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Semantic Maps Based on Conceptual Meta-Model of Cognitive Architecture of Concepts

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The semantic analysis and semantic mapping based on the triangular model of cognitive architecture of concepts [4] enables curriculum makers, textbook designers and teachers to visualize complete structure of scientific/common concepts and their semantic frames for the purposes of curriculum creation, textbook design, and, in addition, for better understanding of key concepts in instruction and learning especially in the model based instruction [3].

The triangular model of the cognitive architecture of concepts is a conceptual meta-model which shows a specific structure of common and scientific concepts and their semantic frames as basic cognitive units of conceptual models [1, 2] used as human tools for cognition in science, mathematics, and in everyday life. This structure consists of the concept core, concept periphery, the semantic frame, and the relations among all the components of this structure. The semantic frame consists of the meaning and the sense of the concept. The meaning is a set of all subordinated concepts and images. The sense is a set of all concepts which can be meaningfully connected with the given concept core in speech, thought or symbolic expression (except for subordinated concepts). The meaning and the sense are two disjunctive sets. Three developmental levels of common and scientific concepts are presented in a frame of the model: empirical, exact, and formal. The empirical is provided as level of the common concepts. The exact and formal are provided as levels of the scientific concepts.

The semantic maps of physics concepts ‘force’, ‘mass’, ‘body’, ‘matter’, ‘field’, and others ones in a frame of a cognitive map of the physics at the scientific (exact) level and at the empirical level for primary and secondary school will be designed.

Keywords: cognitive architecture, concept, conceptual model, conceptual meta-model, semantic frame, level of concept, semantic map, cognitive map.

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Analysis of Students' Conceptual Perceptions of Quantum Physics

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Quantum physics was perhaps the most problematical theory of all theories of physics including relativity but the real dilemma is what makes it so difficult that everybody complains about it. Introductory classical physics courses strongly encourage students to develop a perspective that can be described as being a pragmatist; from this perspective, any given motion can be utilized to determine its future physical properties. Such an approach can be very problematic for the students who take introductory quantum physics courses since above perspective can be very destructive for the development of newer and more abstract ideas. The present study investigates college students' conceptual understanding of selected concepts of quantum physics. This paper is a follow-up investigation of previously published dissertation (Akarsu, 2009).

The current research stems from a published dissertation of the author (Akarsu, 2009) and scrutinize pre-service teacher' conceptual understandings of central issues of the QP. In the study of understanding of modern physics otherwise known quantum physics themes, Asikainen et al. (2009) proposed useful teaching models in their studies with pre-service teachers. The main rationales of the study are two fold: to validate the data collection tool and to carry out an investigation on students studying quantum themes at different disciplines such as chemistry, physics, or biology and compare their conceptual understanding of the theory.

Current study utilized quantitative research approach since it is useful method to see the classification and characteristics of students' conceptual understanding of QP. Data collection process of the study was successfully implemented during fall 2009 at a big Mid-eastern public university in Turkey. The main reason for three different departments was to initiate a new perspective of exploring students' levels of understanding and their grasps of quantum concepts which is one of the research questions of this investigation. In addition, it is guided by the aim of scrutinizing students' conceptions of quantum phenomena to explain the peculiarities of the theory by utilizing philosophical statistical analysis of their responses. In order to acquire the goal, participants were decisively selected from three different departments at two particular schools, science education department at the school of education and physics and chemistry at the faculty of art and sciences. Out of 350 students asked to complete the questionnaires, a total of 229 students participated into the study and volunteered to contribute. The ages of them range between 21 and 24.

Below table illustrates the number of students from each department and their grade levels and number of physics courses in their curriculum at their departments at the time of the study.

Disciplines	Number of students		Grade			Number of Physics Courses		
	n	%	S	J	Se	S	J	Se
Physics	30	13	0	0	30	3	5	7
Chemistry	127	56	52	48	37	3	4	4
Science Ed	72	31	0	72	0	3	4	4

S: Sophomore J: Junior Se: Senior

Table1. Description of the participants regarding their disciplines and prior science course background.

Following cluster analysis, evaluation of students' responses at three diverse disciplines were analysed and visualized in table 2.

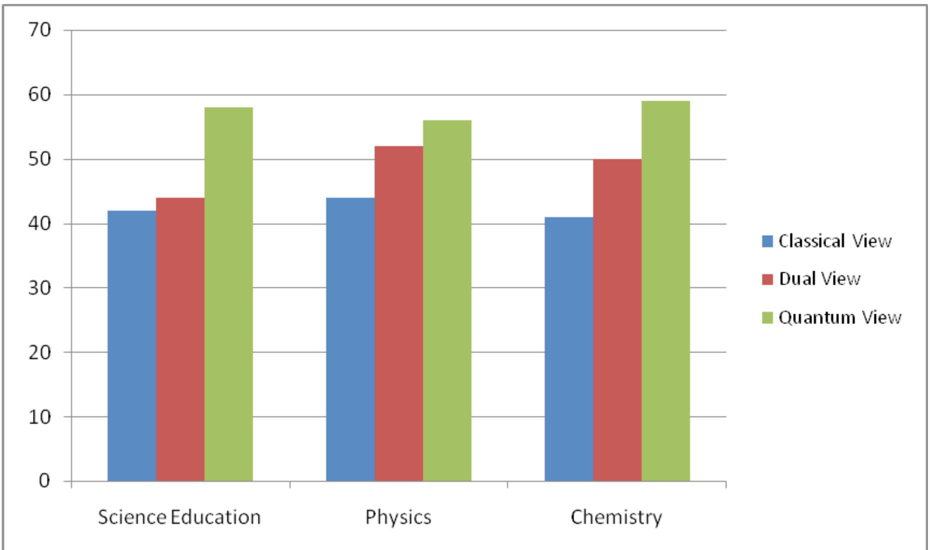

Table 2. Percents of classical, dual, and quantum themes achieved by the students

The results of the current study indicated that students struggle to develop quantum thinking because of their preceding perspective to the physical world and it is extremely hard to dispose of classical thinking and evolve it into quantum thinking. Also, data implement is shown to be effective to be utilized for the data collection in this purpose.

Workshops on science and the impact they have on the pseudo sciences.

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There are several reasons because the installation of new cultural manifestations. Some of them are due to the dissatisfaction that it has generated the current economic model, the enormous proliferation of information which teenagers have access, because the mass media and the influence of the Internet. Some of these are closer to the consumer, such as family's disintegration. Recently, the pseudo-sciences also have been playing an important role in the approach to specific dates in which supposedly the Maya culture as some other has announced the end of the world. Based on these reasons, some demonstrations have updated their concepts, as the study of UFOs, it has taken science concepts and language. In another cases, as in reading the tarot, the old ideas persist and are resistant to change.

There are some other events that have become sectarian and more radically have affected their users.

Given these developments, the value of science and its propagation has become extremely important, one of the values of the popularization of science gives individuals the ability to develop critical and analytical concepts, so that they can form their own supported judgments. This work collects information from experts related to pseudoscience and its problems mentioned above. From this information, workshops have been developed that allow adolescents to approach and propose strategies for parents and teachers can understand and prevent destructive behaviors for youth.

We have developed four workshops:

ALIENS: This workshop aims to show young people the necessary characteristics that actual science considers necessary in order to make space trips. Some of the concepts involved are: the speed of light, interstellar distances, the characteristics of the areas in which life could be develop. On the other hand, the use of software to processing images that allows a further detailed analysis of the images. The activities allow us to obtain information on the sects that are related to this pseudoscience

TAROT: Demonstrate to the user, the techniques used by practitioners to do a tarot reading and induction by deduction to reach conclusions after reading the call, in addition that allows the students to see the ease with which can create ideologies around mancias and that the user can use combinatorial analysis and probability for reading.

ESP: This workshop is divided into two: the first because of the equivalence between binary and decimal, the decimal system can guess a positive integer from 1 to 40. In the second workshop the Zener cards are used in the classroom to show to users how the probability determined the outcome.

ASTROLOGY: Using the mathematical basis of 12 within the astrological circle, will show the apparent equilibrium that is inside of astrology, the four elements fire earth air water and relations between them, and discuss the evolution of proto astrology to astronomy to demonstrate through technology as they really are not the twelve constellations that handle the astrologers, who are 30 days each as they are told, the variations between each zodiac sign, in addition to the fraud related to astrology modern and ancient.

These workshops have created excitement among teachers who are overwhelmed by the arrival of 2012. The needs that exist in young people, looking for someplace where they can be displayed with friendly techniques that there is something more behind pseudoscience, which one is science, and what can be fascinating

An Instrument for Measuring Self-Efficacy Beliefs of Secondary School Physics Teachers

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This work presents the procedures and results of the validation process of a data collecting instrument to survey the self-efficacy beliefs of Secondary School Physics Teachers. The methodology of our investigation is of a quantitative nature and the data were collected from 136 Secondary School Physics Teachers in Brazil. The instrument used to collect the data was a Likert questionnaire with 34 items. Of these, half refer to what we term the Personal Efficacy Beliefs of Physics Teachers. The remaining items refer to General Efficacy Beliefs in Physics Teaching. To carry out this test we used the statistical software package SPSS® 13 (Statistical Package for the Social Sciences for Windows). For the elaboration of the instrument related to Physics Teaching, we began by adapting two existing instruments developed by Woolfolk & Roy (1990) and by Riggs & Enochs (1990), respectively. Thus, we sought to reformulate some items and develop other aspects that corresponded to issues in Physics Teaching, such as: experimentation, conceptual structures and mathematical formalism. For the construct validation, we conducted two tests for each item of the questionnaire: the item-total correlation test, and the reliability coefficient test or Cronbach s Alpha. As a cut-off value criterion for the test results of item-total correlation, we eliminated all items with a correlation index of less than 0.20. This resulted in the exclusion of eight items from General Efficacy Beliefs in Physics Teaching and six from Personal Efficacy Beliefs of Physics Teachers. We found the value of 0.61 for the Cronbach s Alpha regarding the General Efficacy Beliefs in Physics Teaching, and 0.79 for items corresponding to the Personal Efficacy Beliefs of Physics Teachers. Regarding the internal consistency of the instrument, we found similar results in studies conducted with a similar methodology and theoretical foundation as this work (Palmer, 2006; Enochs and Riggs, 1990; Riggs and Enochs, 1990). Among the main implications of this study, we hope to contribute to the research on the self-efficacy beliefs of Physics Teachers so that we can better understand which elements influence the teacher-student relationship regarding motivational beliefs in the classroom.

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Difficulties in the Implementation of the Teaching-Learning Sequence on Topics of Nanoscience and Nanotechnology in the Initial Training of Physics Teachers

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The aim of this work is to investigate difficulties of implementing teaching-learning sequence (TLS) on Nanoscience & Nanotechnology in context of curricular innovation in training of Physics teaches. A great deal of research (Pinto, 2005) has focused on projects both teacher training and inservice teachers, and the study of the role of teachers as transformative intentions of educational programs and researchers. Thus, Andersson et al. (2005) argue that researchers and teachers should work together to create sequences of teaching-learning as well as evaluate their efficacy. To carry out this research, the perspective used was based on the teaching approach: Science/Technology/Society. The research methodology was qualitative nature (Bogdan & Biklen, 1994), case study type, and was structured in the following stages: interviews with the future teachers before and after a 40h training course, which objective was organize didactic sequences on Nanoscience & Nanotechnology topics by future teachers and identify difficulties related to the teachinglearning of these topics in the High School; application of the proposed didactic sequences to students in a secondary school and evaluation of the results obtained, based on the didactic sequences developed. Among themes dealt, we highlight: applications of Nanotechnology, its social and environmental impact; phenomena on a nanometric scale, the properties of elements and the application of electron microscopy. The data was collected from interviews with 4 future teachers on the undergraduate course in Exact Sciences at the São Carlos Institute of Physics of the University of São Paulo Brazil. Criteria for the selection of these topics were the relevance of publications on these matters in educational and scientific dissemination magazines and consultations with researchers in the area. Among the principal results we would highlight that during the implementation of the didactic sequences with High School students, the future teachers favored a traditional teaching perspective with emphasis on the transmission of information. When questioned with regard to the difficulties encountered in the application of the didactic sequences on the students, they attributed them to external factors, such as the lack of time to deal adequately with the proposed sequences, the lack of pupil attention and preparation, and problems with the materials used. In conclusion, we would emphasize the need to promote changes in the initial training courses of teachers, not only from the conceptual but also from the methodological point of view, in the way this innovative content is taught. In future research, we will seek to broaden our sample, developing teaching-learning sequences for teachers both in initial and in-service training. In this way, we hope to contribute to the research in the area of scientific education and the introduction of Modern and Contemporary Physics, insofar as the results of this investigation are directed at the training of Physics teachers.

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Ion-plasma cluster for functional nanofilms synthesis. Research and education.

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Nanotechnologies are considered the most priority direction in science and technology in the majority of countries. Qualitative and fundamental education of young scientists of corresponding specialities is one of key factors on achievement of the formulated scientific tasks and problems. Our department trains specialists in the field of plasma technolog ies for all sectors of national economy and manufacturing. There are basic courses such as plasma physics, solid-state and thin-films physics, etc. Equally with them specialized disciplines are taught – nanophysics and ion-plasma nanotechnologies and instrumentation.

Evolution of the experiment equipment for synthesis and analysis of thin films has risen from simple single-chamber installations to compound multimodule UHV systems meant for complex solution research and technological problems. Generally it i s due to the specific character of nanofilms systems synthesis, where special experiment conditions are necessary. Therefore nowadays there is a tendency to creation of integrated cluster systems with high level computer automation and with local stabiliza tion contours for main technological parameters.

In the current report the project of high-vacuum cluster for synthesis of fu nctional nanoscaled films and their further research is presented. It is created in a joint laboratory of V.N. Karazin Kharkiv National University and Scientific Centre of Physics and Technology . This cluster is composed of three high-vacuum chambers (load-in chamber, technological and analytical), linked among themselves with vacuum sluices. Their specific and modern design allows to significantly improve the effectiveness of nano-scaled films synthesis with previously defined stoichiometry and structure parameters.

Students from both department of Physics and Technology and department of Computer Science already take an active part in the creation of this installation.

Involving students in project designing of cluster installation for research activity has a number of educational purposes:

1. Development of students' understanding not only physics, but also chemistry and biology. Future specialist should obtain a conception about interconnection of these sciences, - otherwise nanotechnologies can't develop.
2. Development of students', as future researchers, ability of more widely, philosophical comprehension of research results and obtaine d scientific knowledges.
3. Educate students for higher social responsibility while using nanotechnologies achievements.

