement or they are unable to link the constructed meaning to appropriate aspects of knowledge structures either because of inadequate linkages or because the structures have not been generated in the earlier learning process." Reasons for this include science curricula no longer meeting the needs, interests and aspirations of young citizens (Hodson, 2003).

While there are concerns that the teaching of science subjects is not perceived as 'education through science' (Holbrook and Rannikmae, 2007), it is also suggested that secondary chemistry education is not meaningfully engaging students in the additional desire for further chemistry learning (Fensham, 2008). Science teachers at the secondary level are failing to find ways to select a context where conceptual learning can take place, make the learning relevant and interesting and, at the same time, encouraging students to develop problem solving skills both geared to education for all and as a conceptual base for tertiary and lifelong learning. The 'true' nature of science education needs to put the learning of science into an educational framework (Holbrook, 2010).

Results. A potentially promising improvement is proposed from the application of a different philosophy in the secondary science class. A European project (PROFILES, www.profiles-project.eu) involving 21 partners from 19 different countries attempts to awake students' intrinsic motivation as a stepping stone to engaging them in tackling scientific problems and making socio-scientific decisions. The approach is from a socio-scientific situation seen as familiar and motivational by students, while the teaching is challenging, inquiry-based and student-centred. Because of the central role of teachers in any educational improvement, a central goal of the project is the promotion of teacher's scientific, as well as pedagogic/didactic, competencies. Ideas, actions, successes and difficulties in implementing the project in Italy will be presented.

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Key words: secondary science education; student motivation, inquiry-based; student-centred.

From SER to STL: translating science education research into science teaching and learning

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Despite many decades of Science Education Research (SER) there seem to have been little transfer into the classroom or lecture theatre. (Childs, 2009) This talk identifies several factors that contribute to this and ways they might be addressed: the academic rat-race; the shortness of initial teacher training (ITT); the communication gap with teachers; the relevance of much SER; the lack of involvement in SER by teachers.

The Chemistry Education Research Group at the University of Limerick has being trying various models of incorporating the findings of SER into the improvement of the teaching and learning of Chemistry in Irish schools, and also at third level. Three examples of this work are described: TY Science (Childs,); ITS Chemistry -Introducing Thinking Skills into Chemistry (Sheehan and Childs, 2011); Organic Chemistry in Action! (OCIA) (Childs and O'Dwyer, 2012)

Key words: Science education research; action research; initial teacher training; pedagogical content knowledge; communicating research

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Interdisciplinary educational paths: Physics for geographers

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The shape of the Earth is geoid, or earth-sphere. It says little to student, even less to pupils.

In this view we undertake interdisciplinary issues on the borderline between physics and geography. In this way we respond, that geoid is an equipotential surface (constant effective potential, which is the sum of gravitational and centrifugal potentials).

New satelite Goce was launched to map Earth's gravity potential.

Correlations between science subject are also required to explanation the mechanisms of continental drift. Temperature, density, phase transitions, of first and second kind, of rocs and their components lead to the specific mechanisms of subduction plate. This depend mainly on the relative drift velocity and angle of subduction. Specific tectonics determines the observed landscape.

Purpose of this paper is to identify interdisciplinary educational paths to the subject of Science, on the borders of geography, physics, geology, materials science, and others and translation of these educational paths for the new Polish high school.

Key words: Science, geoid, effective potential, continental drift

Ecological Aspect of Fuel Cells Applications

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Pollutions resulting from production of energy by conventional methods cause of degradation of our environment. Fuel cells (FC) are excellent an alternative as power source, because they are neutral or nearly neutral for the environment [1]. The idea of electrochemical combustion was born at the beginning of XIX century when H. B. Davy and partners carried out electrolysis of water into oxygen and hydrogen. They suggested that since the electric current decomposes water into oxygen and hydrogen, so the synthesis of water from oxygen and hydrogen should give electricity. This idea was realized in 1839 by W. R. Grove who connected several hydrogen-oxygen cells thereby obtained a voltage for the electrolysis of an aqueous solution of sulfuric acid [2]. Expected reactions in FCs are presented below:

Anode: oxidation of hydrogen: $2H_2 \longrightarrow 4H^+ + 4e^-$

Cathode: reduction of oxygen: $O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$ [1]

The main principle of fuel cell operation is that the fuel and oxidant are continuously supplied to electrodes and reaction products are taken away, whereas in the external circuit DC is created. In comparison with combustion engines, the fuel cells distinguish much higher potential efficiency [3]. FCs are taken in account as a future energy system with a high potential for environmentally-friendly energy conversion. They can be used in mobile as well as stationary applications. Polymer electrolyte membrane fuel cell (PEM FC) can be used to power cars, trains, boats and other portable low power systems for various uses such as laptops, cell phones or flashlights. Fuel cells can be applied in various stationary applications, ranging from 1-kW systems for domestic use, up to megawatts applications for industrial electricity production. In the case when fuel cells are powered by hydrogen, the quantity of produced pollutions is a negligible. Even other fuel is used they produce 25 time less pollution in comparison to internal combustion generators [1].

Fuel cells are promising energy converters for mobile, portable and stationary applications. However, because of still existing technical problem and cost barrier it is not expected quick and mass introduction of FCs as energy source in automotive industry but definitely we will see the fuel cells in small, scattered stationary power stations and in portable, low-power devices. Let's believe in Jules Verne prophecy:

"I believe that water will one day be used as a fuel, that the hydrogen and oxygen of which it is constituted will be used, simultaneously or in isolation, to furnish an inexhaustible source of heat and light, more powerful than coal can ever be." [4]

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Key words: Fuel Cells; PEM FC, Ecology, Energy Converters

The influence of Interdisciplinary Motivational Examples on Popularity of Subject Chemistry at Primary Schools in the Czech Republic

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Background: Chemistry has been one of the less popular subjects for a long time (e.g. Budiš, 1996; Höfer, 2005, Grecmanová, 2007). This article presents the results of nearly two-year research focused on influence of interdisciplinary motivational examples on popularity of the subject chemistry.

Methods: In the end of the first half-year of the 8th class of primary school 307 pupils answered a questionnaire, containing following questions: *What is your favourite subject? What is your least favourite subject? How do you rate chemistry? Render it with „school mark".* Afterwards, the experimental group actively used interdisciplinary motivational examples (chemical crosswords, stags, fill ups etc. in combination with one other science subject - biology, geography, mathematics or physics - Cídlová, 2009). In the end of 9th class all the pupils answered the same questionnaire again.

Results: Within 1,5 year mentioned above we found these changes for chemistry as a school subject: *What is your favourite subject?* In reference group we observed degradation of chemistry by 6 positions, in experimental group we found improvement by 5 positions. *What is your least favourite subject?* In reference group chemistry got upwards by 3 positions, in experimental group it got upwards by 7 positions. *How do you rate chemistry? Render it with „school mark".* The mark given by reference group changed from 2,48 to 2,95; with experimental group it was from 2,53 to 2,66.

Conclusions: A huge decrease of interest in chemistry during the first two years of its study at primary school was proved first of all. The use of interdisciplinary motivational examples reduces this decrease and it makes the relationship of pupils towards chemistry more intensive (after using them, more pupils like chemistry and more pupils dislike it as well).

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Key words: education, chemistry, motivation, popularity

Chemistry Education at Primary and Secondary Grammar Schools in the Czech Republic: Target Skills from the Point of View of Pupils and Graduates

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Background, framework and purpose: The question, what the pupils should be taught, is one of the key problems of subject didactics. The aim of authors of this article was to find out the opinion of primary and secondary grammar schools pupils and that of the graduates. The most important results are analyzed more in detail using another questionnaire investigation realized between primary and secondary schools teachers.

Methods: A questionnaire survey performed with 1254 pupils of primary schools and eight-year high schools, 122 respondents with completed chemistry training (university study was not included). This article deals with only one question taken from each of the questionnaires. Pupils: *Concerning chemistry, what would you like to learn?* Graduates: *Concerning chemistry, what are you interested in?* Another questionnaire was answered by 82 teachers (primary and secondary grammar school, eight-year high school). This article deals just only with *issues of chemical experiments at school*.

Results: In the results, we deal with: differences between primary school and responding years of study eight-year high school pupils` opinions; the effect of age on the responses; a comparison of the answers of pupils with those of the graduates; teachers` views on the problem, to which extent should graduates from primary and secondary grammar school manage different stages of school chemical experiments.

Conclusions: It seems that dominant interest in experiments (the youngest pupils) disappears with age. On the other hand, specific requirements for certain practical problems (chemistry of food, detergents, cosmetics, ...) arise. The opinions of the teachers on target skills connected with school chemical experiments of pupils leaving primary or secondary school correlate together very well. The only disagreement concerns chemical calculations.

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Key words: chemistry, education, skills, research, questionnaire

Is everything, what we teach at chemistry lessons at school correct, up to date and necessary?

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The core curriculum for the teaching of chemistry at the lower levels of education in recent years in Poland underwent several changes, and further it underwent changes in curricula and textbooks. However, these changes are only superficial.

The arrangement of the contents has slightly changed, the content was reduced and sometimes is more detailed. Unfortunately in many cases chemistry at the university level is divergent with that what is taught in high schools and colleges. A lot of research in the field of chemistry and in other fields of science are carried out. Better and more accurate measuring instruments allow to reach ever deeper into the structure of matter. A large number of scientific publications is created, but this does not translate to update the content of training programs at lower levels of education.

In principle school should provide general knowledge and prepare for high school study in selected fields. For various reasons, but mostly financial, teaching hours devoted to training in a certain branch is being decreased. On the other hand many of the outdated theories are taught but there is no place for recent scientific content. Increasingly, this leads to a reduction in the level and quality of knowledge and skills. Young people who start their graduate studies in chemistry and related, non-chemical, fields are not well prepared and they have to start learning from the beginning. This, in consequence, leads to decrease the quality of the studying at the university level.

A thorough revision and reconstruction of taught content should be made in terms of their updates. those items that are inaccurate and outdated have to be removed, and instead new ones should be placed. Definitions of certain terms should be updated. Moreover the renewal ought to be done in such a way that curricula are compatible with scientific knowledge. The current theories should be simplified for teaching purposes. At the same, simplification cannot rely on the fact that we use a simple, but outdated and therefore inaccurate theories or definitions. Littering the brain with inaccurate information leads to negative transfer and disinformation.

Key words: chemistry education, secondary school

The First Year of Chemistry Study at Faculty of Education, Masaryk University: Printed or Electronic Study Materials?

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Background: The authors of this article prepared both printed and electronic study materials for inorganic chemistry nomenclature and they are finishing study materials for general chemistry (both for students of Faculty of Education, Masaryk University). The research was focused on a question, which form (printed, or electronic) is preferred by students.

Methods: To obtain the data to find the response, following methods were used:

– questionnaire survey I (answered by students after completing the subject *General Chemistry*); question: *Which form of university materials (printed, electronic) do you prefer?*

– questionnaire survey II (answered by students after completing the subject *Recapitulation of Inorganic Chemistry Nomenclature*); they were asked about *real frequency of their use of printed and electronic version of to study chemical nomenclature in previous semester*

– electronic statistics I of approaches to electronic textbook on chemical nomenclature

– electronic statistics II of approaches to electronic exercises on chemical nomenclature.

Results: By results of questionnaire survey I, the vast majority of respondents preferred printed material to study general chemistry. Conversely, by survey II, electronic materials were used more than printed ones to study the nomenclature and textbook was used as often as exercises. It is in conflict with electronic statistics for the textbook (unlike exercises, the students had no idea that also approaches to the textbook are electronically monitored).

Conclusions: For the subject *General chemistry,* students of Faculty of Education, Masaryk University prefer printed study material, for study of inorganic chemistry nomenclature they slightly prefer electronic exercises in combination with their own notes. Moreover, it was proved, that not all the questionnaire answers of students are true.

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Key words: chemistry, study materials, e-learning, questionnaire, university

Science Skills Of Pupils/Students In The Period Of Curricular Reform Implementation

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Starting points and methods of research. Activities of the European Union (EU) provide incentives but also new demands on the educational reform in the EU member states. When the EU was established, the educational system was originally regarded as a distinct national area that would differ one country from another. Nowadays it is evident that this original pre-requisite has not been fulfilled, quite the contrary has arisen. At first, cross-comparing of the educational outcomes in the individual countries was initiated within the international research such as TIMSS or PISA, then this was followed by recommendations and by the EU programs that directly focused the national educational systems towards the reforms required by EU. The curricular reform in the Czech Republic was implemented in the period of 2000-2010, already in accordance with the EU program and this reform defined new demands on the expected educational results, in particular in the area of competencies and the related skills.

A focus of our study was to identify and set a hierarchy of the required science skills of pupils/students at different stages of elementary and secondary school and to determine the level of these skills in terms of intended, realised and acquired curriculum. The starting point for the proposed system of skills was IBSE (Inquiry Based Science Education). The basic method of our research became the method of critical analysis of strategic European and national documents and subject-field literature as well as questionnaire investigations and their statistical evaluation.

Results and conclusions of research. Questionnaire investigation realised among the group of more than 250 teachers of science subjects at elementary and secondary schools revealed very little awareness of our teachers as for the IBSE method and its practical applications. Therefore, in the first phase, the focus was placed on the theoretical analysis of IBSE method and on the structure of the related skills.

IBSE represents a teaching strategy based on own investigations where a number of activating methods are applied. It is a process of problem diagnosis, experimenting, identifying of alternatives, research planning, setting and verifying of hypotheses, information retrieval, developing of models, and discussion with colleagues and argumentation. It turned out that there is an analogy between the manner of how the scientists conduct their research that can be illustrated as a research cycle taking different forms and the teaching method of IBSE that can be illustrated in the form of different models; all of them can be considered as variations of the so-called learning cycle. We used a model of five-stage learning cycle 5E, which can be in Czech described as the learning cycle 5Z with a structure based on IBSE. In connection with this learning cycle we consequently created a structure of skills necessary for the cycle implementation in the school practice.

These conclusions became a starting point to create the teacher's guide, which would enable the teachers to practise the necessary skills and to develop them with pupils/students; at the same time we also prepared sample learning tasks, which would enable to verify the acquisition of the necessary skills.

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Key words: primary and secondary schools, curricular reform, IBSE method, science skills

Inquiry-Based Activities in topics: polymers, plasticS and plastic waste

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Starting points and methods of research. The European Union is currently funding through the 7th Framework Programme for Research the international projects, which address the issues of education and the teaching of mathematics and natural sciences. One of them is the ESTABLISH (European Science and Technology in Action Building Links with Industry, Schools and Home) project. Within this project, we are preparing the inquiry activities related to the selected topics such as Polymers, Plastics and Plastic Waste, which are being prepared by CUNI in Prague and UPJŠ in Košice.

A focus of this contribution is to present the developed inquiry activities and to show their benefits for chemistry teaching on a pilot group of students/pupils. These activities have been designed in accordance with the principles of inquiry-based education so that within the activity the students/pupils would complete an educational cycle from determination of the problem and stating the hypothesis of experimental verification and its theoretical explanation. Therefore the emphasis is laid upon a purposeful process: formulating questions, critical experimentation, judging the alternatives, exploring and verifying, drawing conclusions, information retrieval, debating with others and forming of coherent arguments. The interpretation of educational activities included various methods such as discussion methods, problem-based teaching, group and cooperative teaching or project-based teaching.

Within the framework of piloting verification of the prepared activities, a method of questionnaire investigation was used as well as statistical methods of their processing.

Results and conclusions of research. The topic was delivered in the form of three sub-units, which include in total 12 inquiry-based activities, e.g. Materials around us, Properties of polymers and plastics, Preparation of plastics, Use of plastics in everyday life, Separating and recycling of waste, etc.

The prepared activities use mainly the guided and limited inquiry. For example in the activity Properties of polymers and plastics, the teacher guides the student/pupil towards the problem formulation, and the experiment enabling to solve the problem is proposed by the students/pupils. The students/pupils' task is to discover the combustibility of plastics, their thermal and electric conductivity, and reaction with acids, alkali or salt solutions. The results of observations are recorded in the tables, which improves such skills necessary for research as to determine the hypotheses, realise the experiments, collect and record the data, process the data, etc. Space for communication, argumentation, and formulation of explanations is allowed by another activity where the students/pupils solve the tasks focused on properties of plastics, their recycling, processing and sorting of waste. In this activity, a project-based method is applied.

The designed activities were verified using a sample of about 100 students of grammar schools and 50 pupils of elementary schools. The verification that was conducted in the form of questionnaire investigation showed that the activities are interesting for the students/pupils and that they develop the skills necessary to streamline the teaching process and to apply the acquired knowledge in the real life.

This contribution was completed within the project ESTABLISH (7th EU Framework Programme, FP7/2007-2013 based on the contract n° 244749).

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Key words: primary and secondary schools, curricular reform, IBSE method, science skills

Students' understanding of environment

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Humans need to change their behaviour patterns to make the world a better place to live. Therefore, the role of education is of vital importance to transmit scientific expert advice to citizens. This study aim was to record and investigate the understanding of students about the environment. The possible different representations of students in general, therefore, have an impact in the formation of different approaches and trends both at the theoretical and practical levels.

Data were collected from a convenience sample of 150 students of one public middle school (11-14 years). The research used the open ended questionnaire to explore the students' understandings of environmental issues. The student's written answers to the open ended questions were coded by the author and statistically processed. Beyond descriptive statics, the data were further elaborated in order to asses whether the categories for the student's ideas could be related to gender or grade level. Data were analyzed using SPSS (v.12).

The findings indicated that students are well conscious of environmental problems but have inadequate substantive-knowledge about how environments work, how societal and personal actions affect the environment, or how environmental problems affect society.

Results reveal that environmental education were insufficient in changing their personal values and behaviour patterns. These results suggest that the strategy should include activities in the curriculum that helps students to understand how daily life and work can be adapted to improve the environment, both now and in the future. We also suggest that besides *development of new techniques* of environmental education, at the same time to *improving strategies* to remove barriers to behavior change, so that adoption of sustainable life style can be facilitated.

Key words: Student, environment, education, understanding

Future Brazilian and Portuguese biology teachers' conceptions about science ethical values

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One of the main Epistemological issues is the discussion about the influence of values on science. In a traditional view, based on the Positivism philosophy, science is free from non-cognitive values (Lacey, 1999). However, some authors like Gil-Pérez and Vilches (2005); Aikenhead (1994); Matthews (1991); Linsingen (2007), Gil-Pérez, Vilches, Fernández, Cachapuz, Praia, Valdés, & Salinas (2005), among others, argue that there is no consensus about it. . This idea of a non-neutral science has also been discussed in science teachings researches, under the argument that a less distorted (i.e., free critical thinking) view of Science could contribute to citizens' preparation for questioning about the impacts of scientific advancements on Society and the Environment.

In this study we aim to understand how two groups of future Biology teachers, from Brazil and Portugal, perceive the connection between the recent biotechnological advances and the bioethical issues related to these advances, such as the use of embryonic stem cells (which relates to the issue of when does life start, and, because of that, when is it legal to eliminate one life at the expense of another) and transgenic food (which presents a series of questionings in, but not limited to, the ecological, health and economical fields). We also aim to understand if the students perceive the influence of social values on the development and when applying the aforementioned biotechnological researches or if they just credit them cognitive values. Social values can be comprehended as the personal values that are shared by a community. Thus, social values vary according to the history, culture and beliefs of a people, and its elements compose the way said people think, act and express.

For the data gathering, we built a Likert scale (Babbie, 1990). After the validation (Cronbach, 1951), the questionnaire was filled up by students of the state of São Paulo (Brazil – BR) and from the Braga district (Portugal – PT). The size of the sample (35 BR and 49 PT), the percentage of women (83.3% BR and 83.4% PT) and the age average (23.0 BR and 20.4 PT) show the good balance between the samples. For the data analysis, we applied a technique of *Multivariate* Analysis, the *Principal Components Analysis* (Lebart, Morineau&Warwick, 1984). The statistical analysis was made using the software *Statistical Packet for Social Sciences* (SPSS).

The results showed a strong influence of social and cultural values on the students' conceptions, such as in the transgenic products issue, in which the answers varied according to the most present ethical discussions in each country. We also noticed a strong salvationist perspective in the answers, i.e., the strong presence of the conception that both science and technology exist with the sole purpose of "saving humanity", ignoring other matters, such as political and economical interests, existing in some researches. We found interesting the fact that students, although declaring they are in favour of the influence of ethical and social values in research, they showed a neutral Science conception, i.e., free from those values.