During the project students obtain skills of: calculations, designing, search of the necessary information, working in small groups; they can: master formation process of nanofilms, supervising experiments on the interstitial in cluster chambers diagnostic equipment with microprocessor system of monitoring, independently operate and stabilize ion-beam and ion-plasma synthesis.

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The new technologies in teaching and learning Physics

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The new technologies are changing our world and our life. Over the last two decades, information technologies and the Internet have been transforming the way students learn. At their Lisbon summit, EU leaders acknowledged that future competitiveness depended on a renovated education policy including e-learning. Europe-wide 'eLearning' initiative promotes new online ways of learning throughout the EU. In recent years, many studies have highlighted an alarming decline in young people's interest for key science studies. Digital technologies can help improve the quality of knowledge and life for everybody and information and communication technologies (ICTs) have become 'enabling technologies' in school too. Physics laboratory has been for a long time now

an important part of school physics education. Lately, the technique and technologies devices have know an explosive development and pupils, students are fascinated by this. In this context, the audio - video tools have an important impact for the teaching - learning process of Physics. The Computer Assisted Instruction stimulates the visual and hearing memory and transposes the students in the midst of the Phenomena. In first parts, I explained why it is important to use simulated experiments, graphics on computer, and which is the impact to use the modern tools. In next step, I propose a Lesson Plan and I illustrated how the teacher can integrate audio - video tools on instruction in diverse stages of learning unit. I have corroborated the real experiments with simulation in real times of the experiments. This way of teaching complete the knowledge of students and make the lesson more attractive.

Keywords: Virtual physics laboratory, simulation on the computer, computer modeling, teaching/ learning physics.

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Computer assisted symbolic calculations in university physics courses.

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The solution of problems in undergraduate and graduate Physics courses requires: 1) A clear understanding of the concepts involved, which is developed through years of exposition to these concepts, from elementary to advanced courses. 2) A clear understanding of the mathematical structure of the theory involved. This understanding is usually developed through solving a lot of examples, some elementary, some advanced. 3) Capability of calculation, once a problem has been correctly posed, and all the additional hypotheses that define the problem have been clearly stated. It is in this point that our proposal can be of some use. We give a couple of examples where software on symbolic calculation can facilitate obtaining a solution to a complex problem. Of course after obtaining a solution it remains the task of giving a physical interpretation of this, task where conceptual clarity is the pertinent tool.

Example a) Calculating the period of an anharmonic oscillator. In this case, the theory of time dependent canonical perturbations offers general expressions for both, the energy and the frequency, in principle to all approximation order as long as we know the Hamiltonian of the system. These expressions, although general, are not easily obtained due to their great complexity but with the aid of computer calculation –specifically Mathematica, such results become workable and therefore this tools are very useful not only for teaching but also for research.

Example b) Dynamics of one end of a string, initially hung from both ends. This problem has been studied for a long time, but the results, even in texts, are contradictory. Recently M.G. Calkin and R.H. March (Am. J. of Phys.57, p. 154-159, 1989) solved numerically the equation which results from The Law of Conservation of Energy for the time T of fall and demonstrated that such time is less than the one for the free fall of a particle. Nevertheless, given the complexity of the equation of motion obtained, this is not evident. In the solving of this problem, the canonical method of Poisson can be very useful, though the support of symbolic calculation is needed in order to obtain the parentheses of Poisson with the aid of computer calculation. In this case we specifically have used Mathematica. The calculated by any other means turns out to be a very laborious task. With this method the solution for x (t), approximate, exhibits immediately the result obtained by Calkin and March and others, and this makes it being of great value for teaching in advanced courses

Physics and Inclusive Education: a partnership promoting research, teacher qualification and inclusion

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All around the world efforts are been made to guarantee that deaf or hard hearing students have full access to education and according to Stison and Kluwin (MARSCHARK; SPENCER, 2003), to perform inclusive education we must consider placement, philosophical and pragmatic perspectives. The last one deals with a problem not too hard to be solved, but one that is present inside most of our classrooms as pointed by Sapon-Shevin (2007) and by Lang (MARSCHARK; SPENCER, 2003): underprepared personal and inadequate support. By not too hard to be solved, we mean that if efforts are performed and conditions are provided, we can overcome the problem. Although we could figure out the situation, in Brazil, we are still failing to prepare Science and Physics teachers to work on inclusive classrooms. This situation occurs in our own undergraduate program, at Sinop Campus of Mato Grosso Federal University. Our undergradute course is supposed to prepare Science and Physics teachers following a holistic perspective, but even with such a goal, we do not offer a good inclusive discussion despite the fact we have sign language disciplines, as demanded by a quite recent Brazilian federal law. To manage this situation, we have started the "Signing Physics" project, which aims to research about teaching Physics through Brazilian Sign Language (Libras), being main goal the production of Physics teaching materials and to make them accessible to people. So, our first research was based on finding and proposing signs for teaching Physics. In 2008, when we sent the project to a sponsoring foundation, we have just three people who want to work on it: a Professor, a Physics student and a Libras teacher. By doing our work and showing it to other students, our group have now two Physics students, one Mathematics student, six Chemistry students and a M. Sc. student, and we are starting to work with Chemistry concepts as well. These achievements show how small actions could affect teacher qualification: the involved students are trying to understand deaf education and are worried about their future work. They are also demanding more programs to discuss inclusive education and are stimulating other undergraduate students and society to focus on this important subject through sign language courses offered by the project. So far, we have promoted sign language contact up to a hundred people and we are offering more advanced courses in 2010. Other products from our work are three vocabulary that covers main Physics concepts found on Brazilian basic education. All three are available at www.ufmt.br/sinop/sinaisdafisica and are expected to help teachers, students and interpreters. As a suggestion for promote access to these vocabularies, we will offer in 2011 continuous formation courses for teachers and interpreters. Thus, the partnership between Physics and inclusive education is proving to be very important to our academic community and we hope to continue working and to consolidate our research group, dreaming that some day we could have an environment like that found at Rochester Institute of Technology.

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Experimental Approach at Elementary School in Sinop, Mato Grosso, Brazil: Students Constructing the Atmospheric Pressure Concept

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Well show here some experimental activities that were performed by a collaborative work between teachers and students of Mato Grosso Federal University and teachers from a local public school. The fact that about 40% of Science teachers working in Sinop do not have appropriate formation, which bring several difficulties on teaching Science at local schools, had stimulated this work. First of all, we had visited some institutions to collect data about their educational and instructional necessities. Then, to respond their expectations, we had tried to develop low cost activities that could be performed in elementary classrooms. We have started a pilot project at Tiago Aranda Martin City Public School, located inside the university campus, attending two grades, each one having 40 children with age range from eight to eleven years. Our methods were based on three distinctive moments, as realized by Delizoicov and Angotti, two Brazilian teaching Physics researchers. This methodology consists in elaborate and present some problem situations about the subject we will deal with, then we organize some experiments and discussions about the theme and, finally, we proceed to make conclusions and to answer the former questions. Before and after the experiments, we had proposed questionnaires, based on possible difficulties that will be encountered by students, and we had used Novak concept maps for assessment of students' ability to understand the scientific concepts. Each student was demanded to constructed his/her own map and then, to discuss it with two others students. After the discussion, and base on it, the group had developed another map, which was presented to the whole class. Over all the possible hypotheses, keywords emerge from students themselves, revealing the evolution of their comprehension. The subject we have chosen to work with is the atmospheric pressure and this choice was made because this concept requires a good level of abstraction, becoming interesting and complex. Among our data it is important to stress that some, initial, students maps had shown the absent or misuse of concepts needed to explain what is atmospheric pressure. For example, several maps show air as something without mass or that it does not take up space, while others use the pressure concept as the only factor related the phenomenon. However, maps developed after discussions and experiments were richer and more related to scientific theory than the formers. This research had showed that this teaching strategy is a motivational one and able to help students conceptual and cognitive development. Also, it is clear, as find in others researches, that performing experiments in classrooms is an extremely important practice. We do not discuss here why this kind of approach is not more present at school, but we wish, by using low cost materials, to improve the qualification and teaching process of the involved teachers. It is important to say that these professionals are trying hard to do their jobs, despite the fact they do not have the appropriate formation on Science. We are still carrying on this project hoping we could construct a more collaborative connection between university and schools, which will certain place local Science education on a higher level, what could affect the social-cultural development of our community.

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Studying the Students' Concepts on Motion and Force in Sinop, a City in the Mid West of Brazil

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Physics, as it is taught nowadays, shows the phenomena unveiled mathematically almost exclusively through linear differential equations. This typical deterministic view not always favors the explanation of natural phenomena so frequently dealt with in this subject. This research is an essential part of an Extension Program named: Educative Actions in Science (developed by professors and students) in the courses of Natural Science and Mathematics at the Federal University of Mato Grosso – Campus of Sinop – which tries to understand better the conceptions of Brazilian students about the concepts of Force and Motion through written tests. The main question of that test is: Why does a rock still keep going even after being thrown? But in another proposal, the students were invited to draw the trajectory a little ball performs on a table, from the moment it abandons that surface until it gets down to the floor. The emergent evidences of the test analysis find resonance in researches carried out by VIENNOT (1979, 1985), CLEMENT (1982) and McCLOSKEY (1980, 1983) when studying the conceptions of students in France and in the United States and their relations to some theories from the pre-Newtonian period. The study about the spontaneous conceptions presented by the students are extremely important so that we can understand coherently the conceptual difficulties presented by the students through written tests once this kind of diagnostic assessment can lead to the understanding of cognitive processes that are established when Physics is first presented to students, helping teachers to develop their work. The concept maps were made by the students first individually and then these maps were defended by their authors in small groups of students, what has brought about a new version of the map that was exposed to the entire classroom. Concerning the results gathered we can point some maps where very important concepts in order to understand Force and Motion have been neglected, such as: initial position, final position, speed, acceleration, and others. Also, some had pointed out that "Energy concept should to take up central position on the maps", and some people had mentioned the necessity for considering all the "imperfections", as attrition, energy dissipation and more "irregularities", considerations that remits us to Bachelard, who assured that neglecting some aspects on a phenomenon is the most violent operation practiced by Classical Science. We hope this research may contribute to develop a new citizen's profile and to help teachers in this "new process", understanding students' learning process and their disabilities towards Physics.

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Art, Poetry, Quantum Physics and worldviews in Secondary School

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The argument to including Modern and Contemporary Physics in science curriculum is, mostly, the need of a blow of contemporaneity and the construction of connections to world and nature, in science education. Particularly, we consider the importance of Quantum Physics in worldviews making.

Being the *comprehension* a singular and identitary process, of relationship with the knowledge included in culture, a human multidimensionality emerges as central in these processes. Therefore, the pursuit of possible crossings between the various forms of knowledge and human expression for the capture of the world is relevant. A teacher of physical sciences, which looks in its lesson into realities far-removed from our senses as, for example, the infinitely small, must be aware of these possible links, to provide students with cross elements for the construction of personal representations, individual senses, singular links of each one to the world. Contributions of art and literature, as well as technology or science, should be taken into account.

Awaken in the teachers training the desire to find points in common, for example, between a poem by Robert Frost and traces left by particles of high energy in a chamber of bubbles, or what unites the women in the picture *Embroidering Earth's Mantle,* of Remedios Varo, and the *women scanners* of Berkeley Laboratory, it is present as a way for training. We search for dialogues between diversified contexts, exploration of frontiers between different areas, the crossing of multidisciplinary perspectives, in an effort able to generate critical minds and able to endorse the understanding of the Real.

This poster explains this path in the context of Physics teachers training, based on a research/action focused the topic of Quantum Physics and is possibilities of reflex in classroom. Here, this crossroads seems to contribute to increase the value of each one with the knowledge and to rekindle the enchantment in front of the mysteries of nature. We believe in the potentiality of these attitudes of teachers in the development of professionality more open to the spirit of the present time.

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Ethical issues in Physics: the convergence between STS and History of Science in the example of Radioactivity

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The examples of great technological developments and equally great catastrophic implications left by the last century certainly brought a grand challenge to physics teaching: the discussion of what is an ethical attitude towards science and technology. The two Great World Wars and their scientific weapons – such as the poison gas and the atomic bomb – revealed a facet of science not acknowledged until then, and science was no longer seen as neutral, nor as a substitute morality. The ethical and social issues related to the scientific and technological enterprise were never as loud and clear – and they demanded a new approach to science teaching. Thus was born a science-technology-society perspective (STS) to science teaching that preaches a socially contextualized science education that allows, among other features, democratic and ethical actions (SOLOMON, 1993).

Not only the catastrophic events of the 20th century were responsible for this new behavior, but also the many changes those hundred years saw happen. The history of that period's science is full of episodes rich in socioscientific issues (ZEIDLER&SADLER, 2008), mainly because of the enormous practical significance of modern physics. Radioactivity is one of this science's phenomena often used to a STS physics teaching. It is loaded in possibilities of applications for the greater good, like radiotherapy, as well as in its terrible implications, such as radioactive accidents. But little attention has been devoted to the possible use of its history to illustrate that, from its early developments, radioactivity was already regarded as a socioscientific issue by the great names who studied it.

The history of radioactivity is analyzed and passages of papers, biographies and Nobel Lectures are cited to show, for instance, that scientists as Pierre and Marie Curie and Frederick Soddy were strongly interested in the energetic and medical possibilities of the radioactive matter, and that Otto Hahn and Soddy's researches were financed by chemical industries, among other examples. A philosophical reflection on the ethical values involved in this phenomenon's development, as well as its relationship to social and technological demands is further carried out. In this way, the physics teacher interested in approaching radioactivity by STS means can also be empowered historically and philosophically (and vice-versa), which may contribute to an ethical upbringing of the students.

Despite thirty years of STS and history of science approaches, it is not until the last few years that scholars observed the points of convergence between these two perspectives. Little has been produced on it, even though the richness in education – especially in modern physics education – that can come from its utilization. This paper is one attempt to touch by those means the delicate issue which is ethics in science, as the authors believe ethics can be a challenge to physics teaching that, if successfully achieved, may configure as a general benefit to this century's social life.

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Light as a Substance

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It is well known that the thermodynamics of blackbody radiation supports the idea that light can be interpreted as a gas of photons, with properties similar to a material gas[1]. The substance model for light is not only didactically coherent, but it is already in use, even tough not officially recognized. The common language is "ready" to use this model as you can see from the following examples, where the light is considered a kind of stuff: The room filled up with light; source of light; light flux; to receive the light; pure and mixed light; the dispersion of light; analyzing, filtering light; light signals; focusing the light; the warm light of the sun and the cold winter light; light sensitive film; the velocity of light; the polarization of light; the energy of light; to absorb the light.

Recovering what is worth teaching in the old theories about the "simple substances", and keeping an eye wide open to the modern quantum theories of electrodynamics and thermodynamics, we get a representation of light which is both intuitive and narrative, and substantially correct from the point of view of physics.

The precise subject of the poster is an attempt to popularize physics with illustrations in the «comics» style and statements in the «slogan» style. The 14 pictures represent experiments carried out in thought, some more «gedanken» and unrealistic than others, and they want to show that the substance model for light completes the traditional description with rays, waves, and particles[2]. The whole exhibition is meant as a challenge to teachers, students and visitors about the following claim: any experiments with light can be simply explained, at the corresponding low level, with the model of light as a substance.

But my major hope is to demonstrate the possibility to build a substantial understanding of an important theme from natural sciences through narrative understanding, with no unnecessary simplification and no dumbing down.

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Reform of curriculum in Slovakia as a challenge for physics education

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In the last few years radical changes are done in the physics education in Slovakia. The basic document ruling the content and goals of physics education has been developed and authorised in the parliament as a part of National Curriculum (ŠVP), the implementation of the external final exams in physics has been stopped, and work on a new series of textbooks has been initiated. All these changes are done very quickly in time pressure, without broad enough discussion and without allocation of necessary resources. This conference presentation and paper brings some of the parameters of these changes and prognoses some consequences.

Such radical changes and also quite obsolete curriculum issued in necessity to prepare the physics curriculum in new format. Firstly, we saw the high pressure to physics content. Teachers used to teach content based curriculum could not easily adapt to teaching less content in less time. Also teaching in allocation 1 hour per week in majority schools does not allow teach double lessons (90 min lessons) usually used for pupil's physics experiments. So we decided to allocate some hours in gymnazium for pupil's experimentation. We allocated 40 hours (out of 150 hours) for a direct pupil's work on physics empirical cognition (including planning of experiments, assembling apparatus, measurement, presentation of the outputs, but excluding data processing writing reports and teacher's demonstrations). These experiments are not allocated to content. This part of curriculum is focused to pupil's competences and teacher (in few planning experiments pupil) will match these hours to content. This allocation is compulsory, but each teacher/school can fill it up with the most favourite experiments taking into consideration the equipment available and specialization of the school. So we had 110 hours for content based curriculum. Of course we still need to develop the basic and subject related competences of pupils within these hours. This was the most difficult (and we hope never ending) work. What is absolutely clear, we need to have in this content a cross section of contemporary physics available on secondary school level of understanding, we should have content to high level comparable with the rest of world, we should go deep enough to develop subject competences, and we must not be too strict in formulations to keep enough space for textbooks authors and teachers/schools specialization. On the other hand we should be strict enough to allow national comparison of schools/pupils educational results. Within this frame we saw that is not possible to adapt previous content to these circumstances. So we prepared new form, based on our previous research in this field.

If we compare the previous and new content, we see that some content is new. Here, in the abstract, we bring it only in some points: using of proper number of digits; planning of pupils' experiment, defining of a problem, stating a hypothesis; linearization of a diagram; energy of food; energy in our body; energy in housing, travelling, industry; Doppler effect; role of research in physics in society; physical base of information, digital technology.

The article brings also experiences with in-service teachers' training related to this reform.

Lost Work, Extra Work and Entropy Production for an Unconventional Heat Engine: The Stepwise "Circular Cycle"

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When some entropy is transferred, by means of a reversible engine, from a hot heat source to a colder one, we have the maximum of efficiency, i.e. we obtain the maximum available work.

Similarly the reversible heat pumps transfer entropy from a cold heat source to a hotter one with the minimum expense of energy. On the contrary if we are faced with non reversible devices there is some Lost Work, for heat engines, and some Extra Work for the heat pumps. These quantities are both related to the Entropy production. The Lost Work i.e. Lost v Irrev $W_{Lost} = W_{rev} - W_{Irrev}$ is also called 'degraded energy' or 'Energy unavailable to do work'.The Extra Work i.e. $W_{Extra} = W_{Irrev} - W_{Rev}$ is the excess of work performed on the system in the irreversible process with respect to the reversible one (or the excess of heat given to the hotter source in the irreversible process). In this paper, which follows two previous ones on the Lost Work [**Phil. Mag.** 87 569 (2007), **Phil. Mag. 88** 4177-4187 (2008)] both quantities are analyzed in deep and are evaluated for a process with complexity, i.e.the stepwise Circular Cycle which is similar to the stepwise Carnot cycle [**PhysicaA314**,331(2002)]. The stepwise Circular Cycle is a cycle performed by means of N small weights which are first added and the removed from the piston of the vessel containing the gas or *viceversa*. The work performed by the gas can be found as increase of the potential energy of the *dw's*. We identify each single *dw* and thus evaluate its raising i.e. its increase in potential energy. In such a way we find how the energy output of the cycle is distributed among the *dw's*. The size of the *dw's* affects the Entropy production and therefore the Lost and Extra work. The raising distribution depends on the removing process we choose.

Using a pendulum made out of simple materials to teach electrodynamics: examples of experiments

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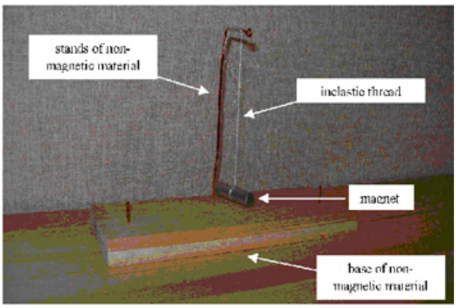
One feature of modern physics lesson is the use of modern technology, showing how the school or university goes together with technological development. The teacher should be able to take into account and involve in their daily work rapidly changing technologies and new approaches and standards in the education field, which requires a higher performance both from students and teachers. It is important for teacher appreciate - why or why not to use ICT: on the one hand can be considered and quickly obtained regularities of physical processes, which are rapidly or aren’t always visible, on the other – working in the virtual reality may lose connection with the actual processes.

We use the complex devices everyday such as microwave ovens, mobile phones, computers etc. The working principles of these household devices based on complicated integration of many simple physics principles. The electrodynamics processes most closely resembles that description. The question is - how to give students an understanding about nature of invisible processes; how to demonstrate quantitative and qualitative regularities of these processes.

One solution is to offer students small, brief experiments that students can make their own. Experimental devices are low cost and easy to build. These experiments create opportunities for students to try the experiments itself directly, to demonstrate historical inventions, as well as use the device in their studies of regularities of physical processes. The qualitative and quantitative regularities of processes can be obtained using sensors. If you have interactive whiteboard in physics lesson, then using the whiteboards software options, you can use an interactive environment for different tasks. Teacher’s professional competence determines how to use the possibilities offered by technology effectively.



For the experiments, we use a low cost and easy – to – build pendulum suitable for observing - compass working principles, Oersted`s experiment, oscillations in Earth’s magnetic field, electromagnetic damping by eddy current and different Maud of oscillations. The *Vernier LabPro* data-collection interface with *Logger Pro* software and magnetic field sensor from *Vernier* controls the experiments. It allows many activities of data analyzing and visualization of physical processes to be carried out using *ActivBoard* – interactive whiteboard from *Promethean* with *Activ Inspire* software.

Working out various educational methods for teaching physics and methodological materials supporting educational process.

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Today each student in grades 8 to 9 should have an opportunity to study physics in a way which is attractive, related to the real life and involving use of modern teaching and learning methods, electronic study aids and possibilities provided by the e-learning environment. Teachers' role in the classroom is more to consult, support and guide through the new topic rather than pure lecturing to ensure that students learn physics with real interest and in a contemporary way.

Our project team consists from former teachers and teachers that are still involved in teaching process. We have already devised and published different study materials and teacher support materials for grades 10 to 12. Printed materials, CDs, visual hand-outs have been disseminated to all secondary schools, vocational schools and evening schools in Latvia.

All the support materials are tested in 26 Latvian schools that represent all types of schools: big, average and small country schools. Only after testing the materials are available for further permanent use at schools.

Project experts are currently working on teacher support materials in physics for grades 8 to 9. In school year 2009/2010 project pilot schools started piloting of these materials.

Project Objectives:

To improve the curriculum of physics for grades 8 to 9 by emphasizing students' scientific inquiry and their skills to apply the classroom-gained knowledge in real life situations, and to facilitate the use of information technologies during the teaching and learning process.

To ensure methodological support for teachers and students in teaching-learning of physics in general education – to prepare various materials on the use of teaching and learning strategies, on assessment of students' learning achievements, as well as diverse visual aids for teachers and students in printed and electronic form.

To raise professional capacity of teachers of physics, as well as of field experts and pre-service teachers in their work with the contemporary curriculum and the devised teacher support materials.

To raise students' interest in science and mathematics by organizing extensive cooperation with universities, scientific institutions and entrepreneurs.

Study semiotic-communicative of construction of scientifics meanings. Case: explanations in college´s physics classes.

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In basic training of engineering students, 'physics' promotes learning of basic skills fundamental to study of engineering and to resolve problem situations. Taking into account engineer's 'profile', the physics' lecturer for training of engineering students is presented with challenge of integrating teaching of disciplinary content with development of skills necessary for their future careers. Considering that body of knowledge of teachers is related to 'context', experience and develop as result of relationship with practice, we develop a research in a Faculty of Engineering in order to characterize explanations made in physics classes by experienced lecturers.

The methodological approach is qualitative. It's an instrumental and collective study of cases (Stake, 1998). Considering the social, educational, semiotic, multimodal and communicative character of science classes, we choice theoretical framework given by Ogborn, Kress, Martins & McGillicuddy (1996): "Explaining science in the classroom». This focuses on 'how to explain' science's professors studying the semiotic significance of practices, objects and their activities in the classroom. Participants are three experienced physics lecturers of Engineering Faculty of Carabobo University, Venezuela.

Data are formed by episodes of classes collected from video recordings and field notes. Recordings were transcribed in a data table that includes oral and multimodal language. Study is divided into 'phases' each one with a defined purpose and involving qualitative activities, data collection techniques and analysis. Phase 1: Formation of theoretical framework. It's based on review of references that guided construction of analytical framework. Phase 2: Exploratory analysis: Here is organized basic information. It involved watching videos and definition of criteria for selection of episodes to be analyzed. Phase 3: Transformation of information. Here we specify the data finally analyzed. We designed a table for recording transcription of different communication modes used by professor for their explanations and development of coding system that would know when are incorporated communication modes and other characteristic aspects of class (vocal emphasis, repetition, syllabic expressions). Phase 4: Development of analysis categories from theoretical references. Phase 5: Data analysis process. It involved design of analytical instruments, analysis and results

Results let us know in detail characteristics of explanations about topics of mechanics. The process of meaning constructing is an 'whole' in which convergence different communication modes and learning resources, as well as elements related to nature of 'audience' (students), basis aspects for development of explanations (starting point for explanations), students needs of ‘know more’ and how professors ‘chosen’ construction of scientific meanings. We miss inclusion of descriptors to analyze and characterize multimodal and argumentative aspects of explanations, which are present in physics classes and we value as fundamental.

From the test results, and the ‘strength’ and ‘weaknesses’ studied the lessons we have been able to identify, we extract elements of work of professors that guide us in relation to certain’ aspects related to professor and task of teaching physics on which we have to think ‘to improve the practice of physics teachers.

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Force measuring by video camera

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Video analysis provides an educational, motivating and cost-effective alternative to traditional course-related activities in physics education.

The poster presents methods of measuring and results can be obtained from the high speed video analysis (Acting forces of moving objects) to illustrate indirect force measuring. A twodimensional high speed video motion analysis is used to find the instantaneous velocity, accelerations and acting forces. In addition, the data collected from Vernier’s force plate and accelerometers compared direct and indirect measuring forces.

The attached video analysis was devised to provide a comprehensive record of falling balls and moving bodies. The video footage shows step by step measurements of simple impacts of the ball to the more complicated impacts of the human body in motion.

The method can easily be implemented in the undergraduate physics classroom and involves a digital high speed video recording of the moving objects. The use of video analysis software (e.g Tracker) will allow us to locate the centers of mass of the various body segments of interest as functions of time. Then, the data is used to find the acceleration of the centers of mass of the body segments of interest, and the determination of the forces acting on those body segments from their accelerations and anatomical geometry.

Videos of classroom physics demonstrations.

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For the past several years, we have produced videos of physics demonstrations for the introductory physics course. More than two hours of video clips are now placed on our website*. The following topics are available: turning frames of reference, Foucault's pendulum, moment of inertia, Maxwell's wheel, the gyroscope, conservation of angular momentum, rotating liquids, equilibrium of balls in rotation, rotation of a mass suspended by a wire, waves in the ripple tank, elastic and inelastic collisions on an air track, propulsion experiments, Newton's cradle, standing waves on a wire, standing waves in a spring, measuring the speed of sound in air, resonance of an elastic pendulum, coupled pendulums, tuning forks and beats. The selection of topics was based on our observation of difficulties in conceptual understanding that students face during tutorial activities and problems solving sessions. We found that basic mechanics topics are especially tedious for most of first year students. Therefore we focussed on this field until now.

Comments and texts included in the movies are in French, but we expect to have an English version online by August 2010.

We found that the effectiveness of multimedia learning material can be greatly enhanced if it is combined with a self-assessment tool. That is the reason why we added a multiple choice test on the site°. In order to motivate students to train during the year, we tell them that some of the questions at their final exam will be drawn from the multiple choice test on our website.

In the near future, we plan to add videos in the field of electricity and magnetism. The last developments will be presented at the poster session.

* http://www.fundp.ac.be/sciences/physique/udp/videos/

° http://webapps.fundp.ac.be/PhysQCM/ - Choose the category "Mécanique (bac1)"

Using a Learning Cycle for Teaching of Classical Mechanics

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The teaching of Classical Mechanics in the first year of Physics career at the University is a challenge for teachers, because the students are changing from one educational system to another more formal. The students must be prepared to put their attention in new points of view not seen before by them. In this case, the role of the teacher is to look for the best strategy to make easy what is complex. With this purpose, we have been testing in our courses for some time, the introduction of a dynamical systems approach, in order to explore and analyze phenomena of motion corresponding to the Second Law of Newton. A set of five phenomena of motion are been designed to be studied with this approach of different ways in the Mechanics Laboratory. That is, first, by the exploration of the phenomena inside a conceptual frame, second, by studying the phenomena through an experimental approach, third, by the modeling the phenomena with numerical or analytical methods and fourth, analyzing new cases by doing predictions. All this components of the teaching and learning processes are linked in a learning cycle of four steps that is iterative, i.e., when it is finished the study of one of the five phenomena of motion designed, the students continue with the following event of motion, repeating the four steps of the learning cycle, until all the phenomena have been studied. But, besides of repeating procedures in this learning cycle, the physical concepts, the experimental techniques of data collection and the mathematical analysis for modeling the phenomena of motion are also repeated. The consequences are that students increasingly appreciate the finer details of each event, because they are already familiar with the common aspects of these phenomena and they can put their attention on specific aspects more complex of each one. This is an overview of the learning process followed by physics students with the learning cycle described above, which later will be expanded, with the discussion of the results of its application to a group of students and the conclusions reached.