In our view, it is desirable that future Biology teachers debunk the idea of a neutral and simply salvationist science, since, due to the scientific advances, it is extremely important that teachers discuss the impacts of science based on the connections between science, technology and society, in a sustainable perspective.

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Key words: biology teaching; cognitive values; science ethical values.

Learning difficulties presented by Brazilian and Portuguese students in their bioethical training.

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The impact of new discoveries showed by the media, like the biogenetical genome, assisted reproduction, cloning, and so forth, has lead to citizens' expectations marked by the search for values, never before seen. For example, we can mention two news brought by 'Jornal Folha de São Paulo' (one of the largest circulated newspapers in Brazil): in one of the news, a former homosexual couple from São Paulo is fighting for the custody of a boy generated with the eggs of one spouse and gestated in the uterus of the other (Collucci, 2012). In the other news, there is a discussion about the legalization of abortion (Abramczyk, 2012). Days before, the same newspaper published that Brazil is the leader in transgenic farming (Freitas, 2012). Facing the great frequency in which the above topics have been discussed, we find that it is practically impossible for the students to be unaware about the Bioethical issues that are involved on the application of scientific knowledge. This means that the need for schools to create opportunities for discussions about these topics becomes even greater, since personal decisions related to the results of these technologies are crucial for society's answer (Silva, 2012). Thus, we consider important that, during their graduation training, future Biology teachers should be preparing themselves to deal with these issues (Downie and Clarkeburn,

2005; Bryant and Baggott La Velle, 2003; Willmott and Wellens, 2004; Pearce, 2009). Knowing that the aforementioned ethical debates are heavily influenced by social and cultural values present in each nation, in this study we have tried to analyze which possible difficulties relating to these topics the future Brazilian and Portuguese Biology teachers believe that they will face when teaching, as well as how prepared these students feel to discuss bioethical issues in the classroom. We would like to point out that up until the year 1822, Brazil was a Portuguese colony and during this process, Portugal had a great influence in Brazil's culture. Thus, we decided to compare the answers from the two countries' students, aiming to analyze the similarities and differences between both groups. For the data gathering, we built a Likert scale (Babbie, 1990). After the validation (Cronbach, 1951), the questionnaire was answered by students from the state of São Paulo (Brasil – BR) and from the Braga district (Portugal – PT). The statistical analysis was made using the software *Statistical Packet for Social Sciences* (SPSS). The data showed that both the Brazilian and Portuguese students considered that their graduation classes had not prepared them enough for discussions about bioethical issues (65.8% BR and 70.8% PT). Most of the students (57.2% BR and 71.7% PT) had also self declared unprepared to deal with these issues inside their classrooms. When being questioned about possible difficulties that the students thought they would have to face when dealing with topics involving bioethics, the "lack of closeness with the subject" was the reply that showed a higher similarity between the students of both groups (60.0% BR and 64.6% PT). Other differences were: the "difficulty to lead discussions in a democratic environment" (37.1% BR and 44.7% PT) and the "fear of losing control of the class" (54.3% BR and 44.7% PT). We attested that even with the cultural, social and legal differences existent between the two countries, both interviewed groups showed similar difficulties when dealing with the topic of bioethics inside the classroom. Because of the relevance of bioethics, this data signals the need for a new organization of graduation courses in both countries, taking into account bioethical issues.

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Keywords: Biology teaching; bioethics teaching; future Biology teachers.

Multiple areas, multiple results: 12 years of the Primeiro de Maio college preparatory course.

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A university is a multidisciplinary institution which forms higher education, research and human knowledge professionals. In Brazil, there are two types of university: private universities, in which students have to pay a monthly fee in order to attend the classes; and the public universities, in which there are no costs to the students, i.e., they are free (Lessa, 2004). Entering and maintaining a tertiary degree in a Brazilian public university is not an easy task (Vasconcelos and Silva, 2005). Public school students that face this process do not compete equally with private school students, specially due to being less prepared compared to them and to students from preparatory courses (Castro, 2011), which aim to revise all the content learned by the student throughout its school life so that, when better prepared, it can guarantee a place in a public university. To help the access to a public university for those that were not well prepared by their school and cannot afford to pay for a private preparatory course, the "Primeiro de Maio", a free college preparatory course, has sought, for twelve years, to work by bringing together participants from several different areas, different university courses, and with many proposals being developed to meet our goal of enhancing education and motivating learning. The "Primeiro de Maio" is a project linked to the São Paulo State University "Júlio de Mesquita Filho" (UNESP) and through classes, study groups, the educational resources offered, the several teams working on the project and the ongoing work of dialogue and interdisciplinarity among all those involved, it allows a finer serving for the population enabling an exchange between the University and the Community. In 2011, with 150 openings, we obtained over 90 acceptances at public universities. Besides providing ingress into college admission exams we also offered to the population an environment that could structure, stimulate and promote the necessary conditions for studying, acquiring knowledge and skills, aside from contributing in a very enriching manner for the academic education of everyone involved. The "Primeiro de Maio" free college preparatory course conducts activities to integrate the academic environment and the community, valuing the Public University and serving the population, providing an experience that is both valid and productive for those who are served and for those participating in organizing the project.

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Key words: University, teaching project; poor community.

Approach between evolutionary adaptation and the niche construction theory: an interdisciplinary perspective for Biology teaching

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The concept of biological evolution has been an important unifying axis for Biology (Futuyma, 1986; Meglhioratti, 2004). Several studies show that students have difficulties to understand this concept (Bizzo, 1991; Sepulveda and El-Hani, 2009), and among other factors, that may result from textbooks that use this theme as a separate chapter, detached from other biological subareas (Dias and Bortolozzi, 2009). In Biology graduation courses of Brazilian universities, students learn biological concepts in a compartmentalized way, without the necessary perception that biological knowledge is interrelated. Therefore, the aim of this work is to propose bringing the subfields of biology together through two concepts, evolutionary adaptation and the niche construction theory (NCT) as a way of providing an interdisciplinary study for Biology education.

The concepts of adaptation and NCT were chosen, because from them on, we can understand many other biological subjects such as trophic levels, morphology, physiology, adaptive convergence and so on, i.e., through them we would not be restricted to each of the biological subareas. An example of these mistakes would be teaching competition, a phenomenon usually presented on the ecology topics, without considering the species' evolution and co evolution.

The insertion of NCT ideas provides a broader perspective on the evolutionary processes by introducing the notion of ecological inheritance. In this type of inheritance, the descendant organisms inherit the legacy of their ancestors, through modifications caused by the latter in the environment (Odling-Smee, Laland and Feldman, 2003). Also according to the NCT, the organisms of a certain environment would have the ability to manipulate it, acting as „co-directors" of its own evolutionary process and of other species too, and they may even influence the way of life of their descendants (Laland, Odling-Smee and Gilbert, 2008; Jablonka, Lamb, 2005).

By exposing these issues we are exploring the interdisciplinary character (Love, 2011) that the approach between the NCT and Evolution provides for Science and its teaching. Interdisciplinary research encompasses the coordination or synthesis of methods, concepts and operating standards from different scientific approaches. Interdisciplinarity is a philosophical concern, because it points to the possibility of a non-reductionist epistemology in Biology. So it increases the collaboration between different sciences and makes these philosophical questions to be important and relevant when educating the next generation of biologists, as well as the general public (Love, 2011).

Thus, the interdisciplinary approach of the biological subfields promoted by this work could instigate a teaching proposal that excels at using evolution as a central theme for biology education. For example, this interdisciplinary property of evolutionary adaptation and NCT could constitute a way to avoid fragmentation of contents and it could decrease the incidence of developing textbooks promoting evolution as a specific chapter.

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Key words: Teaching Biology; teaching of evolution; interdisciplinarity.

The concept of ecological succession in Brazilian textbooks: an essentially botanic topic.

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Ecological succession, one of the oldest processes studied in Ecology (Johnson, 1977), is an important phenomenon for understanding the dynamics of ecosystems, essential, among other things, to assess the resilience of natural environments (Dajoz, 2005). It is noted that the manner in which the researchers understand this process has been changing over time. At the beginning of their inquiries, it was the subject of studies mainly for ecologists (McIntosh, 1999). Because of that, its first descriptions were about the transformations occurred in the associations of organisms in sand dunes, grasslands, forests and rocky shores (Odum, 1969). In these environments, the studies were focused on the most direct aspects of plant species' succession. Despite this initial, primarily botanical, focus, currently it is believed that although the plants provide a base for food chains, there are cases in which animals affect or even dominate the community structure (Begon, Townsend and Harper, 2005).

Regarding the study of this concept in Brazilian high schools, it is seen that sometimes this is discussed in a simplistic way, despite its importance (Nunes, 2012). From its understanding, students can think about solutions to some environmental problems, such as erosion (Ibarra Murillo and Gil Quílez, 2009).

Knowing that this topic has a propensity for researches on ecological succession only under a vegetation point of view, and given the fact that textbooks are the most used didactic resources in

Brazil (Pinheiro da Silva; Cavassan, 2005), in this work we aim to analyze whether the presented examples of ecological succession in Brazilian high schools' textbooks follow this tendency.

To do so, 11 Biology textbooks used by students between 15 and 18 years of age were analyzed by the Bardin (2002) method of content analysis. During the analysis of these materials, it was found that only one of them was mentioning the presence of animals in the succession process: "with the development of vegetation, animals will also be established in the region, until it reaches a stage where the community becomes stable" (Laurence, 2005, p. 53). However, as it can be seen in that passage, the animals are treated as a supporting role on the process. The lack of examples using animals for the succession process can be historically understood, because, as already stated, the studies about ecological succession were started mostly by botanists.

Another factor that makes us understand the primacy of plants in this process is that they are producers in food chains, as well as, contributors to most of the biomass of a community, which is substantial. However, one cannot overlook the importance of animals in the process. Without them, many communities would not be able to efficiently maintain themselves, because of the absence of dispersion of some types of seeds, which is only made by a few animals. Therefore, taking into account the aforementioned statements, we can reinforce the need to further review the quality of instructional materials, at least when regarding to this topic. We also emphasize that this research indicates the need for more works about ecological succession, since, contrasting to the importance of the subject which is fundamental to understanding environmental dynamics, there are few of them. Understanding this concept could help people taking more thoughtful actions regarding their surroundings.

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Key words: Ecology teachings; community evolution; textbooks.

Dissemination of HIV: relations between knowledge, values and social practices

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Concerning the global AIDS epidemic, strategies which aim to decrease this dissemination have been widely disclosed, such as the inclusion of Sexual Education in schools (WHO, 1999). In this research, we aim to investigate the ideas of the individuals who have been studying or have just finished High School about the transmission and prevention of HIV. Our purpose is to verify if the scientific knowledge learning in school is enough to generate prevention attitudes regarding to AIDS/HIV. In order to obtain these results, we have applied a questionnaire based on a Likert-type scale (Babbie, 1990), which related the axis of KVP Model (Carvalho; Bernard; Clément and Berger, 2008; Clément, 2006). In order to have a global idea about the set of answers, we have applied the technique of Principal Component Analysis (PCA). Besides, we have analyzed the interconnection between the answers utilizing the Pearson Correlation Coefficient. In this research, it has been analyzed four questions belonged to the main questionnaire, applied to 90 individuals. Two questions referred to the respondents' scientific knowledge about HIV/AIDS ("**Q1:** AIDS is a disease which affects only people with promiscuous behavior" and ("**Q6:** The HIV transmission occurs only by body fluid contact, such as body secretions, semen and blood"). The other two questions were related to the respondents' attitude regarding to possible situations in which the respondents could be in contact with the virus ("**Q14:** I prefer not to share glasses and cutlery with someone who has HIV") and ("**Q15:** I don't worry to demand if the manicure instruments or dentist instruments have been sterilized"). After analyzing the results, we have noticed that most of the respondents showed scientific knowledge regarding to the theme we have proposed, since 80.9% gave a negative answer for Q1 and 84.3% gave a positive answer for Q6. On the other hand, the Q14 and Q15 analysis has showed that most of the respondents have answered negatively to both questions: 64.1% to Q14 and 58.4% to Q15. Regarding the interconnected analysis, we have obtained a slight correlation between Q6 and Q14 ($r = -0.146$). The same result has been obtained between Q6 and Q15 ($r = 0.012$), Q1 and Q14 ($r = 0.283$) and Q1 and Q15 ($r = 0.074$). It demonstrates that, in regard to those questions, it is not possible to relate the students' knowledge to their social practices. Therefore, it is possible to infer that the scientific knowledge gained by each person doesn't often guarantee social practices which are coherent to what is considered acceptable by science.

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Key words: Sexual Education, AIDS/HIV, KVP model, Likert Scale.

Young People's Attitude Toward Science

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In the paper the attitude of lower- and upper secondary school students towards science is presented. The results of author's research on lower secondary school students were compared with those for upper secondary school performed by SMG/KRC Institute on Bayer's commission. The research formed an element of the program of science promotion among young people, carried out under the patronage of the Minister of Science and Higher Education and the Rector of Warsaw Technical University. The research was meant to answer the question, which science subjects were most appreciated by students from the point of view of their future job choices. It follows from the research that upper secondary school students appreciate the profits that science can bring to their professional life. Those who choose science subjects declare at the same time that they want to tie their future with the favourite subject.

Keywords: interest, favorite school subject, subject competitions, profile of a student scientist

Visualization of Exothermic and Endothermic Processes

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We propose to use thermograms in teaching elements of thermodynamics in physics and chemistry lessons in upper secondary school. Thanks to the visualization of the temperature field with resolution less than 0,1 K it is possible to show small temperature increases or decreases. The thermograms shown in the paper visualize phenomena that occur with giving off of thermal energy, e.g. reaction of concentrated sulphuric acid with magnesium filings. We also visualise reactions in which energy is absorbed, e.g. while a salt is dissolved in water. We have registered the exothermic and endothermic processes with the Flir Therma CAM SC 640 camera. Using coloured thermograms in lessons makes teaching about thermal processes more understandable to students.

Keywords: exothermic process, endothermic process, infrared camera, thermal imaging

Using educational software in teaching Physics and Mathematics

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In basic education many students suffer great difficulties in learning the concepts of physics and mathematics. With the development in technology many has facility in the use of computers, so the development of software, such as Modellus which is discussed in the research is of paramount importance to help in teaching these disciplines. The objective of this research is to verify that with the use of educational software can improve the teaching learning process, initially by the appeal of technological stimulation. According to the applied experience in a certain public school, in a high school education network in the State of Rio de Janeiro (Brazil), students gained a better learning experience, not only concepts but also the analysis of phenomena.

Introduction. In Brazil, high school students face major problems when the subject in the classroom is physics and mathematics. These difficulties, which have been „dragged" from elementary school, have primarily affected the understanding of these disciplines both for analysis and for interpretation of problems related to them. Besides, the lack of minimal knowledge in mathematics leads to problems in the under graduating of college students.

Nowadays the teaching of physics has been „taxed" as boring, soon forgotten by many students. Hence the need to create software that are attractive to these students, in a way that reinforces their willingness to seek knowledge beyond the traditional pencil and paper.

The use of computational tools that have this purpose, provide a virtual laboratory that is able to show how physical and mathematical phenomena happen in a fast and effective way. However, such modeling requires that the student need to worry about the interpretation and the mathematical equations involved in the experiment, not only the „old how to do" but also „why" and „for that". One of these tools is the software Modellus.

The software allows students and teachers perform experiments mathematically modeling the physical phenomena, where they can analyze them in a way more detailed. Nevertheless, the application of computational modeling in education requires its use in practice of the classroom to obtain a satisfactory result of its effectiveness.

About Modellus. Modellus is a modeling program developed to give a new idea and perspective to students not only on the physical phenomena but also in mathematics, chemistry, biology, etc.. It allows users to use it to carry out experiments where they can control variables (such as time, speed, distance, etc..), to examine variations of functions graphically, preparing animations, solve and create exercises within the context of software Modellus.

One of its features is its interactive graphical interface, which enables students to handle without the need for a specific programming language which makes it less complicated software-student interaction.

Modellus can be used in two ways: one which the student uses modeling that have already been created, and other which the student creates their own modeling. And There's a middle ground which the student can modify those already created allowing them new insight into the modeling.

Methodology. The main objective of the research is not only quantitative data but also qualitative. For research to obtain plausible results, we propose a more centered on teaching practice.

The research at school was performed as follows:

The survey was conducted with a group of high school students from Colégio Estadual Paulo de Frontin, the period of two months. The class was divided into two groups A and B of ten students each and supervised by teacher JD. The activities continued as follows:

a) In group A the teacher did not use the software.

b) In group B the same teacher, with the same content, used the software. In the first presentation of the program, students and the teacher had distrust of the software. After presenting, both teacher and students began to interact with the software Modellus.

c) The teacher, realizing the ease of handling it, in order to create new examples, noted that students had a better facility to understand the concepts in relation to group A.

d) At the end of the project developed, the teacher collected opinions from the students.

Acceptance of software by students:

25% said the software was excellent;
30% said the software was very good;
25% said the software was good;
20% said the software was regular.

Results. During application, the group that used the software showed an ability to develop and understand the concepts, physical phenomena and a better ability to apply mathematics as a tool significantly better than the other group.

Conclusion and Implication. The software used is qualified as a group, even though no initial knowledge or interest, can learn things for him was difficult to understand. It also depends on the possibility to build different situations with different properties and concepts. We know that those who must choose the best software for the classroom is the teacher of the discipline as it is in direct contact with students and thus try to visually represent concepts misunderstood.

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Key words: computational modeling, Modellus, modeling phenomena in physics, educational software

Implementation of IBSE methods and teaching materials in science education in Slovakia

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The science education in Slovakia currently faces new challenges that are connected with the huge curriculum reform running from 2009. The reasons for the changes include the oversized curriculum content as well as the findings of the PISA study [1]. They revealed that pupils had acquired a big amount of scientific knowledge but had difficulties in independent thinking and investigating scientific problems including formulating hypotheses, problem solving, data interpretation, drawing conclusions and formulating coherent arguments. In order to change this situation the curriculum reform emphasizes the use of active research methods to gain knowledge and develop competencies and skills that students will need in the future. These trends are in accordance with European trends emphasizing the role of scientific inquiry, in particular. Inquiry-based science education (IBSE) or „inquiry" is an education strategy as well as a model of a pedagogical procedure [2, 3]. A teacher does not present the subject matter in the ready-to-use form but develops pupils' knowledge by means of problem solving and asking open questions that can be done at different levels of inquiry [2]. The 7th framework project ESTABLISH [5] deals with the wide promotion of the IBSE across Europe. The activities include a development of inquiry-based activities with respect to the hierarchy of inquiry levels including e.g. the topics of Investigating holes, Plastic and plastic waste for chemistry, Blood donation and Disability for biology and Sound and Direct current electricity for physics. An inevitable presupposition of successful implementation of IBSE is a well-educated teacher; therefore the in-service and pre-service teacher training is carried out based on a uniformly agreed structure and contents. So far there were 50 science teachers participating at the 4-days training in order to master the IBSE methods and a number of them have been trialled the developed activities at secondary schools with strong emphasize on the corresponding IBSE methods. Within the research the impact of these methods on students' motivation and attitude towards science as well as students' awareness of the significance of science and technology for the society development has been studied. The paper discusses the research in terms of the IBSE activities implementation and the results gained by the analysis of questionnaires answered by teachers and students.

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Key words: inquiry-based science education, inquiry-based activities, chemistry, physics, biology

Digital Library for project and Inquiry-based education methods in chemistry

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Project and inquiry-based education methods are currently ranked among main methods leading to increasing the efficiency of science education. In our research we focussed on building and verification of a digital library efficiency for project and inquiry-based education methods for the topic Plastic and Plastic waste. The library provides chemistry and other science teachers methodological educational resources needed for setting up interdisciplinary projects such as learning texts, proposals of experiments on a particular topic, proposals for and outputs of projects as well as inquiry-based methods. The library is used for teaching chemistry as well as interdisciplinary topics „Setting up a project and presentation skills" and „Environmental chemistry" of the State Educational Programme (SK) and General Educational Programme (CZ).

Inquiry-based methods are made available due to the fact that project-based education is marked with inquiry-research character and inquiry or research activity of pupils within a project represents a unique education method. We would like to point out common features and significance of a inquiry-based method in project-based education. In inquiry-based activities and in doing projects both guided and bounded inquiries are used.

The library can be found on the web site http://kekule.science.upjs.sk. It enables chemistry and other science teachers to carry out project-based education with the use of enquiry-based methods. The library also provides pupils with a lot of ideas for independent practical work. This enables a pupil in a relatively independent way and in co-operation with other pupils to state a problem, suggest a solving method, solve the problem and, thus acquire the necessary knowledge, skills and competences in an active way.