Searching for the Velocity Distribution of Thermionic Electrons: an Inquiry-Based Approach

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Lab-work is a relevant part of the Inquiry Based Science Education (IBSE) approach. It is problem based and the designing of critiquing experiment, planning investigations and constructing models are basic competences involved in inquiring. To perform qualitative experiments is the ground of conceptualization, yet quantitative experiments can better contribute to make evident the epistemological meanings that relate experiments to phenomena as well as to disciplinary models. Moreover, some concepts relevant for the constructions of scientific models are very often directly translated from mathematics without an accurate reflection about the physical meaning of applying a mathematical language to a physical quantity. This is the case of the distribution function that is involved in many physical contexts where it is used as a representation of system properties without any investigation about the meaning of such a type of representation.

The understanding of statistical distributions plays a very important role in any undergraduate physics curriculum. For example, the concept of distribution of molecular velocity is the basis of the kinetic theory of gases, which explains many fundamental gas properties. However, not many laboratory experiments related to this topic are actually available in supporting students in the comprehension of such a concept. In fact, experiments concerning the selection of molecular velocity, even if very simple from a conceptual point of view, are difficult to perform, during an ordinary undergraduate laboratory section, because of the complexity of the required instrumentation. As a consequence of the strictly theoretical approach, usually reserved to this topic, students often consider it as a pure mathematical abstraction.

In the framework of an inquiry-based learning approach we designed a simple experiment aimed at involving students in learning the concept of distribution and its related properties by investigating personally relevant problems. The experiment makes use of a vacuum tube that, in spite of the fact that this kind of devices are nowadays technologically obsolete, reveals very useful in studying both the thermionic electron emission from the hot cathode and the electron velocity distribution.

The paper will describe how the experiment has been used in a laboratory for undergraduate engineering students in order to stimulate processes like diagnosing problems, critiquing experiments, planning investigations and constructing models that describe and explain experimental data.

1

Fostering representational and experimental competence considering students' prior knowledge in middle school physics classes

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When students acquire knowledge by observing or conducting an experiment, they construct multiple internal representations. These representations are influenced by former schemata in long-term memory and act as cognitive instruments for the construction of propositional representations and mental models of the experimental processes (Schnotz & Bannert, 2003; Schnotz, 2006). Considering this relationship, it is necessary to keep in mind the impact of students' prior knowledge on learning from experiments to explain cognitive processes in learning science.

The special difficulty in physics stems from the fact that students' former schemata are composed of physical concepts based on everyday experiences. This common-sense understanding interacts with the new knowledge acquired in school (Wiesner, 1992; Duit, 1993). Research into overcoming students' preconceptions has a long tradition in science education and cognitive psychology (Tyson, Venville, Harrison & Treagust, 1997). However, few studies investigated the interplay of preconceptions, external representations and the construction of internal mental models in physics. For this reason, this research aims to implement instructions, which take into consideration students' prior knowledge being reflected in external representations (Cox, 1999), in order to support students in creating "scientifically appropriate" representations.

The domain of the study is geometrical optics. Two classes of the 8th grade of a German Gymnasium have generated real pictures by using a spherical concave mirror. Two conditions have been implemented: the first condition has included instructions taking into consideration students' ideas about picture formation. In contrast, students' ideas about this issue have not been addressed in the second condition. In both conditions students have been encouraged to use various kinds of representations. A cognitive task analysis (Gagné, Briggs & Wager, 1988) was prepared to recognize cognitive demands of the experimental design and data analysis procedure in geometrical optics.

The study is designed as a pre- and post-test quasi-experiment. The following variables have been collected: intelligence, especially visual thinking and spatial visualization, motivation in physics lessons, students' prior knowledge in optics, knowledge and problem solving in optics, the design of representations and the ability to deal with them in optics. In the framework of generalized linear model (GLM), analysis of covariance and multiple regression / path analysis are applied to detect changes in motivation, students' prior knowledge, knowledge and problem solving, as well as changes in the use of representations in optics. 2

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The Persian Young Physicists' Tournament (PYPT) and Physics Education

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There is increasing evidence that many students are unable to apply the physics that they have studied. In order for meaningful learning to occur, students need more assistance than they can obtain through listening to lectures, reading the textbook, and solving standard quantitative problems. We should guide students to construct concepts and to apply them in real-world situations. If students perceive the relevance to their lives, they are more likely to invest time in understanding the physics. If you teach physics in the context of everyday life applications, students are more likely to recognize other applications where physics enters their daily lives. To engage students through interactive exploration of the physics and through the creation of fun, challenges are one the most important parameters and these can impact their learning and their attitudes towards physics.

To substitute the traditional modes of teaching and learning physics with new one we are organizing different national and international programs which are either valuable to students or educators to improve their skills.

International Young Physicists' Tournament (IYPT) is one of the programs which Iran involved there from 2007. This tournament provides practice in interpreting various representations (e.g., formulas, graphs, diagrams, verbal descriptions). Scientific laws, principles and concepts can be better understood and experienced by the interactions of individuals solving problems in groups and in a laboratory style and the correlation between algorithmic mathematical skills and problem solving. To provide a program of educating and supporting teaching assistants, Persian Young Physicists' Tournament, PYPT, has been organized to develop assessment tools to evaluate student progress in problem solving, technical presentation in English which is not their native language, and team working. The 1st Persian Young Physicists' Tournament (PYPT) was in March 2008 which two selected teams participated in Austria (AYPT) and IYPT to get the first experience from this attractive challenge. Now any high school in Iran is able to request entry into PYPT which is carried out in a period determined by the PYPT Committee. The best teams will challenge in final and receive rewards but the best students with highest individually scores as the PYPT Regulations are selected and after education participate in International Young Physicists' Tournament, IYPT. IYPT is a competition involves teams of five high school students from all over the world, preparing solutions to seventeen problems in English. The rules for presentation of the results, opposition, reviewing and judgment by the jury are fixed in the Regulations of PYPT which is different from regulations of IYPT in some parts. To encourage more physics teachers and students who cannot compete in English, the Prize in Solving IYPT Problems Competition (PSIPC) will held each year in Iran and those who participate will receive an international certificate by the president of IYPT. The 3rd PYPT was organized by the IOC member of IYPT in Iran, the Ariaian Young Innovative Minds Institute (AYIMI), Amirkabir University of Technology one of the best universities in Iran, and Iranian Society of Marine Science and Technology. University partnership plays an important role in attracting more teachers and students to participate in this tournament. There are students and teachers from different schools and universities who are members of PYPT committee. To invite different neighboring countries like AYPT, PYPT will be as an international tournament from 2011 and AYIMI as a member of WFPHC is going to attract more sponsors in science competitions specifically in PYPT.

http://www.pyptonline.com
http://www.ayimi.org
http://phet.colorado.edu
http://www.phys.washington.edu
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Physics Education and Talented Students

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Physics Education Research is research into the learning, understanding and teaching of physics and the application of physics knowledge. Systematic studies indicate that universities and high schools students often have conceptual difficulties. So new approaches to teaching based on active learning and data analysis can help them overcome learning difficulties. Students should learn and experience physics laws and concepts with research to improve their creative minds. Our group has a broad range of programs in basic sciences especially in physic that include the role of experiments and its reflection in physics learning, motion between novices, transfer studies and the design and implementation of different competitions. Students need to be both imaginative and practical in drawing up their research proposals. To improve and promote the education of future physics, our students are encouraged to present their researches in different national and international competitions. Also findings from researches are published in national or international scientific journals or presented in conferences and meetings since this motivates students in active learning. High school Writing Competition (STC, Ohio Chapter) is one of them which three papers from Iran received certificates of honorable mention.

A BASE ON THE MOON:

This is the topic which was selected by one of the students to do her research and two methods have been proposed about building bases on the Moon by considering some important factors. The diagrams shown in this paper describe how these factors should be considered to design the bases. There are some important problems such as cosmic rays, striking by asteroids, vacuum, extreme temperature and breathing air that must be solved to build bases and researching locations on the Moon. By considering the most important of all, cosmic rays and strikes, two ways is offered: Underground Base and Over ground Base.

Underground Base: The Moon's surface is solid and its structure is like the Earth, but with fewer Silicon, Aluminum, and more Iron, Titanium, Magnesium and Calcium; also there are some colored rock of volcanic origin called Basalts. So it can be excavated in about 20 meters depth, easily or more if necessary, because we know that the Moon's radius is about 1738 Km and the distance to its core is about 1138 Km so we are kept of any extreme temperature, and the most important of all, the space radiations. It is necessary to cover all sides of this station by Lead (which melts in 327.45°C) to keep it from probable penetrating of radioactive rays, dangerous particles of cosmic rays and also from solar winds and high temperature.

Over ground Base: This base is made of a kind of plastic (fiber glass), a kind of liquid with high viscosity (like gel), a kind of hard and wide metallic (cast iron) fans/ plates and three steps are proposed to build this one as follows:

1- The outer layer is a very wide and tick plate of cast iron (which melts in 1536.5°C) and carbon (which melts in 3727°C) to block very small and hot asteroids, or reduce the larger ones velocity and even melting some parts by creating friction and high temperature.

2- Next layer is full of liquid (gel) with high viscosity to prevent high velocity and temperature and stop it from moving more.

3) Last layer is made of hard plastic, which can endure remaining forces.

*Having space cover (to produce pressure) to inject gas including O3 (the ozone circulation changes UV rays into IR rays with lower energy).

A revised state network of educating popularisers in science.

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Keywords: Programa Estatal de Formación de Talleristas de Ciencia, TIFE, IPICYT, San Luis Potosí, vulnerable population, populariser of science.

The "Programa Estatal de Formación de Divulgadores de Ciencia" (State Training Program for Science Workshop), PEFTC, has been developed from the experiences of IPICYT and TIFE, whose intention is to create platform for dissemination of science in major cities of the State, to support formal education. PEFTC program objectives are aimed at students and teachers of basic education levels, pre-university and undergraduate education in teacher education.

This proposal has created a network of workshops in secondary schools, high schools and teacher training colleges that will support formal education from the proposal of the popularization of science. At the same time, the PEFTC assist in the vocational guidance of students related levels, as well as the general population with special emphasis on vulnerable populations, such as orphanages, gangs, and some others.

Due to a comprehensive review, which must be presented at ICPE 2009 in Bangkok, Thailand and San Luis Potosí appearance of H1N1 virus, the PEFTC changed their strategies. Now, the main groups of popularizes of science are students being trained as teachers and members of gangs. One of the objectives of the Fondos Mixtos is allowing state governments and municipalities to allocate resources to scientific research and technological developments aimed to solving strategic problems, as specified by the state itself, with the sharing of federal resources. The chosen mode was Dissemination and Divulgation of Science.

The Programa Estatal para la Formación de Divulgadores de Ciencia, PEFTC.

From the increase of scientific and technological information in different media the popularization of science has become a necessity. Traditionally the capital cities have far greater access to the different formats of the popularization of science and technology that municipalities and communities. It is form them, that IPICYT and TIFE developed the PEFTC, State Network of Educating Popularizers in Science.

The intention of this project is to develop a program which promote training of popularizes of science in the form of workshops, with the support of teachers of basic education, teacher's training schools and degree in areas of science and technology. Groups will be integrated with their students' educational level. The motion to allow create workshops support supplemented and replaced scientific content of the formal education. At the same time, the proposal may promote the early career students of all levels near schools and allow the public in general is a branch of knowledge. The project gives priority to vulnerable populations as inhabitants of orphanages, prisons and gang among others.

The first one stage was the visit to the municipalities selected for the detection of teachers and students interested in the proposed group training workshops. The second stage was the performance. It last for 12 months, and consisted in the implementation of proposals for workshop in schools and places, giving priority to vulnerable people. The third stage is the collection and systematization of results. The duration of this stage is 6 months. In this point, the working group is gathering the experiences of groups and workshops are suggesting changes in the content and / or forms of work. Experiences were compiled from the public user to see the relevance of the proposed science workshops.

Improving the Learning and Teaching in Physics with Collaborative Education

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The University of Electro-Communications (UEC) has personnel who have acquired practical capabilities in the engineering, e.g., information science, mechanics and electronics, as well as in the sphere of integrated arts and sciences that are broadly related communications. Staff members of the departments of mechanics and electronics educate general physics for 700 freshmen. Based on our study [1] of the blended leaning between e-Learning and the on-going projects of "clickers", we found that conventional teaching or learning approaches, i.e., teachers educate physics concepts and show problem solving, are less effective that modern approaches such as active learning [2].

Making use of these educative efforts effectively, we have organized a new working group, and have constructed Collaborative Education. The Collaborative Education in UEC (CEUEC) has four aspects: (1) Students and teachers share learning content and the achievement of physics. (2) Teachers share instructional materials and the teaching methods. (3) Students share experiences of understanding the essence of physics through enthusiastic discussion. (4) The university and society share educational content by publishing the results of student learning.

We have reconstructed our physics curriculum for freshmen. Staff members of the departments together with us have started to educate students using CEUEC from 2010 first semester. In this poster, we report on the details of CEUEC and the execution results.

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The Developing Motivation in Physics by Means of Science Presentations of New Format "Paradox Show"

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The problem of decreasing motivation to learn physics among the secondary school students is a very actual nowadays. That's why looking for the new technologies and improving the teaching methods are perspective in physics teaching and pedagogic.

The main goal of our research is theoretical and experimental substantiation and developing the innovative technologies of non-typical physics lessons. We have proposed the new concept of motivation to learn physics and to do simple experiments based on inquiry-based science teaching (IBST) at the lessons and beyond. It was proved that falling interest in key physics topic has been linked to the way they are taught from the earliest age. So the cognitive presentations in unusual format with elements of show as regularly extracurricular events have been worked up and their effectiveness have been examined.

Our research has based on the hypothesis that regularly using technologies connected with inquiry based science teaching (IBST) form a strong motivation to learn physics and improve the creative skills of the students aged from 12-15. The object of our research is a process of learning activity of the students. The first part of our pedagogical experiment has been made at the premises of two Kharkiv schools: Gymnasium # 47 and Lyceum # 116. There non-typical resumptive lessons had been presenting from 2006 to 2009. 302 secondary school students have been involved in the pedagogical experiment. Participants were divided into Control Groups and Experimental Groups. The several tests were proposed to the groups. The results of the tests have demonstrated the effectiveness of our methods. The second part of our experiment has been made at premises of Kharkiv Educational Centre for Gifted Students which is situated at Karazin Kharkiv National University. More than 1580 children aged from 11 to 15 have filled the questionnaire forms after interactive physics competitions which were called "Paradox Show". During the outreach events children were able to use household objects, simple devices and recycled materials (like plastic bottles or paper cans and others). It helps to improve the environmental security as so as simple explanations we have provoked children to make experiments and construct simple devices to understand physics principles and definitions much better.

We have achieved the results using impressive form of interactive competition with paradoxical demonstrations, hands-on activity and evolving skills of constructivism. Those presentations have helped to develop the cognitive interest of target audience to physics from the first stage - "mere curiosity" to second stage –"inquisitiveness" and then achieved the last stage-"professional interest" and wish to choose the carrier of science researcher as a main part of future life.

Cognitive Perspectives on Graphing

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Graphing is general skill which is useful for solving different problems in common life and above all in science. In past several misconceptions in graphing have been identified within carrying out of many researches (e.g. Beichner 1994, McDermott, Rosenquist, Van Zee 1987). Following the results several recommendations for improving quality of teaching have been suggested such as real-time laboratory graphing (for example Redish, Saul, Steinberg, 1997), special introductory lessons etc. These recommendations concern mainly physical (especially kinematics) graphs. A goal of science education should be not only students' training for science career, but also development of students' general skills. Why should be science education focused on developing general skills? General graphing skills are usually developed in math lessons (e.g. Leindhart, Zaslavsky, Stein, 1990), however science can add content to the abstract representation, which is important e.g. for scaling. Secondly, only functions are usually depicted in graphs (except statistics) during teaching math. In science lessons we can present graphs as a more powerful tool. Cognitive psychology can provide detail view of graph perceiving and interpretation, what can lead us to better understanding of graphing also in science education. A paper presents short review of cognitive researches, which have been focused on graphs. In particular, how graphical representations work, how people extract information from graphs (dual coding), recommendations for creating an easy-perceiving graph, difference between novice and expert reading of graphs. The text will be illustrated with examples, mainly from science. At the end issues for further research in this area will be suggested.

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The Role of Iranian Physics Societies in Physics Education

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Iranian Physics Teachers Societies has established and activated individually in different province of Iran. In 22/8/2002 there was a gathering to study the union's problems and to find a solution with participation of representatives from Teachers Educational-Scientific Unions through the country in Bahonar Camping, Tehran. As a marginal event t this gathering, representatives of Physic Teachers' Educational-Scientific centers form East Azarbayjan, West Azarbayjan, Isfahan, Khozestan, Zanjan, Sistan and Balouchestan, Tehran counties, Kohkiloyeh-Va-Boyerahmad, Gilan, Qazvin and Markazi had a special meeting as the board of trustees for the union and after discussion and debates formulated the basis and foundations of the union. Consequently the union articles was arranged and regulated. Then through invitation of Physic Teachers' Educational-Scientific Association of Isfahan province the first general assembly of the union was formed in participation of 14 members of the union. The union articles were approved in this meeting and the first executive council was appointed. The UESSIPT have developed their activities from provinces through the country. There is 30 societies of the Iranian province which are the member of UESSIPT which cover about 10000 physics teacher. They publish some books and a quarterly magazine for the news of the UESSIPT events and activities as well as some short reports about the educational experience of physics teachers. They have a regular meeting in every season and talk about the educational subjects in physics.

One of the main important aims of the UESSIPT is to make the people (Teachers, Students and their Family) interested to physics and arrange some activities include: Conferences, Exhibitions, Shows, Festivals, Talks and Seminars about physics in the country. The UESSIPT is interesting to improve its international cooperation with the physics societies. In this paper we are going to introduce the aims, programs and activities of UESSIPT.

Several experiments with heat for physics education at basic school

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A physics teacher coming to a class has two main tasks: to explain a specific part of physics to the pupils and maybe a more important task, not to deter his or her pupils from studying physics. One of the most important aids in performing this goal is a physics experiment. We wanted to find out a current state of physics experiments that are using at Czech basic schools (pupils aged 11 – 15 years).

We created a questionnaire to determine teachers' opinion about a current state of physics experiments; for example if they experience lack of instructions, equipment, money and time or if they have good conditions for making experiments in the lessons.

The questionnaire shows that teachers would like to do experiments but they usually do not have money for new modern equipment and they also do not have enough time for preparing experiments before lessons. There is also lack of time during lessons for showing experiments. They mainly appreciate new or updated experiments from astronomy, heat and acoustics.

The paper deals with several experiments with heat transfer using simple equipment. These experiments are parts of a set of experiments which can be used in physics education at basics schools. The author's experiences with using these experiments in lessons and in a hobby group are part of description of each experiment.

Low-cost Demonstrational Experiments on Classical Electrodynamics for Future Physics Teachers

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Classical Electrodynamics is one of subjects studied by future high school teachers of Mathematics and Physics at Charles University in Prague in the third year of their bachelor studies. (Two more years of Master studies are required for these students to become qualified teachers but most of basic physics lectures are included into their bachelor studies.) The lecture on Classical Electrodynamics follows a basic lecture on Electricity and Magnetism (two years before) with the aim to extend and deepen students' knowledge and understanding of this field. Up to now this lecture was only theoretical, being a part of the course on Theoretical Physics for future teachers. We decided to enhance this lecture and supplement it with selected demonstrational experiments – relatively simple, low cost and not time consuming but nevertheless also quantitative ones. Though most of these experiments could be also used in the earlier lecture on Electricity and Magnetism our experience showed us that this lecture is already "overloaded" enough. So it is useful to return to many effects, formulas etc. again in Classical Electrodynamics, at a bit deeper level and with better understanding using the experience students gained in their first two years of their studies. We now want to support this "second reading" of the topic also by demonstrational experiments.

The poster will present several experiments from the area of magnetism: demonstration of Ampere's law (using modular transformer used at high schools), non-traditional transformer (which we will not describe in this abstract in more details to leave the element of surprise to the poster), demonstration of the idea of multipole expansion etc.

The experiments will use only simple and cheap instruments (ideally being the "experiments for 3 Euros") to enable future teachers to use simpler versions of selected experiments also in their future teaching at high schools.

Active physics learning using probabilistic prognosis

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Efficiency of the lesson is a function of a series of factors, but to a large extent it depends on the students' motivation and attention.

One of the pedagogical techniques aiming at emotional activation and increasing motivation is the selective mobilization of attention which based on the knowledge of the typical misconceptions in the content of the teaching material and using the probabilistic prognosis (PP) theory. PP is an ability to foresee what events will follow the existing state with a greater probability. This prognosis is based on the probabilistic structure of previous experience, contained in memory, it seems to be one of memory's most important functions. On this presentation we will discuss how PP is related to the learning activity and creation of students positive emotional reactions.

This technique is efficient in cases when the lesson deals with something, on which the students have preliminary knowledge (even at the level of everyday routine), while for some of them this knowledge may be erroneous. At the very beginning of the lesson the students are asked a question related to the material to be taught. The question is formulated in accordance with the principle of multiple choice, while characteristic misconceptions should be presumed as possible answers.

After the student made his choice, he is immediately responded and provided with the correct answer. The discrepancy between the student's opinion (in case he was wrong) and the correct answer arouses an emotional reaction and increases his attention that very moment, when the teacher begins his discussion of the issue, which was misunderstood by the student.

Several video-documented examples of this technique will be done in reference to physics teaching (optics and mechanics) in colleges. An approach to learning, based on PP, proved to be successful in the teaching of science and math. Results of our investigation and teaching perspectives will be discussed.

Our research on SM method was conducted in two groups: first group of students of Jerusalem College, on the faculty for natural sciences, and second of students of one of Jerusalem secondary school. The students were divided into two groups, A and B. In the group A (the experimental group) the lesson was given using SM, whereas in the group B (the control group) the same material was explained in the traditional way.

On the next lesson the groups changed roles, so that group A became the control group, and group B became the experimental group.

On the third lesson both groups were re-united in order to participate in a lesson with the use of SM system. The above manipulations allow us to compare SM method with the traditional method, and minimize the influence of group diversity variable.

There was a week gap between the lessons. SM tests were given in the written form.

After the third lesson the students were given an evaluation questionnaire about the SM method. All the lessons were recorded on a video tape and then given to independent judges for evaluation. Judges' ratings were used to evaluate the activity level in the experimental group comparing to the control group.

On the first two lessons the teacher was getting "on-line" information about students' answers. On the third lesson students' answers were not reported to the teacher, but the emotional response and metacognitive triggering after the announcement of the wrong answer still remained significant.

Astronomy versus Spatiality: a Proposal for Science Teacher Development in Elementary School

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This research involves the development and evaluation of a course of continued teacher development in the subject of Astronomy, aimed at Science teachers of public schools in São Paulo. Around thirteen activities were produced, taking into account the development of elements of spatiality, like proportion and changes of perspective. The main reason for this focus is the great difficulty that teachers show in relation to what Piaget calls ‘centrality’ or ‘non-coordination’ of perspectives, that is, an attachment to the one and only first point of view, with a lack of articulation between what they see and what they study. In this way, the clash between the first and, sometimes, naive observations of the teachers and the particular scientific knowledge was part of all the activities in the course. Some of these activities were: debates about the shape of the Earth and other stars, movement of the Moon and the Earth in the explanation of the phenomena, the construction in scales of “time” and “space” dimensions in the study of proportion and dynamics of movement of the Solar System planets, a visit to a planetarium, and the study of a simulating program of celestial observation. The discussion about teacher learning in relation to form, proportion, and mainly, the establishment of connections between the whole and the part, in relation not only to astronomic objects like the relations between them through the phenomena were also part of the course. Ten Science teachers, who had already taught Astronomy subject matter in elementary school, participated in the research project. The tridimensional construction of the Universe in a model, done individually, was used as a pre-test. At the end of the course, another evaluative look from each teacher at their initial construction took part of the evaluation of the course. The methodology of analysis is essentially centered on the perspective of the analysis of the content matter. Two big analysis categories were constructed in the attempt to find characteristic elements of a spatial perspective, decentralized from a single point of view in the reconstruction of the model of the Universe, so as to establish a relation between the whole and the part in an articulated way, of the astronomic objects, as well as the phenomena. In this way, a comparison between the data found in the pre and post tests was done. As well as the data, the material was composed of recordings of the activities on video, recordings of the daily assessment of the members of the team of researchers in audio, and written records made by the teachers during the course. It was observed that the subjects that need more frequent changes of perspective were the most difficult to be understood, like the phases of the Moon, in which the moon and earth movements oblige us to constantly review their relative positions. The teachers report in different moments that their perception in relation to the Earth, the Moon, the seasons of the year, and the proportions of the Solar System improved considerably and that the tridimensional form of the activities was important for the understanding of the spatial composition of the stars, making the idea of these more real and dynamic for them. We observed from the nature of the teachers’ reflections that this course surpassed the dimension of the content, making it possible for them to rethink their own teaching practice as they became aware of the skills and difficulties inherent to the study of Astronomy.

Crafting of teaching practice in physics in relation to the choice of representation needed to enhance learning outcomes

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In the area of the teaching and learning of science recent contributions by, for example, Airey & Linder (2009) and Kress et al. (2001), have brought out a new significance in terms of examining the notion of "text" (where such text includes all semiotic representational items such as gestures, pictures, language, mathematics, graphs, demonstrations etc.). The perspective growing out of such work may be broadly described as one that views "modes" of representations in terms of their transformation over time, with aspects stressing the continued modification within scientific practices (for example, Lemke 1995).

A study was initiated to explore, from the teaching perspective, the use and experience of these disciplinary-specific representations in relation to the crafting of teaching practice (from the point of view of learners) in three introductory undergraduate physics learning contexts – geometric optics, mechanics, and electricity and magnetism.

The data collection was conceptualised in terms of Donald Schön's modelling of reflection-in-action and reflection-on-action (Schön 1983, 1987). University physics teachers' reflections on the representations that they chose to draw on for a given section of their teaching and the affordances for learning that they saw their choices presenting to their students were explored in open ended discussions. These discussions were recorded and transcribed verbatim. The transcripts were then used to characterize the teacher's reflection in relation to their perceptions of students-as-learners and their crafting of teaching practice.

The teacher's storylines reveal that their reflection on what representations to call upon for the crafting of their teaching practices could be characterized in terms of themes of taken for grantedness, pragmatism, and transaction vis-à-vis insight into how extending and enhancing the possibility of learning of physics may be achieved. These results suggest that in order for new significance to be seen for teacher reflection on representation in the teaching and learning of physics, further research is needed to explore relations between representation, crafting teaching practice, perceptions of learning, and learning outcomes.

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Computer based Tools for Development Physics Problem solving Abilities of Students

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Independent solving of specific physics tasks by students is the most important component of successful learning in physics education. Any physics task possible present as a small research problem thus solving it student learns as well basic physics concept and laws, as overtake by physics methods and using them in practices. Exercises in the tasks solution must be permanent, but for majority of students who are incapable to solve tasks independently it looks bore and difficult problem and as result frightens them off from physics. For overcoming these obstacles and help students cope with task solution independently we elaborate computer based tools for self-dependent learning of students.

The user interface for students includes 2 modes with learning and training possibilities. In learning mode student during task solving could get supporting help information relative with the task: theory, formulas, models, examples of similar tasks with solutions and so on. A student copes with the task get detail information about his solutions. In training mode student attempts solve task with assistance of system - step by step: the system follows for student's actions, notes mistakes, advices correct steps and permits solve although part of the task independently.

For tasks assigned for student's training and learning had been elaborated task solution scenario that subdivided on separated steps. Tasks are different, simple and not quite, with an original conditions and standard, but they help to student overtake with important physics terms and laws and as result allow him to combine theoretical information received on lectures with the active individual practice. After task choice is displays the task text with picture in the upper part of the page. Below the assignment of the task are present links to theory allocate with the task, to basic formulas, to animation of the task, scenario of solution and answer. For some tasks is possible to look the model also.