The efficiency of the digital library verification was evaluated based on a scale questionnaire for both teachers and pupils. The findings of the verification revealed that the activities were of a significantly motivating character, the interest in sciences increased. The teachers appreciated mainly the tasks developing higher mind operations, experimental skills and key competences. The disadvantage is mainly time-consuming preparation of an education unit.

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Key words: inquiry-based method, project-based method, digital library

Content of sodium and potassium in human cells of esophagus, stomach, small intestine and large intestine among patients from hospitals in Cracow

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Each human cell needs sodium and potassium for proper functioning. In spite of this some human organs concentrate much more of these elements than on the others, which are present in the majority of food products. The digestive system plays the most important part in the process of absorption ionic substances into organism. Until now only the limited number of tests have been conducted about the concentration of Na+ and K+ in different parts of the digestive system and the results display high rate of differentiation. Moreover, it is assumed that some of biogenic metals have a protective impact on the development of cancer. This should draw the public's attention to eat more types of food that include the above mentioned microelements.

Wet mineralization was the first step made in order to prepare samples for the next step which aim was to calculate the contents of sodium and potassium in tissues of the esophagus, stomach, small intestine and large intestine of human. Dried and weighed samples of tissues were put into glass tubes. Then 1cm3of 65% nitric acid was added. The samples were heated for two hours in 105ºC. When the mineralization was completed samples were transferred into 10cm3 flasks which were then filled with distilled water. The flasks' content was mixed by shaking it slightly. The solution thus obtained was used for the analysis of sodium and potassium concentration using FAAS method.

The average quantities of sodium in mucosa were respectively: esophagus 17001.582±4744.084 $\mu g \bullet g^{-1}$s.m.; stomach 618±5212.751 $\mu g \bullet g^{-1}$s.m.; small intestine 16612.822±4841.574 $\mu g \bullet g^{-1}$s.m. and large intestine 30020.315±25909.881 $\mu g \bullet g^{-1}$s.m. The mean contents of potassium in mucosa were respectively: esophagus 13088.722±4667.685 $\mu g \bullet g^{-1}$s.m.; stomach 30097.985±29285.942 $\mu g \bullet g^{-1}$s.m.; small intestine 16612.822±4841.574 $\mu g \bullet g^{-1}$s.m.; large intestine 30020.315±25909.881 $\mu g \bullet g^{-1}$s.m. The level of concentration of sodium was similar in all samples when it comes to potassium the highest level of potassium was noticed in mucosa of stomach and colon.

key words : esophagus, stomach, small intestine, colon, sodium, potassium

The Content of mercury comparison between human small intestine and colon tissues

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Metals – such as mercury - are involved in different physical and chemical processes, which are common in cancer development. There are different effects caused by metals in the process of carcinogenesis , such as: damage in DNA, formation of DNA cross-links, the interference of metals with DNA-repair enzymes. Some metals affect the transduction signal by initiation of gene expression disturbances and intracellular communication. Moreover metals may cause of negative effects of the immune system function and disturbances of cellular homeostasis. The influence of metals on carcinogenesis is determined by several factors: the type of metal, their speciation, solubility, metal-metal interactions and others. Moreover metals may cause the negative effects in the immune system functioning as well as the serious damage in cells. It is crucial to realize that mercury is especially dangerous because it can be found in things and places which are surrounding us for example tuna has a capacity to accumulate high quantities of mercury in muscles. Information of this kind should be highlighted from the earliest stage of education.

Research were conducted on small intestine and colon tissues. Samples were taken from patients during autopsy in 5th Military Hospital with Polyclinic in Cracow. After collection / Collected tissues were placed in polyethylene containers, tightly closed, labeled and frozen. Samples of mucosa from small intestine were taken from 12 patients (n=12) and mucosa from colon were taken from 19 patients (n=19). Mercury contents were tested by using Cold Vapor Spectrophotometric Method (CVAAS). This method does not require mineralization and allows the measurement directly in tissue. The small fragments of tissues were placed into the special crucible directly after defrosting and precise weighing. Results of weighting were recorded in the computer using the program, which operate spectrophotometer MA2. Results were expressed in ppm. The measuring was repeated three times for each sample. In statistical description the following statistics were used: the arithmetic mean, standard deviation, standard error of the mean. Normality of the distribution was examined by Shapiro-Wilk test.

Mean content of mercury for mucosa of small intestine is 0.012±0.010 µg•g-1s.m. and for colon is 0.012±0.001 µg•g-1s.m. Mercury accumulates at the similar levels both in mucosa of small intestine and colon. There are statistically significant differences between mercury contents in males and females tissues (the highest content of mercury is in tissues of a man suffering from cancer), what is probably related to major differences in the quantity of food consumed.

key words: mercury, small intestine, colon, heavy metals

Development of the ecological mindset in children and adolescents with the help of knowledge of the natural sciences

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One of the main goals of teaching natural sciences in elementary and middle school is to allow students to form a long-lasting attitude of appreciation towards nature and its preservation. From the same perspective, this report presents the results of research on the evolution of childhood concepts of the connection between man and nature, and on the development of the ecological mindset. The general conclusions of this research can be presented on several levels:

The development of childhood concepts of nature in the pre-school period includes the establishment of a positive emotional connection with nature, an understanding of clean and contaminated sites, of resources and waste, of the reusing of materials obtained from natural resources, of healthful and harmful foods and hygiene habits.

The ecological education in mainstream elementary and middle schools helps to develop the ecological mindset and culture of the students by presenting the basic ecological terms and ideas, providing knowledge of environmental preservation, the ecology of man, waters, soils and forests, as well as of the plant and animal kingdoms. The main goal of introducing students to knowledge of the natural sciences in the mainstream school is to help them grasp the notion that the diversity of substances and living organisms is valuable and needs to be preserved. One of the global missions of mankind today is to preserve the ecosystems of substances and living organisms functioning together in unison.

Key words: ecological mindset, childhood concepts of nature, ecological education

Microwaves in the School Organic Chemistry Experiment

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Organic reactions under microwave irradiation are a new alternative in school experiments area. The technique is very useful for the acceleration of organic reactions. The microwave irradiation have a positive influence on the reaction yield. The reactions can be realized in commercially microwave oven. Microwave assisted reactions we can use also in the school organic chemistry courses.

In this case, we to be interested very much in the acylation of amines and alcohols. We study the influence of reaction conditions on the yield and selectivity of this reactions. Another area of our interests are condensation reactions aldehydes and ketones, nucleophilic substitution of the halogen derivatives of hydrocarbons and the sulfonic acids. Microwave assisted synthesis of heterocycles are another type of the school experiments.

This trend is very significant in the chemistry education, because we can use commercially owen for this experimens in the high school.

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Key words: Organic chemistry, School experiments, Microwave assisted reactions

Principles of Green Chemistry and their Using in Organic Synthesis

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Green chemistry is a new trend in chemistry, which have regard for ecology and economy aspect of the chemical reactions. It was suggested the 12 principles of Green chemistry. From this we chose as follows for school chemical experiments.Microwave assisted solvent – free synthesis of organic compounds was use for the chemistry teaching. Reaction of the aromatic carboxylic acids with aliphatic and aromatic amines was selected as school laboratory experiment.The mixture of carboxylic acid and amine in the porcelain crucible were heated in the commercially microwave oven. The reactions under this conditions, according to Green chemistry principles respect: 1.any hazardous substances use in the experiments, 2.reduce of the auxiliary substances for example solvents,3.save of the energy for heating of the reaction mixture,4.time of reaction is very short, 5.very good yield of reactions is achieve, 6.no adjacent products arise.These reactions, as school chemical experimets, show the contemporary trend in organic synthesis – ecologic and economic aspects of reactions.

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Tradition and Future of Inductive Approach to Education

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1. Background, framework and purpose

This article is trying to reconstruct the applications of Vygotsky followers' ideas, which have led to asserting deductive approach in the middle Europe educational area. This contribution points out that by consistent reinterpretation; Vygotsky's ideas might be the starting point for inductive educational processes in the future Science education.

2. Methods

The author clarifies, expounds and gives examples of well-established term "Inductive Science Education" which emerged in agenda of the European Union on the field of education. Although scientists have amassed an extensive body of knowledge, learning science should not focus on memorising scientific "facts", but rather on making meaning of scientific concepts and ideas, actively constructing scientific knowledge, analysing, evaluating, and utilising that knowledge in familiar and unfamiliar situations to develop critical thinking and decision-making skills.

3. Results

Inductively approached Science topics are readily available in theoretical educational studies as well as in genuine education materials and programmes. In addition, many topics preferring inductive approach have been developed at the Department of Chemistry Education, University of Trnava as well.

4. Conclusions and implications

Inductive approach to Science education appears to be a compromise between "content empty" competencies and uncritical orientation toward actual scientific concepts with the aim of enhancing scientific literacy by developing in all students the knowledge, understanding, skills, and attitudes they need to critically address the scientific, technological, economic, ethical, and environmental issues.

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Keywords: Science Education, Inductive Approach, Deductive Approach, Vygotsky

Experience of the lecture-experimental tours at secondary schools

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Our Institute of Physical Chemistry and Chemical Physics of Faculty of Chemical and Food Technology was solver of the APVV (Slovak Research and Development Agency) project: „Physics and Chemistry in our Life Today and Tomorrow“. Our activities were concentrated on the realisation of lecture-experimental tours at secondary schools. The topics of these tours were focused on a popularisation of natural sciences and techniques generally, as well as on a transfer of new knowledge of science to students.

In a preliminary phase of our tours we concentrated on the choice of the suitable topics, multimedia tools, on the preparation of new teaching aids and creation of interesting physical and chemical interactive experiments. Every presentation consisted of the lecture with power-point presentations, of illustrative demos, as well as of simple experiments. We had our own video-film library, which consisted of about 19 video films from the field of physics, chemistry and ionising radiation. Simultaneously, the other video clips and internet applets were chosen and introduced into our presentations. Every lecture was attended by interesting demonstrations and simple experiments. Up to the present we prepared 15 topics which we offered to secondary schools.

At the beginning of the lecture, the students received written form of questions concerning the topic and in the end of the lecture the answers were evaluated. By this form we reached student's attention as well as we gained the feed back at which level students understood the matter. The more than 30 lectures have been realised up to now. Duration of every lecture was about 2 – 3 teaching hours. The last year the number of students participated in these presentations was approximately 1200.

We can say that the atmosphere at our presentations was very congenial and therefore we want to continue in these activities.

Key words: lecture-experimental tours, popularisation of natural sciences, multimedia tools, simple experiments.

Natural Sciences in our Life Today and Tomorrow

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We searched for new forms of education of young generation in the field of natural and technical sciences within the scope of the APVV (Slovak Research and Development Agency) project solving: „Physics and Chemistry in our Life Today and Tomorrow". We tried to overcome distaste, sometimes an unconquerable aversion to physics and on the contrary to arouse an interest of youth in the world of nature around us, by means of application of the idea "science by game". Simultaneously with the popularization of well known natural phenomena we were trying also to transfer new science - technical knowledge. This contribution deals with various ways of realization of this idea.

We can divide our activities into two parts. The first group relates to public activities like "Days of the Open Doors" – at our faculty, "Night of Researchers", "Summer University" and "Week of the Science and Techniques". We organised some of these activities and we took part on the other ones with our contributions in the form of lectures, presentations, demonstrations and experiments. Extraordinary important were Days of the Open Doors, where more than 200 students participated in. They came from more than 10 secondary schools of various parts of Slovakia. Apart from the fact that they were informed about our faculty and about employment of our graduates, the students could watch infotainment lectures from various fields of research realised at our faculty. The students changed the lecture from several parallel presentations according to their interest. After a pause, the "chemical fair" was organised for students. There were prepared more than 30 display stands with interactive physical and chemical demonstrations. About the whole course of this activity the documentary video film was recorded.

The second group of our activities deals with our lecture-experimental tours at secondary schools. Every presentation consisted of the lecture with power-point presentations, of illustrative demos, as well as of simple experiments. Our presentations are suitable as a form of repetition of the teaching matter with providing new aspects on the topic and information of the research in given field.

Besides these activities we participated in the regular continuing training of secondary school teachers to acquaint teachers with the new trends of science and techniques development at the faculty. Via these seminars new information and popularisation of science was transferred to secondary school as well.

Key words: science by game, Days of the Open Doors, Night of Researchers, chemical fair

Synthesis and biological activity of thiohydantoins

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Thiohydantoins are heterocyclic five-membered organic compounds. Their structure contains two nitrogen atoms at positions N-1 and N-3 and exocyclic sulfur atom at position C-2. These compounds have been known for many years and because of their biological activity as well as their use in biological systems they and their derivatives have been a subject of scientific research. [1]

One of the most popular methods for synthesis of thiohydantoin derivatives containing a carboxyl group at position N-3, is the reaction of carbon disulphide with amino acids in alkaline conditions. The method leads to an intermediate product which, by the action of hydrochloric acid, cyclizes and gives the corresponding thiohydantoin. [2,3]

Thiohydantoins derivatives containing aryl group at position N-3 may be obtained by heating the corresponding aryl thiocyanates with amino acids in alkaline conditions at the reflux temperature of solvent. This method allows obtaining thiohydantoin with extended aromatic system in position N-3. [4,5]

In some cases, it is also possible to obtain thiohydantoins by transforming the corresponding hydantoins. This method consists of replacing the hydantoin exocyclic oxygen atom at position C-2 with sulfur atom using Lawesson's reagent. Lawesson's reagent is used to convert the carbonyl group into the thio carbonyl group. In many cases its use allows to obtain a sulfur analog of hydantoins inaccessible (impossible to obtain) by other methods.

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Key words: hydantoins, thiohydantoins, Lawesson reagent.

Modern strategies for professional practice of school natural sciences students supported by online learning system within the European Union project.

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The Department of Didactics of Chemistry, Faculty of Chemistry, AMU projects are: „Modern strategies of multilateral prepare students for teaching job by web-enhanced learning system. Nature in the school practice" and „A good school - better practice - an excellent teacher. Preparing schools and practices tutors to work effectively with students of chemistry." During the vocational practice were used micro-teaching method and remote learning method. The purpose of content methodology students internship of science is the ability to independently conduct chemistry or nature class by the students and familiarize yourself with the totality of a teacher job, as well as with the tasks of teaching and education in the school. Thanks to the internship graduating students are adequately preparing to conduct lessons at primary level (first degree), middle school and secondary school level (postgraduate courses). Within the framework of the project are carried out two kinds of content and methodological practices, it is the interim practice and continuous course of practice. Commencing the study we analyzed the training system of natural science teacher at the Adam Mickiewicz University in Poznan. We carried out initially diagnostic survey in a group of students preparing to become teachers and among teachers.

After graduation from internim the final survey was conducted among students - trainees and teachers - school guardians of internims which gives an overview on the examined problems. Surveys were designed to answer questions concerning the implementation of practices, a novel method of preparing students to work as a teacher of chemistry and nature and to develop new standards of training future chemistry teachers in the framework of vocational practice.

key words: chemistry, natural science, teaching practice, blended learning

Methodology of preparing films and educational research with hard of hearing and deaf students in chemistry range

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In order to understand how difficult the problem of teaching an experimental course, which is chemistry and attempts to increase the efficiency of the chemical education of pupils with speech and hearing impaired we should familiar with the basic issues related to cognitive and mental ability of pupils with speech and hearing impaired.

In the natural sciences, including chemistry, knowledge of the surrounding reality, the structure and properties of matter are obtained in different ways. But the most important are ways of information contact of students with the outsider world. This information contact with the environment is ensured by properly functioning receptors. From them begins collecting informations. When any of the senses is damaged then it breaks the connection with reality or breaks the information contact. In this situation, are people with impaired hearing. Deaf people do not know anything about the sounds, rhythms, and above all do not hear the speech whit its intellectual and emotional richness.

Creating learning centers for students with impaired hearing and speech requires a special approach to this issue. This is connected with the impossibility of these students to receive the sound and thus lack of verbal communication.

The Department of Chemistry Teaching, Faculty of Chemistry „AMU has developed and implemented a collection of educational films to study chemistry at the high school and secondary school for pupils with hearing and speech impaired. Conducted investigations on factors such as: extension of video sequences, the introduction of a sign language interpreter, adding subtitles and logos, slowing the pace of commentary, tone of voice, etc., It increases the efficiency of information transmission by means of teaching which is educational video. Creating videos for this group of students with a picture of a sign language interpreter, among other things requires a separate registration course of the experiments and the image of an interpreter. For the films used custom software for special effects and digital processing that is described in detail.

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key words: deaf students, sign language, educational movie

Impact of out-of-school learning on science education in Poland

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Out-of-school learning is becoming increasingly important in science education (Braund and Reiss, 2004). It can take several different forms and usually is not coordinated by the school itself. It includes learning in such contexts as field-work, employment-based settings, museums, science centres and science events organised by universities and other institutions. The purpose of out of school learning is to improve students' motivation, build their self-esteem and help them to become more effective learners. It can also help overcome learning disabilities, develop students' talents, strengthen communities and increase interest in education by creating extra learning opportunities. This form of education has become widely appreciated, which is reflected in the increasing number of organisations launched to support it and international projects whose aim is to develop even more effective ways of implementing it. Simultaneously, research are conducting which aims is determining the impact of out-of-school activities on improving the learning of science, especially on outcomes such as achievement, interest in science, careers in science, self-efficacy, perseverance, and effort in learning science (Tran, 2011).

The findings of studies carried out in Poland in this respect show that the use of out-of-school learning in science education remains limited. This could be due to an insufficient knowledge about the benefits of this form of education and to the fact that the range of out-of-school activities being offered is only starting to be broadened. In order to explore the current situation in Poland regarding this form of education, the forms of out of school experiences which are currently available to Polish students were reviewed. Visits to science centres and museums, as well as events organised by cities, universities and non-profit associations have been analysed in terms of the activities they offer, the age of students they are targeted at and their usefulness from the point of view of science education.

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Key words: science education, out-of-school learning, motivation, interest in science

Science teachers' use of information and communication technology

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In October 2010 the Polish Ministry of National Education published a document called *"An action plan for the education of children and adolescents and the functioning of schools in an information society. New technologies in education".* The aim of the plan is to assist schools in adapting to the needs of an evolving society by integrating the goals schools are to help young people achieve with the requirements imposed by an information society. One of the key priorities in the education of children and adolescents and in the functioning of schools is teacher education. It is seen as a prerequisite for introducing innovation into schools and closing the gap between students' and teachers' skills in technology and communication. Since teachers play a significant role in the education process, which they organise and manage, I conducted a study investigating the use of information and communication technology (ICT) by science teachers in junior high schools.

The main aim of the study was to determine what types of ICT media and tools are used by science teachers and how they are used, as well as to explore the impact of ICT on the quality of science education in junior high schools. The instrument used in the study was a questionnaire which consisted of 14 closed-ended and 3 open-ended questions. The questions were grouped into three categories. The first one concerned the teachers themselves, the second one contained questions about the practical use of ICT both in class and while preparing for the lessons, and the third one dealt with the difficulties and problems the teachers had with using ICT in their work. The participants were 40 teachers of science subjects (biology, chemistry, geography and physics). Each subject was represented by 10 teachers who taught in junior high schools in the city of Lublin.

The study revealed that the teachers rarely use ICT in the education process. During most of their lessons the teachers use traditional methods involving such aids as overhead projectors. This is not due to their lack of IT skills, but to the fact that the schools do not provide them with computers with Internet access or multimedia projectors. The science teachers who do use ICT in the process of teaching and learning claimed that it generates more interest in the subject, motivates students to work independently, makes learning easier and stimulates students' imagination.

All teachers could benefit from using ICT in their work; however, well-educated teachers with good ICT skills will not be able to make use of their abilities if the schools do not provide them with the necessary equipment.

Key words: information and communication technology, science education

Chemistry for non-chemists – coordination compounds

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Teaching non-chemists chemistry requires particular didactic preparation. In the learning process there appear some specific problems, such as very diversified knowledge level in the group as a whole, which is a consequence of a different level of skills gained at secondary school, as well as lack of motivation in case of some students as a result of previous school experiences. Additionally, realization of particular topics requires sometimes sketchy implementation of new scientific methods and concepts, e.g. absorption spectra.

The aim of these classes (3h of seminar + 3h of laboratory work) proposed for students of biology, biology and geology, environmental protection, is to teach them basic concepts relative to coordination compounds, such as definition of complex, coordination number, geometry of the compounds, nomenclature, equilibrium of the chemical reaction and thermodynamic constant. During classes students conduct experiments aiming to synthesis of a particular complex and investigating its chemical properties. Students learn to perform basic laboratory activities and necessary calculations, as well as write chemical reaction equations.