The scenario of solution is subdivided on steps that are placed on the same page below. There can be practically unlimited number of them. Every links open in separated window. This regime supposes several levels, with different permissible system assistance volume to student. Then less is a need in system assistance than is higher level of student. If student couldn't solve the task independently and opened all solution steps, system will suggested to him solve the same task with changing of parameters and check the answer. The student can move between different levels where he is stimulated explore the situations, asked questions and also finds help to answer on these questions.

Our paper devotes to description of the tools and inform about results of system using for student learning and teaching by university physics course. Data are presented showing student reaction to the use of this system and its impact on their attainment and their attendance at classes.

Usage of interactive animation in physics models as method for imagination development of students

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Ability to imagine possible ways of physics process development is one of the main compounds for successful physics problem solving. In our opinion, the main obstacle that prevents the majority of students from solving physics tasks independently is their poor imagination. Simple prompts of a tutor on steps of task solution are interpreted as a formality by most of students. It appears that stimulation development of students' imagination in addition to teaching of specific task solving methods is an important component of successful physics learning. We believe that animation of complicated systems with repeat movement is vital in improving imagination activity and its training.

Interactive elements that allow change of system parameters, conditions and effectively final results of a task can provide additional boost to student's imagination activity. In our opinion, including physical models and tasks with additional interactive animation would be an effective method for imagination development of students. We began working on elaborated user interface for students with the usage of animation in physical models about two year ago and now our base includes 15 models (almost all are currently in Mechanics) and close to 30 tasks with animations and developed solution scenarios. The models were designed by using Flash MX and ImageReady facilities, which allow creation of short stand-alone movie clips as well as built-in HTML-page animation.

Before the model execute need specify system parameters, initial and boundary conditions. After inputting these parameters and pressing button ‘Run’ displays output parameters. All required tools to permit the change of the system’s parameters, for example: mass, size, initial condition of tasks and so on, can be found on the control panel. Take, for example, a model developed specifically for learning of Kepler’s Laws which represents movement of Earth satellites. It is possible to set the starting point and initial velocity of a satellite. After specifying these parameters and pressing the button ‘Run’, the program displays satellite motion on elliptic orbit and orbit’s parameters (semiaxis, eccentricity, orbital period).

The following article outlines our first steps in this direction and our preliminary expectations. Based on our experience so far, we can certainly say that additional interactive animation of specific physics task is a very effective method for developing of students’ imagination and is considered extremely helpful from students’ point of view as well. Most students positively rate animation in physics tasks and majority of them believe that it helps them in understanding process and tasks resolution in Physics. We now only have a small number of animation models at our base so it is too early to say just how effective their usage is on students’ abilities. We can, however, safely say based on our experience at this stage, that using such models allows students to feel more confident with studying Physics, to better understand the role of all parameters of one or the other channels of physics process development and better operate within them. Another positive aspect is a possibility to offer students a solution to a similar task with the changing of parameters or problem specification. Our experience shows, that the majority of students who were previously incapable of solving tasks independently now cope with same tasks much better having worked with our models. Our next goal is to create more animated models and scenarios to apply to every aspect of University level Physics course at least as resource on early stages of learning.

The impact of Technological Advances in Higher Education in Sub-Saharan Africa: Case of Mathematics and Physical Sciences

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The past decade has seen great technological advances that have made significant changes in the teaching of Mathematics and Physical Sciences. Developments in computing and communications, in particular, are helping to accelerate these changes. The ability of computers to calculate definite integrals, to solve complex equations and to simulate natural phenomena has a direct impact on the way of teaching. Thus, the introduction of new technology in education requires the implementation of new teaching practices.

The context in the universities of sub-Saharan Africa is marked by a lack of financial means and an insufficiency of material and human resources. In comparison with universities in developed countries, those of sub-Saharan Africa have not yet truly integrated the systematic use of new technologies in the teaching of Mathematics and Physical Sciences.

The state of teaching in sub-Saharan Africa shows that the use of new technologies could make it possible to fight against the disaffection of the students for Mathematics and Physical sciences. Consequently the integration of new materials in teaching becomes more than one need. However, the institutions of higher education in sub-Saharan Africa will have initially to answer two fundamental questions:

- How?
- With what resources?

Integrating new teaching materials will necessarily be accompanied by specific equipment for classrooms. Experiences across many sub-Saharan Africa countries prove that the barriers come rather from the lack of qualified personnel in the use of new technologies having also an adapted pedagogical training. It thus appears the need for training the teachers in quality and satisfactory quantity.

Thus, it will be possible to solve students massification problem in classrooms, and to arouse their interest to Mathematics and Physical sciences. In physical sciences, for example, practical works by simulation constitute a true attraction for learning and support the comprehension of the concepts approached. Collaboration between African university partners as with those of North will be also reinforced through a collaborative platform of the use of new technologies in the teaching of Mathematics and Physical sciences.

Computer simulations enhance qualitative meaning of the Newton's second law

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Newton's second law is the most important and useful equation in mechanics. This law gives the relationship between force and motion.

Researchers have increasingly showed that students don't have a clear idea of Newton's second law. To many students the force is the cause of motion. Their "misconceptions" produced by the common sense evidence are highly resistant to change. It is important for students to know what the connection between force and motion is.

The Newton's second law in many textbooks for undergraduate level is treated so abstractly and students can't reach a Newtonian view of the connection between force and motion. If the study of all kind of motions is done over the second law and not in separate parts, student's conceptual understanding of mechanics will be increased. The main task of mechanics is the study of the motion's state of the mechanic system through determination of coordinate versus time. The solution of this task is determined when is known the initial state of motion of the particle and when is recognized the specific character of the forces as function of coordinates of the particle. Solving Newton's differential equation we are able to describe how the state changes in time.

Computing and communication technology continue to make an increasing impact on all aspects of education. Easy Java Simulations are powerful didactical resources that give us possibility to focus our student's attention on the physics principles. Using Easy Java Simulations we can create our simulations through which will be studied the motion of a particle under the action of a specific force. In this paper we present the design and development of simulations aiming better understand logical and conceptual aspects of the Newton's second law. They are webbased applications by running web browsers Easy Java Simulations (EJS).

Keywords: Newton's second law, motion, force, change of the state, conceptual understanding, simulations, computational modeling.

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Medical Biophysics Curricula for First Year Students of Medicine and Dentistry at Masaryk University, Brno, Czech Republic

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Medical Biophysics is one of the subjects taught in the first year of Medical and Dental studies at the Medical Faculty, Masaryk University, Brno, Czech Republic and has been part of these study programmes since the foundation of the department in 1920. The content includes general biophysics (physical phenomena in living matter, influence of physical agents on living matter). medical device physics, physiological biophysics (vision, hearing, cardiovascular system mechanics, and bioelectrical phenomena) and an introduction to health care informatics. All the teaching is done in the first semester of the first year (3 hours of lectures and 4 hours of laboratory practicals per week, it means 105 hours in total). In the case of the Dental study programme, the number of lectures is reduced by a third and the content by about 20%. Student assessment is via a multiple-choice filter test and an oral. In our contribution we describe the content of the curriculum and discuss the connection between the level of student prior knowledge of physics on entry to the programme and success or otherwise in subsequent knowledge assimilation and competence level achieved in practical measurement skills. During the fifties the curriculum was designed using a 'general physics applied to medical purposes' approach and was mostly medical device oriented. Later on (partly under the Soviet influence) the emphasis shifted towards general biophysics. Owing to the ever increasing number of medical devices used in diagnosis and therapy we have over the last decade reduced the general biophysics element and have shifted the emphasis back to medical devices. We now consider that the aim of our subject is to acquaint the student with the physics principles underpinning the quality (i.e, clinically-effective and evidence-based), safe (safety from physical agents), and economic use of medical devices.

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What topics should we include in the physics component of the entrance examination for medical schools?

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One of the duties of the academic staff engaged in teaching at the Medical Biophysics department of the Medical Faculty, Masaryk University, Brno, Czech Republic, is to prepare sets of physics test questions for the entrance examination of Medical and Dental students to the faculty. This practice is common to all Czech Medical and Dental faculties because it is considered inapt to start Medical or Dental studies without an appropriate minimum knowledge of physics. The physics entrance test also assesses indirectly the applicants' ability for logical and abstract thinking in general. We are aware that physics is not included in the entrance examination of all Medical and Dental faculties in Europe and we see the effect of this in many students from EU states studying in our English study programme. In fact we are faced with students whose understanding of the physics concepts utilized in modern medicine (e.g., energy, temperature, heat, electric current and voltage, radioactivity etc.) is very low. In this contribution, we present the list of general pre-university physics topics which we expect students to be familiar with for their entrance exam. It is based on our long-time experience in the teaching of Medical Biophysics to Medical and Dental students. Content is categorized in the following areas of general physics: quantities and units, kinetics, forces and motion, periodic motion, energy and work, sound and electromagnetic waves, properties of matter, electrostatics and electromagnetism, electronic circuits and circuit elements, geometrical optics, atomic and nuclear structure. We compared our content with that recommended in the 'Content Outline for Physical Sciences Section of the Medical College Admission Test (MCAT)' of the Association of American Medical Colleges and found a very high level of convergence. Moreover, both institutions use exclusively the multiple choice format.

Association of American Medical Colleges. Content Outline for Physical Sciences Section of the MCAT. Downloaded on 5th March 2010

from http://www.aamc.org/students/mcat/preparing/pstopics.pdf

First experience of teaching General Biophysics to Biomedical Technologists

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In September 2007, a new first cycle Bachelor study programme in Biomedical Technology was launched at the Faculty of Electrical Engineering and Communication, Technical University, Brno. This programme is based on close co-operation between the Faculty of Electrical Engineering and Communication and the Medical Faculty, Masaryk University, Brno. It reflects the need to enhance mutual understanding regarding biomedical devices between professionals graduating from medical and healthcare faculties and those professionals coming from a technical background. The expansion in number and sophistication of medical devices means that their full scientific, effective, safe and economical use is moving beyond the competence of most medical doctors and other healthcare professionals. Therefore, biomedical technologists would in the future increasingly exercise an advisory role regarding the quality use of medical devices within the healthcare service. Unfortunately, biomedical technologists and engineers have in the past often been found to be unable to communicate effectively and using appropriate medical terminology with their medical colleagues. This resulted in an inappropriate level of inter-professional communication and consequently an undesirable effect on the quality of patient care. It had become evident that the only solution to this issue was to increase substantially the biomedical component of the study programme in Biomedical Technology. One of the biomedical subjects taught – General Biophysics is delivered by our department. Student feedback was positive according to the discussions with students. The first students were taught and examined in the school year 2008/2009. Student assessment was based on a viva voce examination. The total number of examined students was 54, 11 % were marked by A, 24 % by B, 22% by C, 11 % by D, 8 % by E, and 13 % by F, 13 % were not examined. These results are better than those reached by e.g. students of Biophysics (Faculty of Science) which is a proof of a good study effort.

The preparation and initial phases of the programme, as well as, this contribution are supported by a development project of the Czech Ministry of Education, Youth and Sports entitled "C42 - Inter-university co-operation in biomedical techniques and biomedical engineering using state-of-the-art technologies" (running in 2006, 2008, 2009 and 2010).

Eolic Energy: a Thematic Alternative to Approach Concepts about Electromagnetism

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The present paper is a description of a project applied with students of the High School's 3rd level that consists in the construction of an eolic energy generator. Fifteen lessons are necessary to contemplate the physical concepts as torque, mechanic energy, electromagnetic energy, energy transformation, conductors and dielectrics, electrical resistance and electrical generators. Our main goals are to identify the applications of energy in everyday life, manipulate the experiments and get autonomy with students' socialization.

As the main epistemological bedding to analyze the students' learning, we use the psychological education of Vygotsky [1,2]. In this theory, one of the main ideas is that learning comes first of development. Thus, in the activities we consider the knowledge that the students learned and the concepts that they are capable to learn. These concepts are related to the zone of proximal development, which is characterized by the learning. Related to Novak's theory, we constructed conceptual maps about the physical concepts considered. These maps are used to organize into a hierarchy the concepts' forms, and it has been served as an instrument that facilitates a significant learning of the students.

We noticed a high number of students' participation, who included some modifications in the construction of the eolic generator - if we compare it to the initial project. The students have discussed among themselves and with their teacher in order to construct concepts involved. They comprehended the importance of this energy gender for environment, the limitations of it - because it needs wind, and the relations between some physics' different areas.

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[2] L.S. Vygotsky: Pensamento e Linguagem (Editora Martins Fontes, Brazil 2000).

Constructing a Solar Heater of Low Cost with Students of High School

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In this work we present the description of a project applied with students of 1st level of High School that consists in the construction of a solar water heater with low cost materials. The twenty necessary lessons are contemplated of physical concepts as thermometers and thermometric scales, waves, electromagnetic waves, propagation of heat, sensible heat, latent heat, thermal capacity and hydrostatic pressure as well as the experimentation which involved the construction. Concepts related to the domestic economy and environmental questions as conscientious consumption of water and electric energy, and power sources with its environmental impacts, also had been contemplated.

Our theoretical bedding to analyze the students' learning was the advanced organizers of Ausubel [1]. His theory is based on the idea that learning is facilitating, since the learner finds the meaning in the new information. If a connection is made between the new information and previous knowledge, the learning experience will become more meaningful to the learner. Therefore, the new information will be learned. In relation to this theory, we constructed a conceptual map about the physical concepts involved, which is used to facilitate the advanced organizers.

In the project's application, we noticed a considerable interest of the students and a improving of their learning. They showed up with questions that other students knew answers. In other cases, they asked questions that the teacher had to reformulate to remind them about other concepts. And sometimes the students were able to construct the involved concepts.

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A detailed Lesson Plan: Unit of “Vector

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Many high school teachers complain about not finding a detailed lesson plan for physics lectures. They expect that there should be as many daily lesson plans as prepared by especially academic educators.

Thus, the purpose of this study is offer a well organized lesson plan as a model about “vector” unit for 10th grade high school science students. Turkish high school physics program is completed in four years and unit of “vector” is given within “force and motion” unit at second year of this program when students are at 10th grade level. The reason selecting “vector” unit as research topic is that, ample researches on students' conceptual understanding show that students have difficulty in understanding of vectorial physical quantities such as force, velocity and electric field. That is, this unit can be considered as a base for learning many physic concepts. Thus, it is thought that only if the real meaning of vector quantities is understood clearly by students, they can understand other physic concepts more easily.