Here, we present our didactic ideas leading to stronger motivation of students and their greater involvement.

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Key words: Coordination compounds, chemistry for non-chemist, laboratory activities

Chemical Competition „One Year Before Matura Exam"

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In chemical competition "One Year Before Matura Exam" was conducted for the first time in 2006. It was prepared for the pupils of II grade of grammar schools who take special interest in chemistry and taking part in the competition creates the possibility of revealing their knowledge and skills according to the requirements for the Matura exam in chemistry and gives motivation for developing their interests and chemical knowledge. The competition is organized by Faculty of Chemistry, M.C. Skłodowska University, Lublin Division of Polish Chemical Society, Director of Studies for teaching chemistry and Lublin Self-Governed Centre for Teacher Education – Division in Zamość. Also pedagogical publishers (earlier Operon and Printing House Pazdro, at present WSiP) as well as the chemical company Merck S.A. take part in the organization of the competition. The competition is divided in two stages:

– The first stage takes place in school usually in April.

– The secondary stage – the provincial one is held in the Faculty of Chemistry, M.C. Skłodowska University in May or June.

The material for the first stage of the Competition includes knowledge and skills specified in the requirements for the ordinary level of the Secondary School Final Exam supplemented with selected items for the advanced level.

The interest in the competition has been growing and the number of pupils willing to take part in it as well as that of schools has increased. There are pupils from other provinces, not only from the Lublin Province, who would like to participate in it. To compare, in 2007 there were 58 pupils selected from 230 who registered for I stage from 30 participating schools. However, in 2011 in the provincial stage there took part 108 pupils selected from 510 registered for I stage from 53 schools participating in the competition. The winners receive rewards but all pupils taking part in the competition and their chemistry teachers are awarded with some tokens of remembrance financed by the competition sponsors.

During the provincial stage the pupils take part in the meetings with faculty authorities and students getting information e.g. about chemistry studies, attend interesting lectures, chemical demonstrations and multimedial presentations.

The Chemical Competition "One Year Before Matura Exam" also provides opportunity for chemistry teachers to improve their skills of evaluating and marking their pupils' papers, similar to the evaluation of papers from the Matura exam in chemistry.

Key words: chemical competition, developing an interests in the chemical knowledge.

Emotional instability as the cause of manifestation of the difficulties in student's teaching

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In the given article theoretical aspects of emotional instability are considered and peculiarities of emotions expression in students are studied. Also, the results of empirical studies of emotional instability's elements diagnosed by such methods as R. Cattell's 16 Personality Factor and method of determining the aggressiveness of the Bass-Darko are presented.

Outdoor science education activities

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Introduction and background. One of the less known, but very attractive form of educational work in which you can use a number of activating methods in connection with information technology resources are complex scientific excursions or field trips. Unusual combination of outdoor activities not only with science education in connection with the use of mobile electronic devices – such as GPS navigation, video, tablets etc., set aim to improve pupils' motivation as well as the whole effectiveness of science education.

Methods. For practical application and usability of complex scientific excursions is necessary to identify suitable outdoor locations. In this regard we have proved a very particular type of regional field trips according to the natural trails to which we have prepared a variety of materials and electronic documents. We also created worksheets for pupils, where the solution requires the use of electronics and didactic technique [1]. Some examples of tasks and documents from worksheets will be presented in the full text. To identify the interest of teachers in this form of educational work and usability of our materials we have carried out a questionnaire survey among science teachers from secondary schools in 2006 and 2010 to 2011 [2]. We found out how excursions are applied in real education, in what subjects excursions are included, how the students are busy and evaluated during and after tours and also the most frequently visited locations, institutions and production. Survey in 2006 was attended by 385 teachers. In 2011 we focused primarily on the chemistry and we received responses from 217 teachers.

Results. We have chosen from the results of questionnaire surveys some notable facts and trends relating to such interest in science or outdoor locations, institutions or firms suitable for school field trips. We also evaluated used equipment, learning materials and modern technique for excursions and the best ideas, materials and methodology for science focused outdoor activities.

Conclusions. The well didactically prepared regional field trips folloving the natural trails with complex scientific specialization and with using the possibilities of modern electronics devices, in addition focused on chemistry can become one of the important tools of science and environmental education and enlightenment both at home and abroad.

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Key words: outdoor science activities, complex excursion, educational electronic devices.

How to replace one hydroxyl group with another in the molecule of ellagic acid?

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Ellagic acid (EA), 2,3,7,8-tetrahydroxy-chromeno[5,4,3-cde]chromene-5,10-dione, is a polyphenolic powerful bioactive compound. It is found in raspberries, strawberries, cranberries, walnuts, pecans, pomegranates, and other plant foods. Interest in EA has increased during last decade due to its biological properties. Ellagic acid has antiviral, antibacterial and antimalarial properties. Recent studies have indicated that ellagic acid, as a potent antioxidant, has anticarcinogenic effects [1-3].

In recent years, attempts have been undertaken to optimize the treatment by application of previously used individual drugs in various combinations with known drugs in order to increase its activity by synergistic effect of a combination of both. It has also been made trials of combinations with new molecules showing interesting biological properties. In particular, the so-called hybrids are synthesized. Hybrid molecules show better activity than their components and can exhibit improved bioavailability. The properties of the hybrids differ from those of the components and also they may be less toxic [4].

In view of these results it seems promising to obtain the modificated form of ellagic acid which can be useful for organic synthesis. The aim of this project is to find the way of replacing the one hydroxyl group with another group, e.g.: formyl or carboxyl grroup, which can easy react with other compounds. This modification allows obtaining new hybrids by linking the molecule of ellagic acid to other compounds.

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Key words: ellagic acid, replacing hydroxyl group, hybrids

Work with school students special educational needs.

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Necessity of "individualizing work with school students during obligatory and supplementary classes, according to developmental and educational needs and mental-physical capabilities of school students" is provided in the paragraph 6.1. of Ordinance of the Minister of National Education of 17th November 2010. Every year there are more and more students being given medical recommendations from psychological-pedagogical clinics, which state that educational requirements have to be aligned with their capabilities. However, teachers are very rarely being informed in detail about how to work with a student with special educational needs. Also, available bibliography does not give any practical ideas, thus teachers are obliged to work out methods of individualizing the learning process of school youth on their own.

In my work I look for optimal methods of transmitting information and skills to students, especially to those whose IQ is lower than the average, or who find some difficulties in their learning process. I present some of them in the article.

Key words: individualization of work, working with a special needs student.

The Role of Free Radicals in Living Organisms

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Free radicals are electrically neutral, paramagnetic atoms, groups of atoms or molecules that contain unpaired or odd electrons in outer orbit of those species. Presence of unpaired electrons is associated with a high reactivity of these compounds as they seek to give or join the electron. Most common source of these chemicals in biological system is oxygen and to some extends nitrogen molecules. The oxidative metabolism causes production of reactive oxygen species (ROS). Due their high chemical activity they may serve many functions in the human body [1]. In our poster we will try to show their deleterious as well as beneficial effects. Additionally testing methods used to monitor free radicals in the living organism such as electron paramagnetic resonance imaging (EPRI) will be presented [2]. EPRI can be used to determine oxygen concentration in the tissue for example mouse brain or cancerous tissue.

ROS are generally considered as harmful species and they are implicated in various processes such as mutagenesis, aging, and series of pathological events. One of the most reactive chemicals are hydroxide radicals formed in Fenton reaction which in a living organism is catalyzed by iron(II) ions. These radicals are considered to be a cause of many serious diseases including atherosclerosis and cancer [2]. Lipid free radicals formed during the oxidation of lipids give rise to a devastating chain reaction. One of the products is malonic dialdehyde which changing the antigenic properties of proteins and inhibitoring activity of many enzymes, which leads to a cracking of the DNA strand [3]. Research is also being conducted on the influence of free radicals on vasospasm in subarachnoid hemorrhage. However, besides the adverse consequences of the free radicals, there can also be found positive effects on the human body and it is accepted that living state of cells and organisms implicitly requires the production of oxyradicals [4]. Free radicals are also used by the immune defense of cells or as neurotransmitters, which may, for example, regulate blood pressure by expanding blood vessels, due to the secretion of histamine [3]. Radical involves nitrogen such as nitric oxide (II) acts as agent relaxing blood vessels and signaler in cell signaling pathways. This radical is also emitted by macrophages in case of infection with pathogenic microorganisms.

Field of free radicals raises a lot of controversy, as they are usually seen unilaterally, as harmful to the body. Knowledge about their positive significance is much smaller, mainly because attention is paid to their toxic effects. Most of the radicals found in living organisms are irreversibly linked to the metabolism of oxygen, so their presence, but not always desirable for them, is inevitable.

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Key words: reactive oxygen species, oxyradicals, nitrogen radicals, EPRI

Revealing and reflecting on Students Prior Concepts about Phenomenon in Inquiry Based Teaching Practice

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An important component of inquiry based instruction process is identifying child's previous experience and knowledge about studied phenomena and reflecting on it during the investigation. Presented research focuses on ways teachers identify existing ideas and previous experience of pupils with studied phenomenon. Once revealed, we monitored to what extend teachers take them into account and how they incorporate them in their teaching.

In-service teachers taking part in inquiry based science education (IBSE) trainings were interviewed and their lessons were observed. All teachers participating in the research were from junior high level of a grade school (ISCED 2).

Results show difficulties in uncovering children's previous knowledge, uncertainty what to do with it once revealed and lack of flexibility on teacher's part.

Key words: Inquiry based science education, previous experience, previous knowledge

Electromagnetic Methods in Diagnostics and Therapy - A Twelve Year Course Experience.

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The continually increasing new methods and applications of electronics, computers, physical, engineering and information technologies and biotechnology have lead to establishment of new study programmes. At Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics, in cooperation with the Faculty of Medicine, started the „Biomedical Physics" as a 5 year physics master programme in the academic year 1995/1996. The newly accredited study programmes (bachelor and master) are based on the tradition and experience acquired in the previous years (Šikurová, 2010). Their educational and professional goal is to train specialists in the interdisciplinary field at the frontiers of natural sciences and medicine, comprising physics, mathematics, informatics, medicine, biology, chemistry. In the bachelor study the programme is focused more on gathering of theoretical knowledge, while in the master study it is focused more on applications of acquired physical knowledge and skills in medicine and biology. To achieve this, students can compose their study programme by choosing from many obligatorily optional or optional courses.

One of these courses is the optional course „Electromagnetic Methods in Diagnostics and Therapy", which is planned in the last year of the study. It comprises anatomical and physiological basis of bioelectromagnetism, bioelectric sources and conductors and their modelling, theoretical methods in bioelectromagnetism, electric and magnetic measurement of electric activity and stimulation of neural tissue and the heart, measurement of intrinsic electric properties of biological tissue, principles of electric and magnetic therapeutic methods. It is given during one term, three hours a week, predominantly lectures.

This course has been successfully accomplished by 30 of 78 master graduates (38%) till summer 2011, all but one with grades excellent or very good. This indicates that the course was chosen only by those students who were really interested in this topic, although during the years the course underwent several changes of study form and examination form.

For lack of study literature in Slovak language, in which this course is given, the students had to study either from the given lectures or, predominantly, from more textbooks in English language. To avoid this drawback, we prepare the course in electronical form (e-learning). The first lectures are nowadays available at the MEFANET Portal of the FM CU In Slovak as well as in English (http://portal.fmed.uniba.sk/). We suppose to prepare the first version of the whole course till the end of this year (Kozlíková et al., 2011).

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Key words: university study, optional course, bioelectromagnetism, physics, e-learning

Semestral projects as the tool of active learning

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Background, framework and purpose. Different modifications of project oriented learning are used in the educational process. It represents an important tool for active learning in the cognitive and social level and it is necessary effectively use it.

Methods. Modified form of project oriented learning of biophysics is used at our faculty. Semestral project elaboration by student and its acceptance by teacher represents significant condition of successful completion of practical training. The individual stages of continual work of students under teacher´s supervision (preparation, realization, finalization) were described previously (Kralova, 2010). Student identify the topics of semestral project at the beginning of semester and work on it according to the timetable designated by teacher. Final stage involves both the presentation in front of student´s auditorium followed by discussion and finally submission it in written form.

The aim of our study was to determine the relationship between application of programmed project learning and final evaluation of students. The statistical population composed of 1st year students of general medicine (acad. year. 2011/2012) was divided into two groups: group A – programmed project learning (52 students) and group B – non-programmed project learning (50 students).

Results. Results of study correspond with our previous findings, weaknesses and importance of project learning werw confirmed. There are problems by semestral projects processing in 1st year students. Their ability to create and work-out semestral projects is not adequate: long, uninformative text, missing structure, vague or missing conclusion. The presentation is often limited only to reading the text and student´s auditory is not sufficiently prepared to discuss. Sometimes they made copies of projects and the same topics are repeatedly presented without the knowledge promotion. This phenomenon is enhanced by new possibilities offered by internet, today.

Conclusions and implications. In the process of project learning students obtain following abilities:

– think about a topic, problem, seek and formulate problems and give answers
– working with professional literature and information, bibliographic standards
– use scientific expressions in writing
– structuring and developing a thinking operations (analysis, synthesis, comparison)
– speaking in front of the professional audience
– visualize the main ideas using appropriate technical means
– accept criticism and critically comment other works
– evaluation, self-evaluation and self-reflection.

The hypothesis that the relationship between final evaluation of students and application of programmed project learning was not confirmed. On the other hand we believe that project learning represents important motivation factor. Moreover it allows the formation of core competencies developed by physically oriented teaching subjects, supports both individual and team study activities and improve study results.

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Key words: project learning, semestral project, biophysics

Is it possible to teach while amusing? Didactic games in the opinion of students of high schools.

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The new core curriculum for subject Chemistry at the fourth educational stage will become binding since September 2012. The greatest changes relate to the implementation of the chemistry content at the basic level. This fact became an inspiration for development of variety of educational games and activities that could be exploited during chemistry classes and extracurricular activities related to the new core curriculum. Exploited primarily at the stage of introduction of some subject as well as a summary, but also during repetitive lessons, they give lots of joy to students. Their intellectual efforts supported with an emotional and ambitious commitment allow to gain knowledge and also to consolidate acquired contents.

At the poster examples of various games together with students' opinions on them as well as conclusions of the testing phase of such game, enabling its modification will be presented.

Key words: didactic games, school activities, chemistry.

Scenarios of chemistry classes in the light of the new core curriculum and their role in developing the student's attitude toward research.

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According to requirements of the new core curriculum for Chemistry, student shall acquire knowledge through researches and use the acquired chemical knowledge in his/her everyday life. However, in recommended conditions and mode of implementation of the curriculum it is confirmed, that student's autonomous observation constitutes a basis for experiencing, inferences, analysis and generalisations of phenomena. Scenarios of classes presented by us - for example: *"No, thank You, I do not smoke"*, *"You are what You drink"*, *"Not with any flour bread could be done"* - allow for implementation of many targets indicated in these recommendations through various teaching methods. Observations of experimental works of students as well as opinions gathered on proposed modes of implementation of a subject indicate the need for use of these recommended didactic solutions within the school practice.

Key words: school students skills, school activities, new core curriculum.

Investigation on possibilities of application of UV/VIS spectroscopy in secondary school.

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In the paper there have been presented the discoveries referring to the possibility of usage the UV/VIS spectroscopy during chemistry lessons in a Secondary School. There has been made an analysis of the syllabus in terms of possible appliance of UV/VIS spectroscopy, then the concept of the lessons (the salt section) was developed with the aim to present difficult things in a clear and accessible way. The last stage resulted in presenting the concept at school, during lessons with 2nd year pupils (of scientific class) of a secondary school. To collect the results there have been used different methods: diagnostic survey, questionnaire technique, an analysis of the documents, results of the students work and as a research tool: the questionnaire survey. In result, it has been acknowledged, the UV/VIS spectroscopy can be used at the lower levels of education. The spectroscopic methods make lessons more attractive and interesting and hence they are motivating pupils to harder work. Moreover, the usage of progressive, measurement methods bring forward the scientific and explorative character of chemistry and also make possible to illustrate the processes occurring at the level of the microworld.

Key words: chemistry education, secondary school

Probe into science research results according to the type of teaching literacy

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Introduction and initial situation. In the beginning it's briefly explained the concept of integrated teaching of science and design of its implementation in selected countries based on the study of their educational curricula in. Further clearly shows the current state of integrated science teaching in European countries. Following levels of education are taken into account: ISCED level 1 for primary education and ISCED level 2 for lower secondary education [1].

The methods and results of research. Comparative methods were used to find the influence of the type of science teaching on pupils' results in studies of scientific literacy projects through international PISA 2006 and TIMMS 2007 [2,3]. The results of pupils from different countries in these studies reflect differences in the approaches of both mentioned studies: PISA research project is focused on the general integrated pupils' skills and their ability to find and propose solutions to general problems of science; TIMMS project reflects especially knowledge and its application of various scientific disciplines (biology, chemistry, physics, geography). Reasons of different results of performance of students from different countries are explained on the basis of substantive and methodological analysis of the tasks used in the both mentioned studies. Czech Republic is used as a model state with separated teaching of sciences and its educational curriculum. Between the countries with integrated teaching of science, we have focused mainly on England, Spain, Norway and Canada whose education curriculum was available [4]. It was made a comparison of content and methodological problems of both surveys with the curricula of the Czech Republic and countries with integrated science teaching.

Conclusions and implications. On the basis of the findings we assessed the suitability of tasks analyzed for verification of scientific literacy in different countries depending on their content, type and rating. Further was derived probable impact of the teaching type on knowledge and skills and for their next research results in scientific literacy from this analysis.

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Keywords: integrated learning, separated instruction, science, PISA 2006, TIMMS 2007

Students' misconceptions about energy

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Every child brings to science lessons their own misconceptions which cause teaching problems. Determination of these misconceptions is important in terms of choosing correct teaching methods and tools as well as preparing effective teaching documents.

The concept of energy plays key role in science, technology and everyday life. Energy is an important idea in all branches of science. We used to talking about energy in ways that are not completely scientific.

Traditionally, energy is presented, in an abstract manner, as an ability to work. In science it is an abstract, mathematical idea. Students graduating generally cannot use energy to describe or explain basic everyday phenomena.

Energy misconceptions have been the subject of debate in academic literature over the last three decades. Watts (1983) presented a list of students' misconceptions about energy which was later substantiated by Gilbert and Pope (1986). The main purpose of this study is to document Slovak student's energy ideas and compare the findings with core alternative frameworks stated frequently in the literature.

The energy conceptions of the pupils were analyzed by interview about instance. The interview about instance technique consists of series of simple pictures that depict situations where the concept of energy may (or may not) be thought to be involved. The drawings contain clear cut examples and some "borderline cases" (unusual applications of the world from the physics point of view). We used pictures involving the energy concept.

Our participants came from four rural and three regional schools in Slovak republic. Pupils were interviewed in small groups and they were asked to discuss their answers. We analyzed students' alternative conceptual frameworks about energy. Children conceptions were classified according the official list of misconceptions.

We compared numbers and kind of students' misconceptions about energy in many countries f. e. Slovak republic, United Kingdom, Israel, Germany, New Zealand and Argentina.

According to Trumper, Raviolo and Shnersch (2000) misconceptions can also develop in situations where the scientific explanation of a phenomenon contradicts the initial or naive concepts students have constructed on the basis of their everyday experience.

Our research shows students have or develop many energy misconceptions based on their everyday experiences and intuitive ideas. Knowing more about preconceptions in school science could help teachers explain nature phenomena better. When teachers know what their students think they can implement instructional activities to challenge existing student ideas.

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Key words: energy, misconceptions, interview about instance, science education

Do you know about energy more? (Influence of education reform on understanding energy concept)

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In terms of legislative and policy framework, in 2007 the European Commission recommended (while assessing the implementation of the National Reform Programme 2006-2008) that Slovakia should prepare and pass a new School Act which should launch the reform of primary and secondary school system in 2007-2008. There was the adoption of the new school system. The emphasis of this Act is put on contents of education in a way to ensure basic skills and quality for all students and to resolve content changes in the field of upbringing and education in the regional school system. The basic element of the reform is the change which endures that upbringing and education at schools will be carried out by means of upbringing education programmes. (National reform programme of the Slovak republic for 2008 – 2010)

The Act defines the state and a school education programme. Each school will determine a section of their teaching material alongside the common curriculum for all schools. It establishes greater independence of the schools. The change constitutes the result of the transformation of the traditional to modern school model. The Act strengthens the teaching of foreign languages, information and communication technologies and related training; it also harmonizes the achieved levels of education at our school with the ISCED international classification. (National reform programme of the Slovak republic for 2008 – 2010)

We tried to evaluate school reform in the field of science education. At first we chose interdisciplinary concept, we used the concept of energy because it plays key role in science, technology and everyday life. It is an important idea in all branches of science. Energy plays a fundamental role in shaping human condition. Its transformation is useful in explaining and predicting natural phenomena. It is difficult to find any courses in science where energy does not play some part. (National reform programme of the Slovak republic for 2008 – 2010)

We focused on energy alternative conceptions, prepared comparison mentioned conceptions before and after school reform in 2008. The energy conceptions of the pupils were analysed by interview about instance. The interview about instance technique consists of series of simple pictures that depict situations where the concept of energy may (or may not) be thought to be involved. The drawings contain clear cut examples and some "borderline cases" (unusual applications of the world from the physics point of view). We used pictures involving the energy concept.

Our participants came from four rural and three regional schools in Slovak republic. Pupils were interviewed in small groups and they were asked to discuss their answers. We analysed students' alternative conceptual frameworks about energy. Children conceptions were classified according the official list of misconceptions. We compared conceptions before and after reform.

References:

National reform programme of the Slovak republic for 2008 - 2010

Key words: energy, misconceptions, interview about instance, science education

Implementing STEM-Teachiing in European countries: the Role of the stakeholders

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Background, framework and purpose. The EU-project ESTABLISH (European Science and Technology in Action Building Links with Industry, Schools and Home) funded through the 7th framework program wants to clear the role of the various stakeholders in implementing new ways of STEM teaching. Among these the companies (industry and SME), academic institutions on third level education, and school administration are seen to be involved as stakeholders. However, neither their influence nor their effectiveness had been researched so far. We present the results of our research, conducted in studies throughout Germany and several countries of Europe. They are linked to the governance concept of modern policy making.

Methods. Persons of companies, administration and science centres were asked ba a semi-structured interview to get information about recent innovations in the STEM field. The persons described important elements of this innovation and the way it was implemented.

The collaboration between schools and companies was researched in two projects, one is a long lasting cooperation of an important industrial company in Finland, the other is a regional network including schools, SME and a university for applied studies. This research is also conducted with interviews, but additionally with observations.

Results. Our results show a widespread awareness on STEM education and a broad willingness to foster new approaches towards a more IBSE orientated science teaching. The methods to implement IBSE are new curricula, teacher professional development courses in a new way of collaborative settings, new experimental workshops for teachers to implement this teaching to the classroom or building up networks for teacher professional development.

Conclusions and implications. The results of the interviews with administrative people show a regional difference from north to south, according to results from sociological studies based on OECD data (Windzio et al. 2006). However, a few new developments were found, based on recent political developments in southern European countries, some of them influenced by external advisors.

The collaboration between schools and companies vary in a large scale. Crucial points are the teachers´ workload and a lack of agreements on the objectives of the cooperation. A very simple relation could be found between the duration of the cooperation and the satisfaction o it on both sides.

This contribution was completed within the project ESTABLISH (7th EU Framework Program, FP7/2007-2013 based on the contract n° 244749).

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Key words: STEM-Education, IBSE, Policy Making, Stakeholders

Science and Heritage – Chemistry in the Bible

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Background. The Youth Activities' Center at Bar Ilan University has many projects whose aim is to bring science into the community. One of these projects is the SAS; Children Homes project which is sponsored by the Legacy Heritage Fund in the USA. This project is aimed at children who live in Children's Homes. These children do not lead the ‚normal' lives of other children as they live without their biological families, sometimes even from early childhood until they graduate from the homes (some to become soldiers or students). The children study in regular schools, and although they have normal learning capabilities, due to their circumstances they suffer from low self esteem and other sociological problems. This prevents them from fully exploiting their learning capabilities, as compared to other children of the same age.

We offer the children scientific workshops in the 5 following subject areas: Physics, Chemistry, Biology/Biotechnology, Nanotechnology and Robotics. Each child participates in two classes per year. All the topics are relevant to everyday life and will deal with basic, relevant. and contemporary science.

Heritage Component. According to the agreement with the fund, 25% of the classes have to deal with jewish or Israeli heritage We decided that this component will deal with the subject „Chemistry in the Bible". For this purpose we developed materials on the the following major two subjects:

1. The ancient dyes that the Jewish people used for coloring the phylacteries (Tzitzit), blue (Tchelet) and purple (Argaman). The children learn how the dyes were extracted from snails, and participate in the dyeing process.

2. Other major topic is the story and experiments that deal with manufacturing metals (especially copper) in old times.

Conclusions and Implications. It is well known that students in our era lack basic knowledge not only in science but also in history and tradition. Such a combination between science and tradition can be another way to attract students to both areas. This implication is actually valid not only to special children such as those who participate in the project but also to others in all ranges of age.

In ChemEd 2011, held in Kalamazoo MI last summer I presented the „Chemistry in the Bible" project to chemistry and science teachers, mostly American Christians. Some of them had drawn my attention that many American students, especially in the Midwest (in what is called; the Bible belt), are quite familiar with the Bible (The old testimony), as their families are religious or traditional. They had mentioned that in their opinion dealing with chemistry (science) in the bible is a nice and useful way to attract students from such families to chemistry.

From our results we know for sure that the children exposed to these demo-lectures had learnt many things that they did not know before scientifically. Also the children expressed their satisfaction from these special lessons.

Key words: Science, Society, Bible, Old dyes and dyeing, Copper production

Science and Society – Parents and Children Doing Science Together

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Background. The Youth Activities' Center Unit at Bar-Ilan University has many projects whose aim is to bring science into the community. On November 2011 we started a unique new science hands-on workshop for children and their parents (or grandparents). 13 children, ages 6-10, are participating in this program and each of them is escorted by an adult (parent or grandparent).

The full scientific workshop consists of 8 meetings, 90 minutes each. Each meeting deals with one or two scientific subjects, mainly Chemistry and Physics. The subjects chosen for the course deal with basic science topics that mostly relate to everyday life. Some such topics are:

1. Water
2. Fire
3. Air
4. Gases
5. Science in the kitchen
6. Electricity and magnetism
7. Smart materials
8. Light and colors

During the 1.5 hours of each meeting, the participants are able to perform about 7 experiments that are pre-explained and sometime demonstrated by the instructors. Questions and explanations follow each experiment and conclusions are drawn.

Conclusions and Implications. To date 6 out of the 8 meetings have already taken place, and the participants, both children and adults, enjoyed the meetings thoroughly. The feedback has been very positive and news about this course has already spread within the university and in its neighborhood. Thus, we have received many requests to open more such courses, which we may actually do.

There are many advantages to adults and children regarding the concept of conducting such workshops:

1. Practically each child has his own "private" instructor
2. No discipline problems
3. Less worry about safety
4. A greater variety of experiments can be offered to the children

Key words: Hands-on science; Children and parents; Informal science education; Enrichment; Science through experience; Science in our everyday life.

Fuel Cells as Alternative Energy Sources: Preparation of Protonconducting Membranes Based on Poly (vinyl alcohol)

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Fuel cells have recently occupied an important position as next generation type clean energy sources. Hydrogen and direct methanol fuel cells are recognized among several kinds of fuel cells to utilize proton-conducting membranes. Thus high price and toxic production process of fluorinated protonconducting polymers prohibits commercialization of fuel cells (FCs). As a solution, development of novel nonfluorinated polymer electrolyte membranes (PEMs) based on polysulfone [1] andpolybenzimidazole [2] are taken into consideration. As an alternative route to mentioned above polymers, synthesis of protonconducting polymers (PCPs) that are based on common plastics seems to be more plausible for industrial applications.

Performed experiments were mainly oriented on obtaining novel protonconducting non-fluorinated polymers that are based on poly (vinyl alcohol) and its copolymers with ethylene (**PEVA**). Polymers for membranes production (Figure 1) were obtained by a two-step crosslinking of PEVA based polymer combining introduction of protonconducting binder (sulfosuccinic acid-**SSA**) and another non protiated crossliker (glutar aldehyde-**GA**) [3].

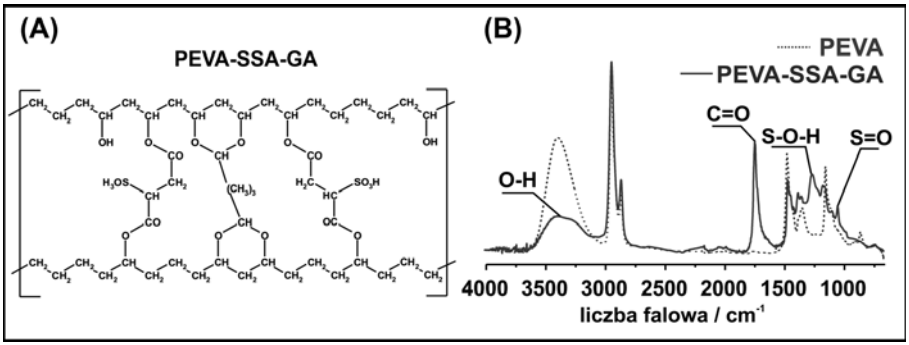

Figure 1. (A) Schematic structure of PEVA-SSA-GA polymer. (B) ATR-FTIR spectra of PEVA (·····) and PEVA-SSA-GA (——) polymers; bands assignment: 3350 cm^{-1}–O-H 1735 cm^{-1}–C=O, 1044 i 1250cm^{-1}–SO_3H.

In order to effectively reduce amount of free radicals causing polymer degradation membranes were stabilized with transition metal cations (Mn^{2+}, Ce^{2+}). The exact characteristics of the obtained polymer required the use of a wide range of research techniques such as FTIR, TGA-QMS, EA analysis, SEM as well as measuring the ion exchange capacity and electric conductivity.

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Towards Computer Supported Model Based Learning in Chemistry – The Example of Acid-base Titration Simulators

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The Chemistry instruction is firmly relates to using models in general. The learning models are the didactic means providing and mediating information, increasing the clearness of the explanations and are expected to enable students to understand the topic. The increasing importance of ICT-supported instruction is adding another high-potential category to the traditional ones, i.e. computer models of visualizations, animations and simulations.

The Model Based Learning is understood to be a constructive process focusing on learner's activities and forming the mental model of the studied phenomena. Since 1990s, when the increase in creating learning dynamic computer models started because of wide development of Java and Flash programming languages, the Model Based Learning has become one of key fields of pedagogic research in the Science education (Le Maréchal, Bécu-Robinault, 2006). Researches deal with several fields, e.g. characterizing the learning objects and their role in the process of instruction, analyzing and evaluating the quality of learning simulations and defining their influence on the learning process running in the form of pedagogical experiments.

Our research activities aim at analyzing and evaluating the open-access simulations on the Internet relating to the acid-based titrations. The research sample includes 35 online acid-base titration simulations. First, the learning simulations underwent the didactic analysis (Machková, Bílek, 2011); second, the expert evaluation was applied on selected simulations. The results proved the open-access learning acid-based simulations reached different qualitative level, follow different educational objectives and were prepared for learners of different educational levels, for various forms, phases and methods of education. These are the reasons why learning applications should by analyzed and evaluated from the point of learner's cognitive level and learning objectives before applied in the process of instruction.

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Keywords: Acid-base Titration, Instructional Simulation, Model Based Learning, Didactics Analysis, Expert Evaluation

Plans Of The Tough In Design Of Didactic´S Units In The Physic Teaching Learning Process[1]

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*1. Esta comunicación se inscribe dentro de las directrices teóricas y metodológicas de los proyectos **FONDECYT 1110598 y AKA-04** que dirige el Dr. Mario Quintanilla, académico e investigador de la Pontificia Universidad Católica de Chile.*
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Reflection on teaching, learning, assessment or other questions themselves and closely linked with the performance of the teacher, have a value, unquestioned, from there the importance of reflective teaching design workshops, from which we could identify, describe and analyze the movement of two physic secondary´s teachers, between tough plans: Operative Instrumental (IO), significant personal (PS) and Social Relationship (RS). The analysis presented in this paper corresponds to those made from the personal reflections made by teachers, for a total of 5 sessions; we share the analysis of physics teachers (2) participants of the TRD, the content analysis were made for Atlas ti software (6.0). Some of our findings we can say that the movement of development plans were progressive and complexity it was the transition during the development of meetings, initially from a strong tendency from the plane (IO) to the planes (PS) and (RS).

Key words: teacher reflection, scientific thinking skills, tough plans.

Analysis of the results of the compensatory courses in physics and mathematics realised in the affiliate Branch of the Warsaw University of Technology

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In the affiliate Branch of the Warsaw University of Technology since 2008/2009 there has been realised a task: „Preparation und realisation of the compensatory classes in physics and mathematics, development and implementation of compensatory programmes for first-year students ". The Programme was co-financed by the European Social Funds. It aimed at compensation of the achievement levels and bridging a gap between what the students learn at secondary schools and what they should know at the University of Technology. The target group, who was direct beneficiaries, included 210 university students in seven classes of physics courses and 270 students in nine classes of maths courses.

In the article there have been introduced the statistical analysis of test results. The authors present the essence of compensatory programmes used for assistance to education process and to a process of developing the skills the students need to continue courses. They present a lot of illustrations the searched material and undertakes an attempt to formulate the conclusions referring to contracted courses. The authors concentrate on the mutual connections between the results of the final tests and the results of the exams in mathematics. Also there have been analysed the changes of average grades gained at the tests over the last years. The conclusions explicitly confirm the rightness of the realised task and at the same time emphasize the constant lowering of mathematics and physics skills of secondary school pupils.

Key words: International programmes and projects in science education

Critical Analysis of Scientific Web Sites

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Background and objective. In this research, we present the results of a critical analysis of scientific web sites that aims to introduce pupils from 10 to 14 years old to science through experiences.

Description of the population and methodology. This analysis has been carried with sixty students enrolled in a teacher education program who filled a questionnaire we built up for that purpose. The questionnaire contains twelve statements and for each statement, the student's teacher must put a cross next to his choice, followed by a brief commentary. To this end, he must answers each statement by: "ALWAYS", "OFTEN, "RARELY or "EVER." The various statements can be classified around six themes.

Results. The results show that, according to the students' teachers, the majority of these sites do not provide enough guidance to introduce effectively the primary school pupils to the basic skills of scientific investigation. As such, no mechanism (such as for example, simulation) in these sites allows the user to interact with the scientific content of the site. For example, the majority of the sites analyzed in this study directs the observation of the scientific phenomena by closed questions and don't allow to the pupil the liberty to explore their properties, to plan or execute the experience, nor do they allow the pupil to interpret his results.

Conclusions and implications. Based on the shortcomings of these sites, we propose guidelines to design web sites that could foster learning of physical concepts. To this end, we propose the development of an interactive site including different modules centered on epistemological questions, and offering guidance to the pupil to help him in the experimentation process, including simulation of historical experiments with software as well as historical and social considerations.

Key words: Critical analysis, educational web sites, scientific investigation, instructional design, interactivity, electrostatic.

The movement according to Aristotle (384-322 AV. J.-C.), Buridan (1229-1363) and the student's teachers

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Background and objective. The majority of the research in didactics recognizes the merit to take into account the naïve conceptions of the pupils and students (from the elementary to the university). However, their analyses don't take in consideration adequately the history of the sciences since several of these conceptions look surprisingly like those constructed by scientists of previous times. The present research tries to acknowledge the significance of history of science in the diagnosis of naïve conceptions and, to this end, follow a two steps presentation. Firstly, we present the essential of the physics of the motion developed by Aristotle and by Buridan. Secondly, we will compare the conceptions of the students ,teachers with those developed by these two scientists.

Description of the population and methodology. One hundred and ten (110) students participated in this research. These students are registered in the third year of a four years baccalaureate program in primary education. These students came from the sector of human science and during their secondary school they studied, as part of general physics course, some notions linked up with motion, such as Newtonian' laws. To identify their conceptions, we proceeded with a paper-pencil questionnaire. The questionnaire included nine statements (9) which can be answered as right or wrong. A space after each question is provided in order that the student's teacher can justify his choice.

Results. The results reveal that the students' teachers conceptions about the concepts of force and motion are like those constructed by Aristotle and by Buridan. For example, the following statement "it is true that a ball that one releases at the top of the mast of a boat traveling at constant speed will fall at the rear of the foot of the mast, because of the speed of the boat" rings true for the majority of students' teachers. However, this conception, which is false, is similar to the one advanced in the framework of the physics of motion developed by Aristotle.

Conclusions and implications. The development of teaching strategies that take into account the scientific conceptions developed during history and compare it with those of the students will undoubtedly facilitate the acquisition of the concepts of the motion.

Key words: motion, conceptions, student's teachers, Aristotle, Buridan, history of science.

Effect of chemical knowledge on the correctness of information retrieval on the Internet base on the example of atomic structure.

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Nowadays, the Internet has become the main source of information. The students look up for information in the Web but do not check the credibility of the information found. Unfortunately, the Internet sources are either correct or false. Students have some difficulties to find up correct model of atom, because almost 84% models of atoms are with some errors. Many models of atoms are false or incomplete. It is crucial to teach not historical but the latest chemistry theories which favour the learning process. Yet there are still outdated, 80 year-old theories both in the Internet and books. The reserach was carried out among pupils in the first class of the secondary schools. Pupils were taught the base on diferent school curricula and they used different textbooks.

The paper reveals the results of the research whether students are able to select information about models of atoms base on knowledge acquired at the school.

Key words: chemistry education, secondary school

Influence Of Certain Variables In Urban Noise Produced By Vehicular Traffic.

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Traffic noise depends on a great number of variables, some associated with the road characteristics and the surrounding environment, others associated with the vehicles that use the road. Considering all the variables which can influence traffic noise, only a few are studied in depth to see their real relation to acoustic pollution. The Equivalent Continuous Sound Level, (Leq), is the most used index and the measure unit is the decibelius

The main variables are as follows: traffic (speed circulation, traffic composition and traffic intensity), road geometry: slope, number of lanes, buildings (height, façade material and form, crystal surface), intersections (presence of traffic lights or roundabouts). This research considers all the variables presents in a big city which could have any influence on acoustic pollution, for example the noise level in Madrid City. The datum has been achieved through fieldwork measuring 519 points at random.

We first applied a chi square test to see which of the variables are involved on noise pollution and which are not. We then applied correspondence analyses to those variables which are shown to influence noise levels to see how they are associated to Leq levels. Finally we applied discriminant analysis to the data, dividing streets into two groups according to Leq levels.

These analyses allow us to create a model in which we may predict into which group a street may be assigned to depending on identified key variables. Using the key variables studied our results show that our model for the separation of streets into two groups, one for values ≤ 70 dBs and the other for values >70 dBs, works to an accuracy of 76.2%.

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Key words: Leq, noise, vehicles, variables, model

Visualization in chemistry and chemistry teaching

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Nowadays, numerous models that show the structure of atoms, particles or crystals of chemical compounds are used. Some of these models are "material" – pupils can touch them, while other are just pictures in textbooks or on the computer screen. These models, however, are very often inaccurate, contradictory to one another, and they lead to many misconceptions among pupils. During their chemical instruction at all levels, pupils come across different models of the micro-world structure. It sometimes happens that even within one textbook different types of pictures are used, which leads to a negative transfer.

Due to this fact, in 2004 in a coherent concept of computer animated models that allow to present the micro-world was suggested by the Department of Chemistry of Pedagogical University of Cracow.

The models, created in accordance with this concept, are simple enough to be used at the first stages of education but also detailed enough to be used at more advanced stages of chemical instruction.

The main assumptions of the computer animated models include:
– they show spatial structure on the micro-world level,
– they show movements of chemical individuals in solids, liquids, and gases,
– in these models, proportions between individual atoms in particles as well as between ions are maintained,
– chemical individuals do not have clear-cut boundary, and the computer models show the structure of electron cloud in a blurred way, without boundaries,
– they take into account the theory of Brownian motion,
– they show that atoms, ions, and particles are colourless,
– they make it possible to repeat the reaction with pointing to its particular stages,
– they make allowances for simplifications which are due to the pupils' level of knowledge.

Research. Since 2004, the research whose aim is to check the influence of animation on the above-mentioned models on the pupils' comprehension of chemical reactions has been carried out. The research is conducted on different levels of education. Computer animated models are also used to correct assumptions concerning the structure of matter among chemistry teacher-trainees. It takes place when they are asked to create computer animated models, which is one of the requirements to pass the subject "didactics of chemistry." The aim of such a task is to help students imagine the process of a chemical reaction – the shape of particles, the proportion of their size etc. As such it is the final verification of the previously acquired knowledge and an attempt to a holistic perception of quantum chemistry, crystallography, and chemical kinetics.