The lesson plan mentioned in this study includes many things that teachers look for. Timing, objectives, instructional materials, technologies, and media, teaching strategy, preparation of teacher, pre and post assignments are all given deeply in twenty five pages deeply. Thus, who one read this plan can easily understand what has to be done. Moreover, a power point presentation and one paper handout were prepared as additional teaching materials. Handout includes definition of some specific concepts such as vector quantity and some objective type questions written in short answer type.

Pilot study of practice teaching in classroom environment was done to five-year pre-service physics students and this presentation was evaluated by an association physics professor and three physics researches assistants by using a checklist. Classroom environment was constituted to be convenient to real classroom setting. For example, five-year pre-service physics students behave as high school physics students. That is, they try to think what high school students can ask and difficulties that high school students can face. The checklist used for evaluation includes thirty one items. Each item interrogates whether the presenter be successful or not. For example, for item 27, 0 point given for no relationship between lesson and daily life; 1 point given for giving only one daily life example without any explanation; and 2 points given for explanation about where, why and how it used in daily life. The average score of this practice teaching was 90 out of 100 according to these observers. After taking feedbacks on strong and week points of the presentation, final format of lecture plan was formed.

A drop of liquid crystals in school

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The development of modern science and technology brought liquid crystals into everyday life. Many people are aware that liquid crystals are present in displays, phones, laptops… Technologically they are used in systems where fast response is needed. The main properties of liquid crystals which make them useful for application are the optical anisotropy and birefringence.

Despite the fact that liquid crystals are quite common, youngsters have limited knowledge about them. Most of the students who had heard about liquid crystals relate them to displays. These results show that further work on this interdisciplinary topic, which should be carefully included into physics and chemistry curricula, is worth the effort.

In this contribution we present a teaching unit with an emphasis on experiment enabling the observation of the variation of the extraordinary refractive index as a function of the direction of light. The teaching unit was tested among the first year undergraduate students of physics education.

The teaching unit is composed from a lecture in duration of 90 minutes and a practical laboratory work of the same duration at chemistry and at physics. The lecture explains basics about the liquid crystals as materials having a peculiar phase between the commonly known isotropic liquid and crystalline state. Then the lecture introduces the optical properties of liquid crystals and the technology of LC displays.

A part of teaching unit is also an experiment for more illustrative explanation of the birefringence of liquid crystals to the undergraduate students.

The most common experiment to demonstrate double refraction (birefringence) is a doubled image of an object observed through the calcite. When a polarizer is placed behind the crystal or in front of it, one of the images disappears if the polarizer direction coincides with one of the polarizability tenzor eigenvectors. Although the doubling of images is persuasive for a physicist, additional extensive explanation is necessary for students who are confronted by the phenomenon for the first time.

Based on the ideas and work by Shenoy (1994) we designed an experiment, which presents qualitative and quantitative measurements of the angular dependence of the extraordinary refractive index in a uniaxial nematic liquid crystal. For this purpose special wedge cells were designed, which differ in the directions of alignment of liquid crystal molecules. There is a limitation to the proposed experimental setup. Although the light with the ordinary and the extraordinary polarization can propagate in any direction, experimentally we are limited by the refraction of the incident light, since the light source is outside of the birefringent material. The cell size and the cell holder additionally limit the incident angle to less than 45°. However, by putting the wedge cell between two prisms we can increase the incident angle to more than 45°.

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Physics virtual experiments in Model Vision Studium

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One of the most difficult problems in teaching physics is real-world experimental skills training. Real world experiments are often used, but it is too expensive. Computer simulations can be helpful in many cases instead. Computer model must be cheap, variable, and must present initial example to make pupil's own model. Menu, Help, Tutorial, and Teaching materials must be in student's native language. Nealy all these requirements are satisfied by Model Vision Studium [1] developed by MvStudium Group [2,3]. Experiments with the given models and making mathematical and then computer models of the real world phenomena are good tools for student's understanding assessment. Physical phenomena simulation is important in the main physics education consequence: theory – solving theoretical and applied problems – virtual and real-world experiments – assessment.

MvStudium is a high-performance visual environment for the modelling and simulation of multi-domain component models of complex dynamical systems. MvStudium employs a userfriendly, high-level, object-oriented modelling language for fast and efficient design of complex models. MvStudium builds continuous, discrete and hybrid (continuous-discrete) models which can be used to perform interactive computational experiments with clear visualization.

It is for users who devise complicated and labour-intensive numerical computational experiments or wish to create new applications based on mathematical models.

Main fields of application:

- Learning and Training.
- Scientific computational experiments that require high-performance comput-

ing, including hardware-in-loop and real-time simulation;

• Equation-based modelling of physical, technical, chemical, biological and macroeconomic systems and processes, particularly where these models must be embedded

within a complex application.

• Model-based design of technical systems, multi-domain and physical modelling.

• Design of model-based computer simulators and visual models.

Several virtual workshops in the course of General Physics (Mechanics) developed in Model Vision Studium simulator are presented: “Motion investigation using Atwood’s machine”, “Bullet velocity determination by kinematic and dynamic methods”, “Measuring moment of inertia of a bicycle’s wheel using dynamic and oscillation methods”, etc. These workshops are very similar to real world workshops in the General Physics Labs of the Moscow Pedagogical State University and we use it as an additional home study for campus students. Furthermore it can be used in Physics distance leaning as initially it was developed for open education portal. “Physical pendulum oscillations” [4] is a workshop with real-time simulation and at the same time simple real world experiment with hand-made physical pendulum – modified additional computer mouse. Modification is so simple that it can be done by many students and thus it can be recommended as real-world and real-time computer experiment in distance leaning or just for fun.

The new version of Mvstudium (v.6) supports building blocks with non oriented connections that enables to simulate mechanical, electrical, hydraulic and gas circuits. This new feature is illustrated by “RC – circuits investigation” workshop. Brief comparison with the other simulation software is also presented.

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Learning Approaches via National Physics Education Workshops

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The teaching of Physics is in critical situation all over the world. Students think that the subjects are too difficult and boring. In reality, the textbooks are often very theoretical and their topics are far from the everyday life. Due to the rapidly increasing amount of scientific results and their modern technical applications textbooks are not up-to-date. It is important to find interesting task which are connected with real life in order to gain back the students' interest.

Therefore teaching styles (approaches, strategies,…) are changing with time. The choice of selecting suitable style depends on several factors.

It is generally accepted that quality of the long term results of Physics education depends on a suitable initial and life-long teacher training.

So the teacher training organizations in each country are responsible to recognize, plan, support and help to gain Physics teachers knowledge.

The Union of Scientific and Educational Society of Iranian Physics teachers is one of the most important organizations is responsible for this aim. It hopes to gather together teacher trainers, scientists from universities and industry, researches in Physics education and school teachers united in a common aim to improve the quality of Physics education. The interaction between this union and International researches in Physics education helps us to plan:

The workshops support to the learning in different topics, worldwide software products, hands on activities, real-life experiments, and physics lab. As part of our active involvement in supporting physics in high schools, The Union of Scientific and Educational Societies of Iranian Physics Teachers arranges workshops this year for experienced and practising teachers of physics.

The component of the programme is devised to update participants on innovations in physics education and in curriculum matters. «Hands-on» workshops afford teachers opportunities to try new equipment, develop new IT skills, learn new experimental techniques, try out novel investigations and engage with alternative teaching and learning strategies.

The summer school for physics teachers in the field of research and education.

The summer schools bring together physics teachers from across Iran to explore contemporary issues in physics education, enriching their teaching and learning skills .By providing a forum to meet, discuss and enjoy physics, the summer schools draw physics teachers into the wider group of professional scientists, helping teachers to feel that they are part of the physics community and enhancing their work as educators.

The main reasons for physics teachers to participate in these activities

↑ to update their knowledge of recent developments in physics;

↑ to explore new practical activities and resources for use in the classroom;

↑ for opportunities to talk informally and share ideas with other physics specialists;

↑ and, through their own teaching, extend and enrich students' learning.

Interaction between educational research and teachers in each country shows that many aspects are as important as disciplinary contents, such as sharing educational experiences connecting different fields of knowledge, using non formal languages, opening towards new technologies, hands on activities, lesson planning for schools without enough space and facilities for physics lab, simple physics experiments for high schools, the history of national physicist and their discoveries, …..

1-Yunebae Park, Teaching and learning of physics in cultural contexts, 89-95.

2-Edward F. Redish ,Matilde Vicentini , Societa Italiana di fisica, Research on Physics education ,Volume 156.

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4-American Institute of Physics .National Science Education Standards.

Contemporary physics of nanoworld: a learning system with positron-electron annihilation spectroscopy

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Nowadays, at the beginning of the third Millennium, the physics of positron-electron interaction facilitated in the measuring technique known as positron annihilation lifetime spectroscopy (PALS) has became one of the most informative branches in the modern materials science, playing a pivotal role in non-destructive materials characterization. Being a powerful tool to study atomic-deficient free-volume structural formations in solids at different levels of their nanoscale organization (crystals, glasses, ceramics, thin and thick films), the positron nanophysics, nevertheless, has been faced with significant difficulties because of huge number of tested substances. So the combined efforts of physicists, chemists, engineers and materials scientists should be rearranged now to facilitate the educational process in positron nanophysics.

In this report, we analyse a novel learning system in positron-electron interaction nanophysics developed around three interconnected parts:

- theoretical methodological basis serving as unique characterization tool for atomic-deficient nanovoids in solids;

- experimental measuring basis being PALS facilities exemplified by an ORTEC spectrometer and LT PC-aided program to study positron-related physics phenomena with different mathematical fitting procedures and
- experimental materials basis being new kinds of solids for advanced device application, inc. disordered substances, functional ceramics and glasses.

The advantages of the developed learning system will be clearly demonstrated at the example of international university-industry collaboration link between Institute of Materials of Scientific Research Company "Carat" (SRC "Carat"), the Ukrainian materials science leader in industrial electronics, and Institute of Physics of Jan Dlugosz University of Czestochowa, one of the known university institutions having rich traditions in experimental positron nanophysics.

A contribution to understand wing lift

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How do airplane wings work? How does the shape of an aerofoil affect its lift? These questions are argued in many school classrooms, but the correct answer is still a cause of controversy. This controversy is related to the misleading "aerofoil-shape" explanation, which relies on Bernoulli's equation, made popular by widespread use in children's science books, magazine articles, and pilot's textbooks. On other hand, explanations to the general public based upon circulation, curvature streamlines or Newton's laws are scant.

We believe that the conventional explanation of aerodynamic lift based on Bernoulli's equation is eventually the most common mistake in the presentations to school students. The fallacies in this explanation together with an alternative explanation for aerofoil lift have already been presented in an excellent article by Babinsky (2003). However, in Babinsky's explanation, the air friction forces are ignored and the flow field curvature introduced by the aerofoil shape is understood intuitively.

To contribute to a more precise qualitative explanation, Silva and Soares (2010) have presented a simple analysis of the lift with the air friction included. This explanation is based on the generation of a gradient of pressures around the aerofoil, as consequence of the centripetal force created by the air viscosity, Coanda effect (Raskin, 1994) and shape wing.

According to its transversal condition, the wing lift phenomenon is also presented as a reference physical situation which can be profited to teach some contents of a classic mechanics chapter to school students. We refer, as example, the Newton laws and fluid mechanics.

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Electronic Database of Solved Tasks in Physics

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To solve physics problems is a key ability which students should reach during their physics education. Students at our faculty practice this ability during specially designed seminars accompanying each physics course. But there is lack of time to solve enough problems especially for students with worse previous education. For these students the common (unsolved) collections of problems are not very suitable for home study because students are incapable to solve them independently. On the other hand, reading solved problems is an ineffective way how to learn to solve physics problems as well.

We have been developing for five years an electronic database of solved problems. Structure of the problems' solutions is specially designed to substitute tutor's help during lesson and encourage students to solve at least some parts of a problem independently. That's why there are various hints, notes with laws and formulas, plots and other means supporting students' will to solve problem independently before reading the detailed solution.

The database is placed at the website of the Department of Physics Education, Faculty of Mathematics and Physics, Charles University in Prague, the link is:

http://www.fyzikalniulohy.cz/ (Czech version). Nowadays there are more than 300 physics problems divided into chapters Electricity and magnetism, Mechanics and Thermodynamics. The difficulty of most problems corresponds to high school or university level.

The database has already been presented on GIREP conference in 2009. The major news of last year development are: A new chapter Thermodynamics containing about 60 problems has been added and intensive translation of tasks to English has started. The English (and international) version of the collection is placed at: http://www.physicstasks.eu/. In cooperation with colleagues from Poland we are going to translate and prepare some tasks in Polish.

The poster will present new targets to be achieved in the development of this collection, as well as our experience with using this tool in university and high school physics courses. Users' opinions on the collection will be mentioned too.

Feasibility of processing previous ideas about led force with conceptions associated with acceleration

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We analyze the feasibility of using the acceleration as a way to transform the previous ideas regarding the concept of force, in order to make a proposal for a course where the acceleration is conceptualized as a measure of the intensity in a process of interaction. Acceleration is fundamental concepts in physics which is taught in mechanics at all levels and is common introducing the acceleration using an operational definition. For the analysis different groups were selected, one group was taught using project-based teaching which learning-focused approach in the treatment of problematic situations of interest associated with traffic accidents and, the second group was subjected to the traditional process of teaching, with curriculum focused on content. Both groups are taking a university physics course similar in use and cognitive development. The results infer that the proposal is feasible and can help improve the learning process and help in the eradication of previous ideas associated with the concept of force and improve the orientation of the learning of physics as a construction of knowledge through the treatment of problematic situations.

Keywords: Acceleration, force, learning, didactic proposal.

Lectures on physics for pre-school age children.

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Lecturing on physics for children in kindergarten is a true challenge and an exceptionally difficult task. If the lectures are to be successful, they can not be an attempt at building systematic knowledge. Their only aim should be giving inspiration to search for new areas of interest, initiating and provoking to explore them, and directing children's natural curiosity. Real, physical experiments, if accordingly planned and performed, may become a perfect and indispensable didactic tool for that purpose.

Introducing new concepts and ideas as well as creating a basis for future knowledge, requires using some pretexts and associating ideas with everyday life.

The specific character of such experiments is shown with the use, as an example, a lecture on physics entitled „Physics in balloons".

The experiments presented to kids have to be as simple as possible, easily perceived and, first of all, engaging them personally. Toy balloons seem to be universal and brilliant educational equipment for this purpose. Balloons are well known and familiar to every kid. Some experiments with balloons are very well known and children like to perform them very much. However, there is also a rich variety of less known, surprising experiments with balloons, which can be used to initiate discussions and to introduce many basic principles and laws of physics. With the help of simple presentations, the concepts of gravity, atmospheric and hydrostatic pressure, Pascal and Archimedes' principles, conservation of linear momentum, conservation of energy, electrostatic forces and electrostatic induction as well as many other can be introduced and explored.