Conclusions and implication. Summing up, it may be said that creating dynamic computer models of chemical processes in the training of future teachers meet the very important role. On the one hand, computer modelling increases skills in the use of various computer programs. On the other hand allows you to practice the ability to create educational programs. However, the most important thing is that it helps to review images of the micro-world, so that they are close to current views on the structure of matter, it is a factor in shaping and correcting misconceptions about the structure of the world micro-world. Modeling can even be used for testing of skills, because students, thought they have correct theoretical knowledge of the micro structure of the world – they do not have the ability to transfer their images to the computer animation.

An Intervention Project to improve Teaching and Learning of Organic Chemistry in Irish schools.

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Background. Many researchers have identified Organic Chemistry as an area of conceptual difficulty. There is much anecdotal evidence that learners resort to rote-learning and memorisation rather than developing a true understanding of Organic Chemistry. The main areas of difficulty at Second and Third-Level Organic Chemistry in Ireland were identified in the early stages of this research project (O' Dwyer and Childs 2011, O' Dwyer et al. 2011). It was found that many of the same topics are perceived as difficult by learners at both Second-Level and Third-Level. These findings were supported by previous Irish studies (Childs and Sheehan 2009).

Methods. The intervention programme, called *Organic Chemistry in Action!,* was developed using these findings and those from Chemistry Education Research. It is a research-based resource designed to facilitate the teaching and learning of Second Level and Introductory Third Level Organic Chemistry. The intervention materials were designed with specific reference to the current Irish Second-Level syllabus (DES 1999). The materials can be used with introductory Third-Level Organic Chemistry.

The teaching materials were developed using specific design criteria: spiralling of topic development, linking outcomes & assessment, facilitation of cognitive development, inquiry learning, visual aids, integration of contextual applications, integration of practical work and early identification of misconceptions. A variety of teaching approaches were employed throughout the intervention programme.

Results. The materials were trialled in six Second-Level schools with 85 pupils. Teacher questionnaires, diaries and interviews were used for evaluation as well as classroom observations. The attitude and understanding of Organic Chemistry of the participating pupils were compared with a control group of pupils (8 schools, 108 pupils) who were taught using the traditional teaching approach. These results will be discussed in the conference presentation.

Conclusions and Implications. Feedback from the participating teachers and pupils suggests that, while this intervention programme was enjoyable and facilitated the pupils' understanding, the time constraints due to syllabus and examination demands did not allow for the optimum level of inquiry-based learning and investigatory activities. Essentially, how Second-Level Chemistry is assessed and examined will determine how it is taught. Until the assessment becomes less predictable and truly assesses understanding, it will be difficult to change how it is being taught.

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Key words: Action Research, Organic Chemistry, Second-Level.

Teaching of Natural Sciences and Mathematics with the use of literature and poetry examples: an interdisciplinary view

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There are several ways how literature can be used to teach science (Granados, 2006, Orlik, 2002). Literature can enhance the learning of science by providing students with more appealing materials which will motivate them to pursue their interests and explore real-life issues. Appealing materials increase student interests in science and stimulate higher-order thinking while increasing the levels at which students read, write, talk, and learn independently. Finally, this experience will be disseminate from UNILA (Universidade Federal da Integração Latino-Americana) to Foz do Iguaçu (Brazil) secundary public school system.

Examples of literature integrated into science, from different levels of difficulty, are given in the form of poetry, songs, and short fictions. Literature presents the human side of science and provides opportunities for students to experience issues which frequently confront scientists in real life. The case has the special significnce too for the public University (UNILA) and in the context of a triple Latin American frontier (Brazil, Argentina and Paraguay).

The view and principal methods of teachers of this project is the modern approach, when students are active creators of their own knowledge. According to this approach we elaborate a hard collection of pieces of poetry, songs and short fiction from different Spanish and Portuguese contemporary authors. We had many sciences internal events (Biology, Mathematics, Chemistry, etc.) at the UNILA where the students showed how well sciences match with literature, the main objective of this research. Also, a group of the UNILA students bring this experience to Science Festivals of the some public High Schools from the area, and everyone, students and teachers, enjoyed this experience.

To put together sciences and literature is particularly a rich experience for the students and they did not have access to this kind of experience before. It is a very good opportunity for them and for the secondary students to enjoy sciences, to reflex deeply about literature and to understand much better their particular cultural and social context.

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Key words: literature, poetry, science teaching, learning

Journal of Science Education, JSE - a magazine for science teachers and researchers

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This international and bilingual journal publishes articles developed by experts from around the world in topics related on improving education in Science (Physics, Mathematics, Biology, Chemistry) in school and university.

Our authors are from more than 60 countries and the members of the Committee a from 24 countries. Thare are among them such experts as: Alex Johnstone, UK, Antonio Cachapuz, Portugal, Liberato Cardellini, Italy, Hana Ctrnactova, Czech Republic, Alan Goodwin, UK, Agustina Echeverri, Brasil, Carlos Furió, Spain, Ryszard M. Janiuk, Poland, Jenaro Guisasola, Spain, Ram Lamba, Puerto Rico, Mansoor Niaz, Venezuela, Tina Overton, UK, Christofer Randler, Germany, Charly Ryan, UK, Aarne Toldsepp, Estonia, Charles Hollenbeck, USA, Jace Hargis, UAE and many others.

The JSE is bilingual and published two times in the year , the first number was published in January 2000. There was the International Congress of Science Education (Cartagena, Colombia, July 2009) about the theme of 10 years of JSE with 800 participants from different countries (Proceedings, 2009).

This peer reviewed journal is indexed and abstracted in the international databases: SCOPUS, QUALIS, Brasil (qualis.capes.gov.br/webqualis), Chemical Abstracts (CA), ERIC, Educational Research Abstracts (UK), Contents Pages en Education, UK; Latindex, etc.

The main themes of the JSE are:

- Modern active methods and innovations of the teaching of the sciences;
- Design of the modern curriculum;
- Eucational evaluation;
- Laboratories and experiments in teaching;
- Educational technology;
- Educational policy in the teaching of the sciences;
- Book reviews.

The journal publishes and distributes the educational software too. All articles and texts available on the Web site at: http://www.accefyn.org.co/rec/

Proceedings of the INTERNATIONAL CONGRESS OF SCIENCE EDUCATION. 10 years of the Journal of Science Education (**Cartagena, Colombia, July 2009)**, *Journal of Science Education,* Special issue, vol. 10, , 2009, ISBN 978-958-99070-0-9

Key words: science , instraction , magazines, JSE

Some critical points of the minimal guidance approach in science education

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This study summarizes our experience with in-service teachers courses focused on implementation of inquiry-based science education. The IBSE course had a positive impact on the in-service teachers' motivation to teach science ideas following a research design.

This article reports on the IBSE program and offers some recommendations. The application of minimal guidance approach in science education (IBSE) is connected with some crucial problem. One of them is the questioning and the other is the concluding.

Questioning is a natural human interaction and also is the key operation for the initiation of research activity. Even the questioning has a key role in coordination of facts (data) and theories. What data lead to my theory and what data don´t support my theory? The questioning leads to concluding.

The discrete inquiries without the rigorous verbal concluding are not effective. Verbal concluding is the material that could be repeated with purpose to build long-term memory prepositions as a result of effective learning.

We describe results of our classroom observations and content analyses of teachers' propositions. We have classified the teachers' strategies in questioning and concluding with regard to cognitive theories (meaningful learning).

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Key words: science education, IBSE, teachers, in-service training

Deterioration of the Level of Education: Retribution for the Scientifico-Technical Progress

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When stating that a human factor is to be blamed for the recent frequent catastrophes and accidents, what is usually meant is an insufficiently prepared specialist or a professional with a deficient level of education.

Education is considered to be the widest sphere of human activity in the modern society. Consequently, education, especially high education, can be viewed as an important factor of the social and economic progress. It is worth remembering that information and theoretical knowledge represent strategic resources of the country, and together with the level of educational development, they determine country's sovereignty and national security in many respects.

Much has been said and written about the necessity to increase the level of education. It is widely recognized that the level of education characterizes the ability of an individual to perform a certain task and, generally, be engaged in any kind of activity. One can often hear about the worldwide crisis of education today. According to our point of view, the experience of the countries and communities, which reached the highest level of education at a certain period of time, is very useful for analyzing and understanding this problem. Ancient Greece serves the classic example of the high level of education, since Ancient Greek Schooling produced a multitude of philosophers, statesmen, public figures, military leaders. Current generations still learn from their creative results and achievements. The Ancient Greeks made the foundations of the modern pedagogy, which are currently effective.

In the modern world, full of scientific and technological advances, machines and technology took the whole burden of production and the necessity of physical preparation decreased giving way to mental preparation. Undoubtedly, one should have been looking forward to exponential burst of intellectual advances of the human beings, similar to those, which took place in the last third of the XIX – beginning of the XX centuries. One should point at the negative role of technology, which decreased the requirements for human mental preparation, since technology assumed a role, which was primarily intended for the individual. The weakening of the intellectual activity leads to mental backwardness and gradual degradation of the individuality. After all, why should we learn how to think if the computer can choose an optimal variant and solve the problem?

The ideas of Adam Smith, concerning the division of complicated tasks to simpler ones, division of labor to less complicated activity, which can be entrusted to less qualified specialist, thus compromising on expenses, took a negative stance in the scientific activity and education [1]. For example, why should anyone learn how to titrate, weigh, extract in chemistry, if it is possible to take a sample of the material and make an input into the computer chromatograph (spectrometer etc.)? The device will provide the necessary result! Why should a teacher show a student real chemical experiment, if it is possible to show a multimedia video clip? It is enough for a person to have several simple skills instead of education and the reagents can be saved. However, there is no "sense" of substance, respect for a substance, there are no skills in handling the reagents and materials, and, finally, there are no skills of how to conduct a safe work at the laboratory or production site.

That is why such an abundant enthusiasms with technology does not promote the increase of knowledge and leads to the situations when even a not enough qualified employee can do

a certain type of work with the help of prompters, advisors and assistants (including computer and internet). Hence follows a logical conclusion of the student: why would anyone need a high quality education and why would anyone apply serious efforts to get it?

In this case, it is worth remembering the classical statement of B.F. Skinner "Education is something that will stay in your memory, when you forget everything you'd been taught." But, on the other hand, why does a student need memory, if there is a computer memory, Internet, mobile phone in order to get through with someone and obtain a ready answer? Why does a student need to study, strain his brains, read, think, analyze, compare? There are always other, more attractive ways to spend one's time.

The weakening of student's motivation to obtain deep, serious and high quality education takes place here. Some pedagogical methods also push to that kind of conclusion, presenting the process of knowledge obtaining as some sort of a game. But if someone is tired with a toy, it is simply thrown out… and forgotten! But the opinion about education, as something not very much serious and necessary always stays. And then, it is very difficult to instill interest to the process of knowledge obtaining, as a very important, heavy and necessary work, which requires serious attention, concentration, considerable mental efforts etc. And, the famous saying, "easy come, easy go" is very appropriate here.

In our view, the process of knowledge obtaining must be difficult and strenuous.

There follows logical conclusion of the problem: why are teacher's efforts needed? Why should the teacher be bothered to spend the time to get through to the student, if the latter can access ready information in the Internet? Therefore, in our view, such new types of educational technologies as interactive, heuristic etc. will be of little help. Another approach is needed to provide the suitable level of education.

It is necessary to take into account other circumstances, which are not given due attention, namely: what will happen, if this fast and free access to information, knowledge is denied? What if someone blocks information sites and violates normal work of software either with the help of viruses or some other method, provides intentional misinformation to prevent the normal functioning of separate important individuals, organizations, maybe even countries?

To our mind, this all resulted in a certain crisis in the system of education. It might have even been done intentionally: the systems of education are in constant competition, informational space is full of such ideas as "be special", i.e. be different from anybody else although by means of a hole in the ear or pierced nose. And no one recommends, "be bright, knowledgeable and qualified" …

The question is, whether we will solve this crisis of education within the framework of existent technologies or by means of new ideas necessary for the organization of the educational process and post-educational systems of activity. To answer this question, the system of values in education, tasks, aims methods and perspectives should be revised.

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Key words: level of education, educational technologies, crisis of education, education in Ancient Greece, perfection of education.

The assessment of competences regarding human activities in the environment by geography student-candidates for teaching posts

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In the process of training of future teachers, including geography teachers, competences acquired mainly during geography studies and vocational training at school play the vital role.

The aim of the performed research was the self-assessment of the acquired subject and teaching competences by geography teachers and BA and MA students of geography.

Research of competences was conducted by means of the diagnostic poll method, (the survey method). The applied research tools were four questionnaires, containing mostly closed questions. The survey was conducted among 96 geography teachers and 136 geography students from three different faculties of studies at Pedagogical University of Cracow took part in the survey.

Aspects of environment protection and development including sustainable development constitute very important elements of training of future geographers and geography teachers. Competences regarding human activities in the environment consist of five detailed competences. The results obtained vary but very good and good marks constitute the vast majority.

Despite the fact the issues of sustainable development are discussed during the course of studies and also by the mass media, still the percentage of competences in this subject that are not acquired seems to be high. Probably the subject is not defined precisely and thus the notion of sustainable development is not understood and variously interpreted.

The degree of acquisition of competences concerning human activities in the environment among students varies. Geography students – candidates for teachers received poorer marks for the following competences:

– planning initiatives which would limit ecological risks, as much as 40% of respondents received satisfactory marks and only 20% very good marks,
– forecasting the natural environment conditions for individual areas (satisfactory marks - almost 39%, pass marks - 10%, very good marks – only 15%) (Osuch 2010).

Marks received for the important competence of understanding the sustainable development were as follows: very good marks – 33%, good marks - 30%, satisfactory marks - 28%.

The author of this article obtained detailed results in his research which show that competences regarding abilities to describe the relationship between humans and the natural environment were acquired during theoretical classes at university, vocational training at school and field training.

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Key words: geographers' competences, sustainable development

The sustainable development in Polish school – results of questionnaire research

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In the Polish educational system the contents concerning widely understood ecological education are present at every stage of education. In younger classes of a primary school the subject being involved in environmental protection is "environment". From 4th to 6th classes of a primary school a leading subject in integration of ecological and environmental contents is "nature". In gymnasium (lower secondary school) ecological contents is included especially in the school curriculum of particular subjects, namely biology, geography, physics and chemistry.

This article presents examples of ecological education at Polish schools. Ecological education and education for sustainable development at the beginning of 21st century plays an important role in an education of young generation

The investigation conducted in Świętokrzyskie voivodship showed that the largest activity of actions mentioned above takes place in primary schools while the smallest one in an upper secondary schools (the involvement decreases on subsequent stages of education).

According to Żeber-Dzikowska and Buchcic (2008) pupils only in an early phase show a large interest, or even some enthusiasm, which later is significantly decreasing and the commitment is lower as they work in other activity clubs, they involve in other projects as well as information, language, sports interest clubs and subject competition.

The involvement of pupils' parents in a primary school for a local environment is also very large (50%), a lower secondary (35%), an upper secondary (20%). However, the involvement of pupils' parents for a local environment in subsequent stages of education of their children also decreases (Żeber-Dzikowska, Buchcic 2008).

A large amount of subjects of school teaching in widely understood ecological education and great masses of young people nowadays are a large chance for a success in action ensuring their effectiveness.

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Key words: education for sustainable development, questionnaire research

The individual attitude in methods of teaching mathematics and physics at school. Special ways of teaching very good students and students with educational problems

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In my paper I describe my investigations concerning the methodology of individual approach to students taught. I concentrate on teaching mathematics and physics, subjects closely related to my studies. Beside the methods of teaching average students I am also interested in methods relevant to working with very good students as well as with those having difficulties in the subjects taught. The students I had the opportunity to teach were most often under nineteen.

I am writing about the special methods of teaching, e.g. those proposed in the papers of professor Roald Hoffmann1, 2, Cornell Univ. (the Nobel Prize Winner in Chemistry in 1981) and discussed in the interview he gave me. I compare his methods with methods I observed in Poland during my education and the methods which I encountered in The Netherlands during my Erasmus Exchange Program. I also made some extra research asking students about the methods they like most and these they do not prefer. I address the whole background of teaching trying to get as wide view on that topic as possible.

Methods I use are: observations of teaching methods and making comparison of results these methods bring, analyzing the experience of advanced teachers, making the interview with students of different educational levels and skills, describing the influence of the whole living background on the educational process. I collect all my results and applications in my paper.

Key words: teaching, attitude, methods, background

Education of chemistry and chemistry teaching.

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In recent years in Poland many people try to change teaching programs for students as well as for teachers. It is worth to reflect what is the goal of these activities. Once can have the impression that society is under the influence of propaganda. In my opinion intimidated teachers are afraid of teaching well. We are observing that teachers stop teaching but are only "machines" who gives selected facts.

Nowadays we are witnessing the widespread criticism of the level of knowledge of graduates completing the secondary school. Educators maintain that they can do nothing with this fact. The government puts the teaching process to people who are interested in making profits from education. In a consequence new ideas introduced to schools charged to parents and in the same time allow selected enterprises to get profits. This picture is scary, but still not completed. Therefore, we should consider changes in the education. Is the teaching of chemistry, in addition to useful knowledge, has the influence on the intellectual development of young people? Can chemistry be easy and interesting without circus tricks in the classroom? I will try to answer in the article on these questions as well as many others.

The humanitarian treatment of animals in the II-IV grades of education

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Police statistics show that the number of cases involving the abuse of animals rises by the year (PS). This emphasizes the fact that human's attitude towards animals should be defined not only in law (Białocerkiewicz 2005) but also formed through education and teaching moral postures in relation to rights of livestock (Smaga 2010) as well as house pets. "Teaching basic respect for nature" is stated as one of the goals of natural science teaching on the second level of education, and is expended on the third level, but it is not until high school program that the "knowledge of animal rights and a judgment of one's attitude towards living organisms" is considered a part of the extended biological education. The analysis of school programs and the program guidelines prepared at the Ministry of Education (Dz.U. 2009.4.17), shows how little time is allowed for teaching about animal rights and their humanitarian treatment. Education of humanitarian treatment of animals is supposed to make legislation correspond with the true state of things, showing the students that an animal is indeed not an object but a living creature, capable of experiencing suffering and pain (Białocerkiewicz 2005; Smaga 2010; Dz.U. 1997.111.724). The ethical aspects of treating animals are included in the program draft submitted by the Institute of Public Affairs, as a part of the course of Ethics studies, on third and fourth levels of education (Bartnik et al 2005). However it is crucial to remember that Ethics is an optional subject, brought into the school program by the Minister of Education Decree of April 14, 1992 (Dz. U. 1992.36.155), and as such, directed only at a small group of students. Student's knowledge of humanitarian treatment of animals, depends not only on school program in the course of subjects, but also on the commitment of teachers to preparing school classes. To help in this process, various educational societies have published materials and lesson scenarios (LSARD; EIS; ERP; PCEHE; CC programs). Teachers and students can also attend workshops and courses provided by education societies (EPRF; EPP programs). Nevertheless, there are limited theoretical resources to help in preparation of such classes (Bleja-Sosna and Składanowska 2001; Kleszcz 2010; Świderek and Wychowałek 2007), and lessons like these are seldom organized (Szczepko, personal communication).

In our opinion, the education considering humanitarian treatment of animals and respecting their rights should be brought about on the first level of education and broaden on the upper levels. During the course of studies, students should have the chance to become acquainted with the legislation, enabling them to understand the legal consequences of abusing animals, abandoning and keeping them in bad conditions together with the legal status of animals, the situation in animal shelters and the problem of animal adoption (Gabriel-Węglowski 2008), all this put in a simple way, adjusted to each of the levels of education. In this paper we propose examples of topics and issues which can be tackled in the course of studies, along with a commentary considering each level of education.

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Manufacturing of Paper - An Industrial Production of Everyday Life Aid

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Paper is everywhere around us. Tissues, books, banknotes, toilet paper – paper accompanies us every day. Inspired by bees, Chinese people invented the manufacture of paper more than 2000 years ago. The main raw material for paper production is cellulose, which is obtained from the wood both of deciduous and coniferous trees. Scrap paper is also used for environmental and economic reasons. Pure cellulose is produced in three ways: the sodium hydroxide, the sulphite and the sulphate methods. Manufacturing of paper was originally manual; at present the work machines are used. The module "Paper" is one part of the educational package, which is focused on the industrial chemical technologies. The main aim of modules is supporting student's technical thinking.

Each educational module is composed of texts for students and teachers, multimedia PowerPoint presentations, posters and proposals of appropriate chemistry school experiments.

The poster, which was created based on the animated educational presentation, shows all the three methods of the cellulose production, paper manufacture and its final design. There are involved also photos of papers types, with their chemical treatment, and physical and chemical experiments with a paper. All the information was adapted for secondary school students.

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Key words: Cellulose, paper production, experiments

International actions on chemical threats reduction

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Chemistry played an important role in the rapid civilization development around the world in 20th century. This tendency still remains. Unfortunately, progress of civilization has caused unfavourable changes in natural environment. An analysis of possibilities of actions aiming at chemical threats reduction has been made in the paper. These steps are multidirectional and correspond with guidelines of sustainable development. One of them is to implement new technologies known as: sustainable, clean or green ones [1]. Other directions involve international actions, which aims in the reduction of chemical threats, influencing natural environment. The following initiatives have been described in the paper: *International Program on Chemical Safety, Responsible Care Program, Green Chemistry* [2,3] and *REACH System*. Chemical and ecological education play significant directions in the above activities. An analysis of survey results on a green chemistry knowledge among students has been made in the paper.

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Key words: green chemistry, environmental protection, didactics of chemistry, ecological education

Electrical properties of molecules in the teaching of chemistry

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A survey of the most significant information concerning electrical properties of molecules together with a comment of their use in the chemical education was performed in the paper. One of the basic notions is a dipole moment. Much didactic values result from some facts, which will be described in the paper. Moreover, the possibilities of subjects realisation concerning properties of electrical molecules on various educational levels were analysed. The present paper is a continuation of previous paper [1].

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Key words: chemistry, didactics of chemistry.

Research in Chemistry Education in Brazil: An Overview

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The production and dissemination of scientific knowledge on chemistry education has received a great deal of attention from researchers both national and internationally (Bucat, 2005). In this study, 152 master dissertations and two doctoral theses on this topic defended in Graduate Programs in Science and Mathematics Education in Brazil (CAPES - area 46), between 2000 and 2008, were analyzed. The documents were investigated thoroughly based on the following descriptors: year of defense; academic degree; geographic region, institution, and graduate program; supervisor and author; level of education; thematic focus and type of academic work.

The results strongly indicate the consolidation of the Chemistry Education Research area in the country showing an increased production within the period analyzed. The production of University of São Paulo (32.30%) predominated followed by Pontifical Catholic University of Rio Grande do Sul (9.70%), University of Brasília (8.40%), and Federal University of of Pernambuco (8.40%), but there were also master dissertations from all regions in the country. On the other hand, in the majority of the regions, especially North and Northeast, there are few active researchers in this area, which suggests the need for the creation of new research teams.

The levels of education focused were high school (74.68%) and higher education (22.08%), whereas the topics Content-Method (27.27%) Teachers Features (14.93%), and Teacher Education (14.29%) were the most investigated. Surprisingly, the topics Popularization of Science and Special Education, related to issues currently discussed in important educational debates, were scarcely addressed.

Research was the most frequent type of academic work observed as well as methodology supported by content analysis and case studies (Krippendorf, 2004).

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Key words: Brazilian academic production, chemistry education.

Scientific language rhetoric: from the theoretical basis to the production of didactic material for undergraduate chemistry teaching

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Background, framework and purpose. In a scientific community that is constantly expanding, the ability to read scientific texts actively and critically is an essential skill. Unfortunately, many students graduate with a deficiency in these skills. This work is part of a study that focused on analyzing the contributions of didactic activities related to scientific language rhetoric characteristics aimed at developing students' abilities to identify such characteristics in chemistry scientific texts and critical reading of those texts.

Methods. We adopted the theoretical studies of Latour (1987) on the rhetoric aspects of scientific articles and the studies of Oliveira and Queiroz (2007) on the structural aspects of scientific texts in the chemistry field. We analyzed the main characteristics of the scientific language and elaborated the categories of analysis of the scientific text structural and rhetorical elements, as well as the Preliminary Characterization Map of Scientific Text. We also developed didactic materials about the structural and rhetorical aspects of scientific texts, which were applied in higher education chemistry courses. We analyzed the written production of students in activities about rhetorical aspects using peer review. We analyzed the final scientific texts (reports and mini-articles) written by the students and scientific articles written by researchers in the chemistry field. We also investigated the criteria used by professors in the evaluation of scientific texts assigned related to the courses. From these results we developed the Final Characterization Map of Scientific Text. We also developed didactic material about this Final Map, which was applied in a different class. We analyzed the initial and final texts produced by the students of this class, as well as their responses to an evaluation questionnaire about the activities based on the Map under consideration.

Results. In the activities about the rhetorical aspects, the students developed skills to recognize and analyze critically such strategies in the scientific texts. In the peer review activities, although some rhetorical aspects were also mentioned, the students focused on the structural aspects of the scientific texts. Although considering some rhetorical aspects, the professors focused on structural aspects in the evaluation of scientific texts assigned related to the course.

Conclusions and implications. From the activities based on the Final Characterization Map of Scientific Text, the students understood how the scientific text is structured and strengthened, and they improved their scientific writing using structural and rhetorical elements adequately in written texts.

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Key words: scientific writing, higher education, chemistry

Mind Maps in Chemistry Education: Potential and Limitations

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In reaction to Shulman's idea of PCK (Pedagogical and Content Knowledge) (Shulman) a concept of these two educational variables penetration, Mishra and Koehler propose a model TPCAK (Mishra & Koehler) (Škoda). They add technology as an essential quality of technological knowledge required of teachers in the 21st century.

Forceful development in the field of science (including chemistry) naturally brings a lot of new information into particular science school subjects (i. e. content knowledge). This makes these school subjects more difficult as new findings usually require more complicated cogitation. Such school subjects become less popular with students. It is vital to respond to these alarming signals as behaving otherwise might cause severe complications on the labour market and after all in the entire society in the 15 year future. Fortunately, development in biometric science provides teachers with new valuable information about processes in human brain (3). Thank to these information we are able to understand the processes better and present and structure pieces of knowledge in more natural way to students' understanding (pedagogical/psychological knowledge).

The third form of knowledge is the most quickly developing field. New technology - electronic devices have penetrated contemporary society and school as an institution cannot lag behind. The worth of information has changed as well as students' attitude towards learning, their learning habits and learning processes. Teachers' technological knowledge is hence crucial because otherwise they cannot keep their education up to date.

To fulfil requirements of meaningful modern science education, TPCK model needs to correspond with the concept of scientific literacy defined e.g. for the purposes of PISA and TIMSS testing. It is based on four pillars: system of concepts, methods and procedures, methodology and ethic and interaction with other segments of human knowledge (4).

Education following the TPCK model can meet the requirements for scientific literacy when mental maps are used. Not only using mind maps follows scientific knowledge of processes in human brain during learning, but it also enables teachers to present concepts, express relations among them and many more. Therefore mind mapping is presented as a method in this paper. The authors further describe some concrete examples of using mind maps in chemistry education at both the elementary and secondary level respecting available modern technology (software).

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Key words: Mind maps, content knowledge, pedagogical knowledge, technological knowledge, education

Chemistry Education at Vocational Schools with Respect to the Character of Particular Fields

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The educational system in the Czech Republic has been recently reformed. Former educational standards are being replaced with new ones – Framework Educational Programmes (FEP). In FEP for the majority of vocational schools the share of general educational subjects has been extended. Chemistry also belongs among these school subjects thereby a very numerous group of students, who are being taught chemistry, has originated (1).

Vocational school students represent c. 80 % among all secondary school students (2). It is therefore a significant number of students whose more complex bloom may be affected by proper chemistry education. In case of vocational schools, chemistry education is a marginal school subject; therefore it serves different purposes. For that reason, Chemistry education at these schools needs to be led in a different way comparing to Chemistry education at grammar schools.

Vocational school chemistry education is specific for several reasons: low students' motivation to learn a subject unrelated to their field, insufficient equipment (chemical, chemistry dishes), chemistry teachers' expertise etc. (see (1))

In reaction to this situation, *Chemistry as a marginal subject* issue has been included into chemistry didactics at the Faculty of Education, Charles University in Prague. The main aim is to introduce prospective chemistry teachers to the vocational school educational reality and to propose potential solution leading to elimination of these negative effects. One of possible solutions seems to be formation of *motivational elements* – short problem, project, inquiry based or complex composition focused on students' activation. Acting on students' motivational sphere may be accomplished via: generally attractive topics, topics close to students' lives or topics related to the field of their studies they have chosen themselves. Motivational elements in vocational chemistry education have been mainly directed to general topics and students' lives topics so far.

In this paper, there is another approach suggested. Motivation elements directed to topics related to the field of study at presently 275 valid framework educational programmes. Often asked question why to learn Chemistry when it is not related to their field, is at least partly addressed bonding the chemistry subject matter to the main students-chosen field of study. Outcomes of this work represent another important step towards improvement of chemistry education at vocational schools.

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Key words: Chemistry education, vocational schools, motivational elements

Searching for an effective model of teaching practice.

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Even Socrates, one of the first teachers was criticized. The teaching profession is the social role and was, is and will be under continuous supervision of the society. Despite the fact, that in social studies presented in the teaching literature, respondents declare that it is a profession involving a prestige, do not spare criticism show the areas of errors, omissions and deficiencies. Teachers themselves often have pointed out that the studies did not prepare them fully for the profession. The most difficult areas of concern indicated no substantive scope and practice. This entails thinking about improving the quality of vocational training in this field. The undeniable fact is that in shaping the skills preservice teachers should acquire, teaching practices play a keyrole. The article presents various models of teaching practice leading to the further training of future teachers.

Commonsense knowledge versus scientific knowledge about snails – possibilities and negligences

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Common knowledge of students is the type of knowledge that coexist with scientific knowledge in the minds of students, creating two parallel worlds. Many studies have shown that commonsense knowledge is often the cause of failure in exams. In order to replace it with scientific knowledge areas that are source of erroneous perception of reality and interpret natural phenomena should be discovered and evaluated. The aim of our study was to diagnose the commonsense knowledge of primary and middle school students about the snails, and to compare the scientific knowledge available in a few selected textbooks. Investigations allow us to observe some dependences, for example: the existence of compounds of student errors with unclearly written manuals, and the problem with prioritizing common sense knowledge over scientific knowledge. Studies indicate alsoareas which are worth to pay attention while constructing the school activities.

Chemistry Olympics as a Means of Attracting Students´ Attention towards Studying Natural Science Disciplines

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The almost 50-year-long history of Chemistry Olympics in the Czech Republic documents the justifiability of its existence. It has become a form of the gifted pupils´ support catching their interest in chemistry, respectively in natural science. The Chemistry Olympics is a subject competition which in the form of interesting activities not only awakes pupils´ interest in chemistry but also develops their independent work and deeper cognition of the whole field. At the same time it can be considered an organized and institutionally supported form of paying attention to gifted students. Solving tasks the level of difficulty of which overlaps the general content defined by the framework educational programme, requires time- and professionally demanded leadership from the teachers´ side, caring of knowledge and skills development from the theoretical and practical side. The school knowledge is not satisfactory in this case, mainly the systematic work with literary sources and demanding home preparation are demanded.

The competition runs under the same rules within the whole Czech Republic and is held every year. It is structured into categories and rounds. The top result in the A-category is the National Round winners participation in the International Chemistry Olympics and in the E-category winners in the Grand Prix Chimique competition which is held every two years. Successful participants of the National Round can often enrol at selected universities without taking entrance exams.

The above mentioned approaches present not only important support towards studying Natural science disciplines, mainly Chemistry, but they also work as a tool of meaningful spending leisure time, i.e. the tool of sociology with strong social impact.

The Chemistry Olympics is a natural form preparing learners for studying at schools where Chemistry is considered a major subject (Faculties of Chemistry, Medicine, Pharmacy etc.). Numerous examples can be presented, when the Chemistry Olympics winners graduated even from two prestigious faculties. Thus it seems logical to monitor both the pre-conditions of involving students in such activities and competitions and their further development while studying at natural science faculties. This also provides feedback and reflection to the whole process.

That was the reason why the research ran within the district and regional rounds of Chemistry Olympics focusing on analyzing various participants´ features. The main hypothesis is based on the expectation that the development of the gifted students is influenced by various factors the influence of which should be detected and later stipulated and supported, and potential negative factors eliminated. It is generally acknowledged that the talent is not the sufficient pre-condition for successful professional and private life of the graduate. But to reach this, various factors are expected to co-operate. The (partial) detecting of them is the main objective of this research project.

The applied methodology is reflecting the set objectives. Starting with the questionnaire survey within the district and regional rounds of the Chemistry Olympics in B, C, and D-category, the pedagogical observation follows during the process of task-solving in the practical part of the competition and being supported by interviews with selected participants which conclude the whole process.

The research also involves the historical analysis of regional rounds results in several past years which relate to the monitored data. The complete results and conclusions are presented in the full version of the paper.

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Key words: Chemistry Olympics, Monitoring Conditions of Gifted Pupils Selection, Pedagogical Research.

The nest education system – example of using

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The education system has always changed, but the general scheme of education is still the same. We rely on the same content and use of similar teaching aids like we used yesterday. You can see only the replacement of older equipment for new one and better quality. Something is happening, but actually we are still in the same place, only with better equipment. The biggest changes in the learning process was caused by the introduction of multimedia. Only some persons can see the huge opportunities offered by using it. Multimedia creates, among others, the feasibility of realization of nest education system, which until now has been treated with an extreme caution, because it poses new challenges for educators and IT professionals.

Nest curriculum is a big innovation breaking with the current model of education. It puts a great emphasis on the intellectual training of the student to acquire skills. Using a specific example of a problem concerning the radioactivity we tried to explain the mechanism of functioning of the nest system. Radioactivity is the nest in this case and includes concepts such as: atom, proton, element, electron, isotope, radiation α, radiation β and the other ones, so the student will have to find the definitions of them by himself in a shared to him source of knowledge deciding first, which of these definitions he needs, and which not.

Key words: nest education system, multimedia, radioactivity

Stereoscopy in chemistry education – new educational material and attitudes and opinions of teachers and pupils

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Stereoscopic projection is a method of three-dimensional (3D) imaging on a two dimensional (2D) plane. Human vision uses several cues to perceive relative depth in scene in front of him. One of the most important is stereopsis, a binocular cue, i.e. such, where use of both, the left and right eye, is necessary [1]. Binocular vision of a scene creates two different images of the scene, one by left and one by right eye, depending on different angles given by position of eyes on a head. Consequently, brain composes the images together and forms a 3D image with depth information. Stereoscopy uses the corresponding strategy to induce a 3D vision and presents two offset images separately to the left and right eye of a spectator. There is a variety of stereoscopic techniques, frequently used is an active stereoscopy [1]. This technique uses shutter glasses which are synchronized with a projector. The projector very fast switches the images (originally acquired under different angles corresponding to conditions of the binocular vision) for left and right eye and, every frame, the shutter glasses block the light to pass through to the eye which should not see the image. Hence, every eye can see just the image specified for it and consequently, the illusion of depth is formed. Of course, the stereoscopic projection has a potential to be employed in education, especially in technical subjects, or in cases where "more believable" effect of the projection is needed to evoke. Unfortunately, some factors hinder the penetration of stereoscopy into secondary school education. In past decades, the price was a limiting factor, nevertheless, last year, the prices of corresponding technique decreased to a reasonable level. Thus, nowadays, the limiting factors are lack of suitable educational materials and pedagogical knowledge. In addition to that, there is a question whether teachers and pupils support use of the stereoscopy in education and whether the stereoscopy can support the education process.

Concerning the mentioned factors, this contribution is focused on design and preparation of new short stereoscopic videos of chemical experiments and their evaluation by teachers and pupils. It also deals with evaluation of attitudes and opinions of teachers and students to implementation of stereoscopy into secondary school education. The results of orientation questionnaire inquiry showed that majority of teachers as well as pupils support employment of stereoscopy into school education, they also valued positively the created videos and marked them by degree of 2 on 5 degree scale (1 is the best). Orientation inquiry using test also indicates that short-term retention of knowledge in the case of employment of stereoscopy is comparable to the retention of knowledge acquired during a laboratory course.

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Key words: Stereoscopy, Stereoscopic projection, chemistry education, orientation questionnaire inquiry

Support for use of probeware in science for teachers and pupils

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Microcomputer Based Laboratory (MBL), today mostly called probeware, is a one of various ways how to support science education. It is often represented by a system containing sensor(s), which measure some quantities, for example pH, pressure, voltage etc., A/D converters or similar devices which provide an output processable by a computer or a data logger, which records, displays and treats measured data. The advantages of employment of probeware in science education is immediate feedback during measurement, usually low consumption of chemicals and other equipment and, especially, a way of experimental work which reflects real work in current science laboratory, where similar devices are frequently used [1]. Although the employment of probeware into science education is not new, they are not widely spread due to variety of factors, where the price of the devices is not the most important one. The lack of suitable educational materials, lack of experience and pedagogical knowledge and possible technical problems can be considered as other factors which hinder employment of probeware in education [2]. Hence, preparation and testing of new experiments and experimental approaches, educational and supporting materials and technical support provided secondary school teachers is necessary to boost the penetration of probeware into secondary school laboratories. Regarding that, this contribution is focused on MBL description and its possibilities in secondary school education and laboratory experiments, especially in chemistry, attitudes and opinions of secondary school teachers and pupils acquired through orientation questionnaire inquiry and experience with probeware in courses for secondary schools teachers and pupils. In a framework of projects Přírodní vědy a matematika na středních školách v Praze (Science and Math at secondary schools in Prague) and COMBLAB, new materials supporting introduction of probeware into secondary school education were/will be prepared. Also laboratory courses for teachers and pupils were held and evaluated, including their attitudes and opinions. It was shown that majority of teachers (8) and pupils (81) do not consider the experiments made using probeware more or less attractive than "common" experiments, on the other hand, they identified their benefits and support introduction of probeware into secondary school laboratory. Majority of them would appreciate new educational materials, new courses on probeware and technical support information. These materials are considered to be provided by the mentioned projects.

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Key words: MBL, Microcomputer based laboratory, probeware, secondary chemistry education

IPITHIA - a new active learning strategy for the repetition course in mechanics for freshmen

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For the last few years we have been facing the problems of lowering the level of science knowledge and competences of students entering Faculty of Physics, Astronomy and Applied Computer Science at the Jagiellonian University. As an answer to new demands in Winter 2009 a new strategy for a repetition course in mechanics was proposed to ensure equal initial opportunities for all freshmen undertaking studies in physics, astronomy, biophysics and nanotechnology. So far the course has been repeated three times.

Before the course a pre-test is carried out to screen the students who are good enough in mechanics and use different representations at ease, so do not need repetition in solving basic problems. For those who do not overstep the 50% threshold, the repetition course is obligatory. All students participating in the course are working on the same sets of problems.

In 2009 seven out of nine groups were taught using a new active learning strategy, called IPITHIA, based on a sequence of steps for solving simple theoretical problems: (1) Individual (work), (2) Peer Instruction, (3) Tutor/teacher Help and (4) Instruction (for) All (students). Using this approach most of the work was done within the first two steps and the forth step was reached only when the whole group of students encountered substantial difficulties while solving a particular problem. The third step involved individual work with a student and gave opportunity to recognize and "untie" his/her conceptual knots. The other two groups of students were taught traditional way, where most of the problems are solved on the blackboard by random chosen students and with much help of a teacher.

To assess the new active learning strategy, we compared pre- and post-test results of two groups of students: one () trained with IPITHIA approach and the other () taught in the traditional way. The group average normalized gain factors, *g-ave* (Hake,2006) found for both groups were and, respectively, in consistence with other comparative studies between interactive engagement strategies and traditional courses in physics (Coletta, Phillips and Steinert, 2007). To evaluate the significance of this difference, an *unpaired t-test* was used and the results gave a value of (), telling us that IPITHIA method was superior for teaching repetition course in mechanics to freshmen. Further, Cohen's effect size (Cohen, 1988) value () suggested its high practical significance.

After the post-test, students participating in the course filled in an anonymous questionnaire. We learned that the groups taught in the traditional way found the course less motivating and explanations of problems less clear than the groups following IPITHIA.

We believe that proposed method is suitable for all kinds of repetition lessons not only at the academic level but also at earlier levels of education.

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Key words: course in mechanics, active learning strategy, gain factor, Cohen's effect size.