Learning about the Nature of Science from the History of Modern Physics: The Case of Superconductivity

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History of Superconductivity: Heike Kammerling Onnes succeeded to liquefy Helium in 1908 and at his laboratory in Leiden Superconductivity was discovered in 1911 as a low temperature phenomenon. It was observed that the resistance of mercury (Hg) vanished "abruptly" below 4.19K. Later in 1933 Walther Meissner and Robert Ochsenfeld discovered the so-called Meissner effect: the expulsion of magnetic field lines from the interior of a superconducting bulk material. The discovery of superconductivity and related phenomena came as a surprise to the physics community and since then it has been and still remains as a challenging theoretical work for the world's many talented physicists. In the first four decades following the discovery phenomenological theories were proposed in order to explain the observed facts. These were followed by the first successful microscopic theory of superconductivity in 1957 by the publication of the now famous BCS theory named after Bardeen, Cooper, and Schrieffer who were awarded the Nobel Prize in 1972. However, 1986 marked the discovery of superconductivity in cupprates (chemical compounds that contain CuO) which was deemed, at the time, as important as the original discovery since they enormously raised the hopes for room temperature superconductivity and related technological applications.

That dream has not come true yet, although the discoverers, Bednorz and Müller, were awarded the Nobel Prize the next year. But physicists are working for establishing a sound theoretical ground in order to solve and explain one of the nature's mysteries. When the history of superconductivity during the last century is examined we can see several opportunities that lay out up to date vivid and fine examples of the nature of scientific enterprise and its relationship to society and technology. This paper focuses on such examples and attempts to contribute to commemoration of the 100th year of the discovery of the phenomenon.

Utilizing the History of Superconductivity for Teaching the Nature of Science: For several decades now international documents are emphasizing the importance of teaching the nature of science (NOS) as part of scientific literacy for all citizens. From early years to post graduate years selected notions of the NOS are being included in science curricula in many countries all around the world. History of science is often used for teaching the NOS (e.g., Binnie, 2001). Similarly, in this paper outline of a teaching sequence is given. By using the history of superconductivity the following notions of the NOS can be effectively taught: i) the meaning and conditions of scientific discovery, ii) the nature of scientific knowledge, the relationship between facts, theories, and laws, iii) methods employed in scientific research, iv) the place and importance of creativity and imagination in science, v) the nature of scientific endeavor, vi) place and importance of anomalous observations, and vii) the need for a theory for a group of observed facts and the process of development of a successful theory. A two-hour of presentation to pre-service science teachers was made in order to see the effectiveness of this sequence on the history of superconductivity research and the nature of science. It is found that preservice teachers can make unprecedented progress in understanding the notions of the NOS after the instruction.

Keywords: History of Science, Nature of Science, Superconductivity, Scientific Discovery, Scientific Theory, Scientific Facts, Teaching and Learning the Nature of Science

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Proposal: Understanding charging effects in nanosize metal islands by simulations

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As electronic devices are shrunk to nanometer scale, among the many interesting phenomena taking place are the charging effects. As an example, the tunneling of one electron into a small metal island can prevent tunneling of other electrons from the leads. This unintuitive behavior called Coulomb blockade is often difficult for university students to understand and provides an excellent opportunity to develop a simulation for educational purposes.

A simple structure where these effects can be studied is a metallic island that is connected to the leads via the so-called tunnel junctions. This is depicted in Figure 1. In a tunnel junction, two metallic electrodes are separated by a very thin - approximately 1 nm thick, 100x100 nm2 of area - insulating layer, typically made of AlOx. The insulating layer is thin enough for the electrons to tunnel through the potential barrier inflicted by the insulator.

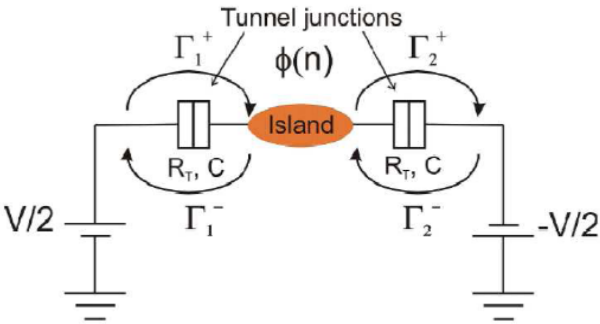

Figure 1. A schematic of a circuit used to study Coulomb blockade. The potential energy of the island φ(n) depends on the number of extra electrons n on it. The electrons come to and leave the island across tunnel junctions with certain tunneling frequencies Γ. The junctions also have a tunneling resistance RT and capacitance C.

We are preparing a simulation exercise to help students understand how the interplay between the charging energy Ech=e2/2C, thermal energy kBT and the energy provided by the bias voltage eV affect the current-voltage (I-V) characteristics of the device. The students will use Monte Carlo simulation code to calculate the I-V's. This allows them to vary the size of the tunnel junctions and the temperature as free parameters and see the charging effects in the I-V curve. The simulation will be used in lessons together with questions to help the students make predictions of the effects and use their reasoning to explain the unexpected behavior, as is shown effective [1].

For the simulation, one has to calculate the changes in the free energy due to all possible tunneling events, by calculating the potential energy φ(n) of the island before and after each tunneling event (n is the number of extra electrons on the island). The tunneling frequencies Γi for each possible tunneling event can then be calculated by using the Fermi Golden rule [2]. The resulting I-V characteristics are nonlinear and yield a conductance curve such as in Figure 2, which is measured from a real device.

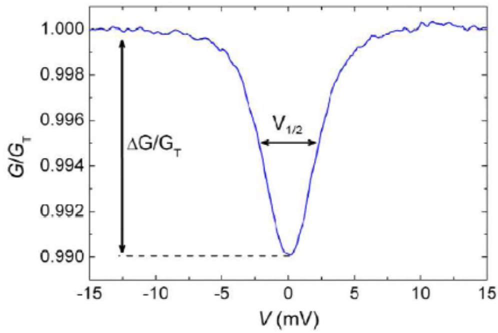

Figure 2. The conductance characteristics of a nanoscale metal island, where V is the bias voltage across the island. Marked in the figure, V1/2 is the characteristic halfwidth of the dip and $\Delta G/G_T$ is the dip height.

In addition to learning about charging, the simulation can be used to exemplify a measurement tool in new physics: the halfwidth $V_{1/2}$ and dip height $\Delta G/G_T$ can be used for absolute thermometry below 30 K [3].

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The Popularization of Science and Technology Literacy through Training Science Volunteer Leaders

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The popularization of science and technology literacy has been an important task for Japanese education groups. However, many of these groups targeted only students.

To promote science and technology literacy among citizens, two major tasks were planned by our comprehensive scientific education center of Meijo University. First task was to bring up science volunteer leaders[1]. Second task was to organize executive groups. These tasks were put into Japanese and Ugandan citizens. The case of Japan, Nagoya Science Literacy Forum has been organized for these tasks. Under the action of the forum, students trained as a science volunteer leader[2]. The under training students helped some science schools of lifelong education centers which have been organized Nagoya city government. In addition, interested pupils and their parents who live in around Meijo University joined in to experimental science schools (Junior Science) that was held in campus of Meijo University. The case of Uganda, Mukono District Apprenticeship Academy was set up by us and our Ugandan partners in 2007. Ugandan youths who entered this Academy got skills of technology and teaching [3]. The trained students worked with members of local communities in Mukono District. The students also introduced their knowledge and skills such that making cloth to the local community's members.

Through above works, it has been observed that the mutual activation between under training students as science volunteer leader and citizens strengthened their science and technology literacy. The local government and local communities requested to develop our work as evidence. Organizing a network of science volunteer group is currently under way.

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The contextualization of concept of energy in the Brazilian National Secondary Education Examination

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Energy is a core concept to Physics and it can be found in different contexts from science to science teaching. For this reason, understand energy concept contextualization is quite important to Physics Education. National and regional educational systems demands for assessment have been growing up, accompanying international assessments. In Brazil, every educational level has implemented one or several evaluation processes. The National Secondary Education Examination (Enem) is one of the most important and widespread institutional assessments in Brazil. The Enem was created to promote contextual and interdisciplinary education, focusing on critical learning that enhances citizenship, reducing an exclusive focus on specific contents. The exam had been following the direction of the Brazilian Educational reform implemented in the 1990s. Besides being used to evaluate educational systems, it is used by some public and private higher education institutions to select freshmen students. The use of Enem as selection criteria minimizes the effect of content focus evaluation that produced a Physics Educations based on memorization of formulas and equations, which was the typical characteristic of the selection processes for higher education in Brazil. In 2009, suggested by Federal Government the most part of Public Universities decides to use Enem as part of their admission processes. This processes created institutional tensions considering those two kinds of evaluation, i.e. focus on the content (predominant at admission evaluation) and the assessment of skills and abilities as recommended at Enem. In this work we studied this tension analyzing the contextualization of questions involving the energy concept. The main hypothesis is that the contextualization reflects the different political and pedagogical interests. The contextual profile usually indicates the assumptions behind the educational items. We identified in this study, textual marks that regulate contexts in questions of Enem during the period between 2004 and 2009. We used Bernstein´s Theory of Pedagogic Discourse (Bernstein, 1971, 2003) as theoretical background. According Bernstein, the contexts are governed by rules and principles, which are linked with the contextual profile defining meanings. Furthermore, Bernstein (1971, 2003) discusses how contents are classified in an area of knowledge and how they are related with the social patterns of individuals involved in educational processes. Furthermore, the author assumes the existence of various contextual hierarchies, indicating a set of macro-contexts that includes a myriad of micro-contexts hierarchally organized. This allows us to model the relationship of regional and national educational systems. Moreover, it propitiates understand the several levels of the educational system. As a result, comparing the period 2006-2008 with the 2009's Enem, we identified a significant change in the way of how context was regulated on questions involving the concept of energy, implying changes of meanings. Because the delimitation of contexts invokes purely content approach, we identified a mischaracterization of the original Enem´s proposal. This preliminary result shows a regression to the older types of evaluation system based in mechanic learning.

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F= ma: Scientific regulations and learning difficulties

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Reflecting a sociocultural view regarding scientific knowledge as comprising socialized regulations and adoption of artifacts, which are novel and discrepant to daily-life conventions, this study examined difficulties in reasoning F=ma encountered by Taiwanese students. The difficulties are interpreted based on the contemporary scientific regulations. Over 250 first year university students answered a fill-in-the-blank test, and 28 of them participated in an interview to explain their reasoning. Then, based on the results of the open-form test, a test including 32 multiple-choice questions was devised, and over 500 high school students took the test. The students' difficulties were examined based on three aspects: (1) what counts as "force" (F). Scientific definition of "force" is discrepant to everyday life convention in terms of its ontological assumption (Chi, et. al., 1994) and epistemological underpinnings (Besson, 2004). (2) how to analyze acceleration (a), and (3) derivations between F and a. The learning difficulties found in this study were beyond the scope of "misconceptions" (Hestenes, Wells & Swackhamer, 1992).

The difficulties that many students encountered can be attributed to three factors summarized below. (1) The required scientific tools are often novel and counter-intuitive to daily life usages. For example, inertial frame of reference is not commonly used in everyday life. However, the artificial tool is essential to explain why impetus and centrifugal force are illegitimate (Sawicki, 1996). (2) The causal flow and derivational sequences between F and a are mismatched. The causal flow and derivation sequences between F and a are mismatched. While drawing force diagrams is normally based on the cause, analysis of acceleration is usually based on its effect rather than the cause (, change of the magnitude and direction of velocity). Some kinds of force are equipped with formulas, i.e., Fg=ma, Ffk=mkN, which can determine the acceleration [FÞa], however, some kinds of force are determined by the states of motion [a Þ F], i.e., tension and static friction. (3) Scientific regulations are not always coherent with sensory perceptions. The experiences of impetus force and centrifugal force are as "real" as other legitimate forces. Therefore, daily life experience may not always be helpful for scientific reasoning.

In conclusion, to facilitate students to effectively learn the topic of F=ma, teachers are suggested to (1) thoroughly introduce the invented/defined scientific tools or terminologies, (2) provide detailed descriptions of the scientific regulations of using the scientific tools (Viennot, et al., 2005), (3) explicitly state the prevalent difficulties that students may encounter and guide the effective perspective of reasoning, and (4) provide abundant examples for the students to think and practice (Airey & Linder, 2009), in order to become familiar with the meanings, usages, and limitations of the scientific tools, and grasp the scientific ways of seeing.

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Wood as a model for liquid crystals

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A simple look on a piece of wood reveals that its structure is anisotropic and it was already shown that wood has strong anisotropic properties (Ziherl et al., 2010). As wood is transparent for microwaves and wood thicknesses are close to the wavelength of microwaves, many anisotropic dielectric properties can be illustrated experimentally, using a simple school microwave kit (consisting of a microwave transmitter, receiver and multimeter). As the structure of wood in general is anisotropic, the wood can serve as a model for demonstration of anisotropic optical properties in crystals in the visible region.

We present two experiments using wood and microwaves. First we show an experiment which proves that biaxial (not only uniaxial) crystal properties can be demonstrated by using piece of wood and microwaves. The value of the order parameter of wood is approximately the same as it is in tilted liquid crystals SmC. If a piece of wood is cut from a big enough trunk of a tree and off the axis of the trunk, the layers, which are formed by annual rings, are nearly parallel. One can easily identify three orthogonal directions with different mechanical and also dielectric properties. One is directed along the wood fibres, the second is perpendicular to the layered annual sheets and the third is perpendicular to both previously described directions.

The second experiment shows how the model of cholesteric liquid crystal can be made of wood and it is based on the article of Gerritsen and Yamaguchi (Gerritsen et al., 1971). They presented an experiment, which is meant to demonstrate an analogue of cholesteric liquid crystals with a stack of birefringent layers (total structure shows a screw-type symmetry). The cause for rotation of microwave polarization (optical activity and rotatory power) in this experiment is absorption, and not anisotropy, like in liquid crystals, so this is not a real analogue. We constructed an experiment with a wood model which is a better analogue to cholesterics. The model is a set of thin wood sheets; every consecutive sheet is rotated for a fixed angle regarding to precedent sheet. We also present a theoretical model.

These experiments with a microwave transmitter and receiver can easily be done in schools for demonstration purposes or as laboratory work.

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