SECURE – Science Education Curriculum Research Project under the 7th Framework Program

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In its latest policy initiatives and outputs in education and training the European Union restated the importance of science literacy and numeracy as fundamental elements of key competences (Journal of European Union C 323/11, 2010). It was recognized that more investment should be undertaken to increase the number of graduates in science, technology, engineering and mathematics (STEM) so as to create the right conditions to deploy key enabling technologies, essential in the R&D and innovation strategies of industry and services ("Agenda for new skills and jobs", 2010). The new benchmark adopted by the EU Council under the ET 2020 framework (Journal of European Union C 119/2, 2009). aims at an adequate level of basic skills in reading, mathematics and science, by calling for the share of low achievers in reading, mathematics and science to be reduced to below 15 % by 2020.

SECURE is founded as a collaborative project under FP7 to provide research results of current mathematics, science and technology (MST) curricula across Europe. The overall aim of the SECURE project is to make a significant contribution to the European knowledge-based society by providing relevant research data that prompt public debates on this issues. Based on good practices and other research results SECURE will formulate a set of recommendations for policy makers and other stakeholders on how MST curricula and

their delivery can be enhanced. These improvements would need to focus on encouraging and preparing children from an early age on for future careers in MST. At the same time curricula should make MST more accessible and enjoyable for all children so that they will always keep a vivid interest in mathematics, science and technology, understanding the importance of their societal role.

A rigorous research program conducted by the SECURE consortium scrutinises and compares current MST curricula for pupils aged 5,8,11 and 13 in ten member states as they are intended by the authorities, implemented by the teachers and perceived by the learners. The instruments used to this end consist of a transnational comparative screening instrument for MST curricula, of teacher and learner questionnaires and interview protocols. Currently the research in schools takes place.

The cornerstone of the valorisation strategy of the research outcomes is the direct and active involvement of a transnational expert group of research and curriculum development institutions outside the consortium that will provide feedback as well as a direct access to policy makers. We encourage potential candidates for the expert group to consider their participation in the project.

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Key words: MST education, school level, European program, research in science education

Derivative of epalrestat – finding crystallization conditions

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A diabetic neuropathy is one of the most common complications at patients with diabetes. About 190 million people are suffering from it. The diabetic neuropathy causes deterioration in standards of living patients, so they expect effective treatments [1]. First-line medicines are antidepressants and anticonvulsants. One of the medicines used to treat this disease is epalrestat, which can effectively delay the progression of the disease [2]. It is a derivative of a carboxylic acid, which strongly inhibits aldose reductase - an enzyme involved in glucose metabolism [3]. Epalrestat is easily absorbed and shows minimal side-effects, which proves good tolerability of the medicine[4].

Nowadays, the seeking for new drugs is an activity what utilizes not only the latest technological achievements but basic science as well. The efforts are concentrated in looking for stable preparation clinically save and effective. One of the method for finding molecules with a good biological activity is structural modification of compounds already being in use as medicines.

As a result of the structural modification of epalrestat, (5-(2-methyl-3-phenyl-2-propenylidene)-4-oxo-2-thioxo-1,3-thiazolidyn-3-yl)butanoic acid (ED) has been obtained [5].

The aim of this project is to find the crystallization conditions for preparing single crystals suitable for X-ray diffraction measurements. The planned studies include finding crystallization conditions for the ED – wherein the following parameters are modified: a solvent, a solvents mixture, a temperature, the rate of evaporation of the solvent. The most important determinant of derivative crystallization is choice of a solvent. Therefore, it is the first parameters to explore in crystallization trials.

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Key words: diabetic nephropathy, epalrestat, aldose reductase inhibitor, crystallization

Imagination of pupils about models of areas around core of atom in light of research

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The research was out among pupils of third class of high school. The aim of this study was to examine pupils' perceptions concerning the area around the nucleus of the atom. The study used a computer program by prof. J.R. Pasko. The results are very diverse. This follows from the fact that in the course of chemical education pupils in the textbooks are faced with various models of the atom, including electron cloud. Thus they present their ideas in research.

The research shows that the most important goal of modern teaching is to develop and apply a single model of atomic structure and to implement it at all stages of education. This model should be consistent with current scientific knowledge.

Key words: Software, didactician of chemistry.

Chemistry for pupils – just for fun?

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Chemicaldemonstrations, spectacular experimentsfullof fireworks andexplosionsalways have agreat interestamong bothchildren andthe adults.However, this has nothingto do witheducational process and isonly ashow which does not changethe generalpositionthatchemistryis oneof the most difficultscientific disciplines.Many adults classified chemistry as a subject impossible to be understood.

In this presentation a sample scenario of activities for pupils will be presented. The goal of proposed experiments is to provide an overviewofselectedchemicalissuesand present themin theattractive way.

Teaching Natural science in primary school in teachers' opinion

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Subject of Natural Science has a long tradition in the Polish education system. As compulsory it was introduced to public primary schools in classes from III to VII in 1922. After World War II it functioned under this name to the 70s of the twentieth century in classes I to IV of primary school, while in the higher classes, were introduced separately taught subjects of natural sciences: biology, chemistry, physics and geography.

Structural and program reform of education system in 1999 re-introduced the subject Natural Science to elementary schools. It was large organizational and essential challenge to prepare teachers to teach this course. In the literature were presented results and evaluation of implemented changes in the general concept and detailed methodical solutions in teaching Natural Science in primary schools (e.g. Suska-Wróbek, Macher 2003, Dudziak 2005, Suska-Wróbek, Macher 2003, Tracz, Hibszer 2010, Wilczynska-Voloshin, 1999). We can find there the results of the study which included a variety of issues focused on the period immediately after the introduction of this subject to schools. From the research point of view, important question seems to be: Did teachers' opinions about the changes in the concept and methodological and organizational solutions change after ten years of Natural Science in primary schools?

Employees of the Institute of Geography, Department of Geography Teaching in Pedagogical University of Cracow conducted researches on representative group of Natural science teachers in order to register their opinion about the taught subject. Detailed objectives of research were:

- The curriculum- its range of content and time devoted to its implementation in the plan of teaching,
- Curricula and textbooks for teaching,
- Status of teaching materials for teaching Natural Science,
- Qualifications of teachers to teach Natural Science and forms of its improvement,
- Selection of teaching methods for teaching Natural Science,
- Pupils' results from Natural science in external exams,
- Difficulties in the teaching and learning Natural Science.

In research authors used the method of diagnostic survey in which respondents answered the 27 questions and few detailed personal questions. In research authors involved 60 teachers of Natural Science.

Key words: natural science, primary school, natural science curricula.

Teacher development in IBSE

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Background, framework and purpose. Teachers all over the world face decreasing interest of students in studying of science. Currently used teaching methods are considered to be one of the main reasons of this unfavourable situation (Rocard et al., 2007) because teaching methods often do not meet needs of the students (Duschl et al., 2007). Different learning style of current NET generation and principles of connectivism (Oblinger & Oblinger, 2005) are not generally accepted. Students find the covered topics unrelated to their everyday lives. There is a growing body of evidence that inquire-based science education (IBSE) motivates students as well as teachers. However, teachers have to learn how to apply this method, therefore is should be incorporated both into pre-servis and in-servis programs and continual professional development (CPD).

Methods. Design-based research is considered the fundamental research method. A questionnaire survey has been used for evaluation of success rate of IBSE implementation. Pre-test and post-test questionnaires were administered to document the progress in students' views after IBSE implementation. The results were compared with control group of students where IBSE was not used.

Results. We present the results of our research in form of IBSE principles with emphasis on maximal use of experiments. The information provided is empiric data that were collected at 20 elementary schools in the Czech Republic. The results confirm the given principles.

Conclusions and implication. We present by our research verified CPD approach leading to increase of teachers' skills in implementation of IBSE into practical use as effective strategy in teaching of science.

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Key words: inquire-based science education, teacher development

Preservice teachers' Modeling Processes of kinematical concepts using a video-based laboratoy

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If there is a domain which causes a lot of difficulties to students, it is the study of motion, or kinematics, for two main reasons: alternative conceptions which students possess on the properties of motion and the emphasis in introductory physics course on their mathematical properties. In this regard, using video-based technology in physics education have several advantages: 1) it allows the student to concentrate on the generation of hypotheses and the interpretation of results, two skills not much developed in the traditional laboratory; 2) it makes possible the use of a strategy of variation of parameters necessary for the reformulation of hypotheses; 3) it allows the student to come back on the results of an experience. However, researchs that investigated how to use this technology to foster conceptual change had produced mixed results, mainly because of their orientation on the technical side. As a consequence, the objective of this research is to investigate the conditions and the effect of a videobased laboratory, based on constructivist principles, upon the understanding of the concept of acceleration, a key concept of introductory course in physics.

A qualitative case study approach for collecting and analyzing the data is used to explore in depth the interaction of 5 volunteering preservice teachers with video-based data collecting and analysis softwares while they are studying the concept of acceleration. Pre-service teachers have been chosen here because of their double status as students and as future teachers. Thus, it is expected that they could inform us both on the efficiciency of the learning approach proposed here as well as the possible results on students' understanding of the acceleration concept.

The first part of the research consists in allowing participants to interact with the video-based laboratory through a series of activities involving the concept of acceleration. The second part consists of verbal interviews to detect elements that could influence the participants' exploration of the learning activities as well as their behaviors in the video-based laboratory. Specifically, we are interested to gather information related to participants' use of the software program as well as information regarding general attitudes towards the video-based technology. Additionally, we set out to use the participants' artifacts to identify preconceptions that seemed most likely to affect their understanding of acceleration.

We assess the impact of the video-based laboratory on conceptual understanding of preservice teachers of acceleration. Moreover, we will present the comments of preservice teachers about the efficacy of the teaching strategy and their suggestions for the amelioration of the video-based laboratory.

The use of computer technology in the physics laboratory may revolutionize physics if it incorporates pedagogical principles, such as constructivist, in the design of learning approaches. Our research offers practitioners guidelines about the conditions of the effective use of technology to foster conceptual change about the accelation, a key concept in the introductory physics course.

Key words: video-based laboratory, preservice teachers' training, kinematics, modeling processes, conceptual understanding.

The diagnostic study on the interests and skills in physics at the initial stage of learning

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The aim of the study was to check the interests of primary school pupils (age 12) and junior secondary school students (age 13-15) in physics and their skills in that domain. The results concerning physics were compared with analogical studies conducted on the same group by different researchers from mathematics and chemistry institutes.

1929 subjects took part in the research, among them 463 primary school pupils, 1008 first and second grade students, and 458 third grade students of junior secondary school. The pupils of primary school had not had any physics lessons at school, therefore the knowledge they applied could have been gained through the observation of the world, through relations with different people such as parents, relatives, friends, teachers of science, or could have been deduced spontaneously basing on the intuition for the need of a particular question. By contrast, the students of junior secondary school (especially those from the 2nd and 3rd grade) were able to use knowledge acquired from physics lessons and scientific structure which is constructed from the beginning of teaching, as physics is their compulsory subject at school.

The items of the test from the field of physics were constructed in such way that the answer could be given basing on textbook knowledge, as well as general or intuitional knowledge which could be, but not necessarily, contradictory to textbook knowledge. In order to achieve that aim, scientific phrases were not used in the content of the items, thus cognitive barrier of scientific language was not an obstacle for providing the correct answer. Additionally, the mathematical knowledge was not needed to provide the correct answer. To put it differently, the items were to check only the skills and intuition in the field of physics.

The results of the test made it possible to select a group of 221 students with considerable cognitive skills at physics. The test of skills revealed that the skills and intuition of students at that stage is relatively high (almost 50% of correct answers, and even more than 60 % in the case of the third grade students of junior secondary school), higher than, for instance, in the field of chemistry and, as shown by numerous studies, at later stages of learning. It may prove that certain innate skills of students in the given field do not develop, but may even regress. Consequently, the test outcome did confirm the immense importance of developing those skills, especially among the students interested and fascinated in physics.

Key words: physics, diagnosis, interests, skills, primary and secondary school

The high school student's opinion on the developing of the nuclear power stations in Poland.

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The Polish government project of the construction of the nuclear power stations as a source of electric power, which know is under developing in Poland (first nuclear power station should be finished about 2020 year) needs also intensive educational and informational companion among the civil society.

The success of this project depends also on the civil society opinion on developing of the nuclear power energy sources generally an especially in Poland. The investigation of society opinion on this subject in 2008 year by the Pentor Res. International showed, that 47% of the Polish society agree with the theses that the nuclear power stations should be build in Poland, although they showed some fears on the safety of the nuclear power.[1]

It is also interesting of the opinion of the high schools student's on this subject. Such questionnaire researches were done in 2011 year. The research were done among 200 students from the first classes of high classes (121 - science classes and 79 - humanistic classes). Research questionnaires included 17 affirmations, for which the students could choose one of the four answers: a) I agree; b) I rather agree, c) I rather disagree, c) I disagree.

The analysis of the research results based on the approval coefficients and Likert scale showed that the most of students represents rather moderate positive attitude on the developing of nuclear power energy sources (50,4% students from science classes and 45.9% from humanistic classes). Only 14,9% students from science classes and 10,1% from humanistic classes represented positive attitude. Moderate negative attitude showed 33,1% students from science classes and 43,0% from humanistic classes.

It's should be notice, that the research were performed before the disaster in Fukushima nuclear power station.

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Key words: students, high school, nuclear energy, attitude, Likerta scale

The knowledge on the nuclear energy student's beginning their study on the Siedlce University.

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In 2009 year the project of building the nuclear power stations in Poland was announcements by Polish government.[1,2)] According to this project first nuclear power station in Poland should be open in 2020 y. The project demand also higher educational activity, especially among the high school and university student's. Some changes in the education on this subject demand also the knowledge about the actual student's knowledge on the nuclear energy achieved in the high school.

For this reason in 2010/2011 and 2011/12 academic years the investigations of the knowledge on the nuclear energy were done among the student's starting their university study on the Siedlce University of Natural Sciences and Humanities. The chemistry student's (103 students) and mathematics (126 students) solved the test (12 questions - multiple chose - maximum result - 12 points).

The analysis of the tests showed that the mean results were equal to 5,8±1,5 and 6,7 ± 1,8 points, respectively in 2010/11 and 2011/12 academic year, for the chemistry students. The mathematic student's results were respectively equal to 6,0 ± 1,6 and 5.5±1,4 points.

The investigations showed that the student's elementary knowledge on the nuclear energy achieved on the high school level is rather insufficient, especially for mathematic students. The results of the tests suggest that on the chemistry and physics courses in high schools the problems of nuclear energy were insufficient explained and/or were not accent the importance of such knowledge. The student's were also not motivated to follow the knowledge on this subject ourselves. In the case of chemistry students an increase of their knowledge was observed in 2011/12 a. y., which can be explained as they were more interested on the knowledge on the radioactivity and nuclear energy probably due to the International Year of Maria Curie-Skłodowska.

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Key words: knowledge, nuclear energy, test, chemistry students, mathematics students,

Nautical Science and Eco-tourism Taught by Means of Research Projects as a Part of Teaching Natural Science in Secondary Schools

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The next stage of the educational reform provides for introduction of natural science from 2013 as a supplementary course on the fourth education level in secondary schools. In the comments to *Core Curriculum, Volume V* (Spalik i in., 2008), the method involving research projects executed by pupils is recommended as *a particularly beneficial work method* in teaching natural science. In the study concepts of the curriculum and methods of teaching natural science in a secondary school using research projects involving four course directions and three thematic directions specified in the *Core Curriculum* were presented (Rozporządzenie MEN, 2008). The approach to teaching proposed therein encompasses the activities put forward in the *Comments to Core Curriculum*, focused on: *mathematical thinking, ability to work in a team, development of the ability to apply by pupils theoretical knowledge in execution of assignments and solving problems, scientific thinking, classes carried out using experimental facilities, connection of the themes with every-day life*. The proposed theme of the classes- nautical science- as a sum of environmental knowledge and experience related to sailing, regards important issues of the heritage of our civilization whereas eco- tourism – a branch originating to a certain extend from nautical science – should shape attitudes to natural environment. Moreover, such topics give opportunity to *develop individual interests in pupils*, for example sailing, which was also proposed in the *Comments to Core Curriculum*.

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Key words: teaching natural science, research project method

Eco- tourism versus Nautical Science. Didactic Project to be implemented among Students Studying Tourism in the Academic Faculties of Natural Sciences

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Tourism is traditionally a field of studies in Physical Education Academies, universities, and recently it has been included in the offer of many private higher schools. Tourism is affiliated in many faculties which is reflected by the syllabi of the offered obligatory courses or, even more often, optional courses. The educational curriculum comprises of relatively few issues regarding natural and environmental science, except of geography. The scope of natural science offered by academies and universities seems to be much below expectations. And each student majoring in tourism should know the heritage of the civilization including historical aspects of discovering of environmental knowledge since this is supposed to shape attitudes necessary for sustainable development of contemporary forms of qualified tourism. Development of modern modelling and experiment design technologies in the teaching process makes it possible to change the existing teaching methods (Wręczycki, 2011). The paper describes a proposal of application of the aerodynamic tunnel for visual presentation of the issues of the yacht stability, windward and leeward directions, forces affecting the yacht during its movement, basic principles of rigging aerodynamics and its aerodynamic efficiency on different courses in relation to wind. An advantage of the aerodynamic tunnel is the possibility of visualisation of the lines of air stream flows around the sails, which a stationary observer perceives as a phenomenon occurring on the model during its actual movement. The project discussed in the study was carried out in form of didactic classes for the major course: *tourism* in the field of Natural Environment Protection at the Jan Długosz Academy in Częstochowa (Syllabus, 2011).

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Key words: syllabi, eco- tourism, nautical science

A computer card based game for chemistry teaching

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Teaching chemistry fundamentals is a special challenge for teachers. The Periodic Table of the Elements, proposed by Mendeleev is one of the main contents to be learned by students. Usually students need to memorize the table, observing the element's rank and groups. We propose and show a new form to present this content using a card based game, more specifically, a digital card based game. The game named *QuimiTruco* was inspired in an old and traditional card game knows as Truco, very common in Latin countries. The rules of QuimiTruco are similar to Truco but some modifications were introduced. The cards are represented by chemistry elements. The cards values depend on the game round. Before start a round, mandatory information must be drafted, e.g, atomic weight or electronegativity. The cards are distributed among players and the round is played. The game was implemented using Java, and can be played on a local computer network (LAN) or over the Internet. Teachers can use the game as a pedagogical instrument, planning activities with it, accommodating it as part of a didactic sequence. One of advantage of this game is that, it can also be used as an ordinary card game without computers. The game construction process that merges pedagogical and entertainment issues is our main contribution for science teaching.

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Key words: digital games, game design, chemistry teaching

Properties of matter – implementation the issue using the workshop method

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Properties of matter are one of the most basic issues in chemistry and physics education.

In this work the possibility of its implementation using the workshop method has been discussed. Descriptions of a series of author's activating exercises have been presented. Among the teaching problems focused on are understanding of terms denoting properties, assigning properties to substances, the distinction between physical and chemical properties, quantitative determination of properties, relationship between the properties and application. Proposed classes are designed as plays that enable realization of the instructive and upbringing aims, e.g. matching facts, training of creativity, active listening and cooperation within group. The drills suit participants all ages and with different knowledge, thus may be employed both in didactics (tutoring and evaluating) and popularization or even integration activities.

Key words: properties of matter, workshop method, active methods, didactics of chemistry and physics, popular science

Success of Students' Education Process in the Context of Didactical and Neurobiological Aspects

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The aim of the research was to establish the degree of chemistry knowledge and skills in terms of new chemical theories and models. 84 biology students of Pedagogical University (Cracow) participated in the research during the organic chemistry - part I. Results of the research indicated on significant problems in chemistry learning, in particular: quantum theory structure of atom, electron effects' models and acids' and bases' theory. Answers on pretest's tasks were analyzed qualitative and quantitative.

The psychological aspect of a strong association was found between the assessment of students' skills and chemistry knowledge, and obtaining better results in pretest's point. A lot of students did not try to solve tasks – significant fraction of omissions above 0.15 was observed in 11 of 20 tested tasks. Similar situation was noted during the maturity exam - a lot of pupils in high school did not solve *untypical, new tasks* (Raport matura, 2010). This phenomenon is disturbing in aspect of learning process because of fact "that news and challenges stimulate neurogenesis in hippocampus" (Gage & Muotri, 2012). During the learning process teachers should develop attitudes to new, untypical and problematic tasks or situation. In time of planning the learning process, teachers should consider, what students (do not) know, understand and can do, how students assess their intellectual and manual skills.

Statistica program was used in detailed analysis of research datas.

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Key words: chemistry theories and models, neurobiology of learning, psychological and didactical aspect of learning, students' learning problems, success of education process, university learning.

Contents