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Program and book of abstracts

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Poster session III

No 1

Screen capture for mini-lessons in physics courses

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Abstract
The electronic pen and screen capture technologies utilized in tablets and tablet PCs opened up new exciting opportunities in undergraduate science and engineering teaching since they allow capturing reasoning, writing and drawing unfolding in real time (with the audio component that can be recorded simultaneously or added later). The entire reasoning process can be exposed and made explicit. The problem-solving process can be recorded in a short video form. These videos can be uploaded into the courses management system where the students can access them on demand as many times as needed. We also find very useful videos of short experimental demonstrations. To be effective, the demonstrations need to be embedded into activities (for example, requiring students to make their predictions before watching the experiment, like in the Interactive Lecture Demonstrations protocol). These demo mini-lessons can be used either as pre-lecture materials for a flipped or partially flipped class or to assign demo-based homework. A wealth of material on problem solving in physics and experimental demos can be found on the internet. YouTube is a particularly rich source of short problem-solving videos. While the quality of some of the YouTube material is excellent, there is also material of lower quality that can even be misleading or incorrect. In addition, using YouTube material for class work and evaluation can pose a problem, as the materials can be removed without notice by the channel owners or YouTube itself. Creating our own content and hosting it within the course management system or using the resources from official sources like COMPADRE provides more reliability. We created a number of mini-lessons targeting particularly difficult core concepts in Mechanics, Electricity and Magnetism. The mini-lessons are designed to model effective problem-solving strategies for introductory and intermediate level physics courses. Our mini-lessons (typically between 5 and 10 minutes in length) normally include a problem statement, diagrams, questions for students' self-assessment and derivations with detailed explanations. Some of the mini-lessons focus on (or refer to) demonstrations also captured on videos, with the experimental data recorded using probes and sensors, such as Vernier probeware. The selected scripts for the mini-lessons were developed by our upper year undergraduate students under the guidance of a faculty member. Examples of mini-lessons will be demonstrated. The introduction of the mini-lesson component is a part of the courses revision/redesign process with the ultimate goal of creating a blended learning environment with significant online presence to extend student learning beyond the classroom.

Keywords
screen capture, mini-lessons, problem-solving, video

No 3

Collection of solved problems in physics – online learning source encourages students' active learning

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Abstract
To solve physics problems is a key ability which students should reach during their physics education. This competency is developed usually on the higher levels of education while the lower ones prefer the conceptual

understanding of physics phenomena. There is usually lack of time to solve enough problems during lessons especially for students with worse previous education or mathematical skills. Moreover, there are hardly any suitable materials for home study of these students. For this reason we have developed collection of fully solved problems. The development of the database started in 2004.

The electronic collection is designed primarily for students in introductory university physics courses to practice and deepen their knowledge gained at high school. However, the availability on public web pages enables usage of the collection by both students and teachers not only at our faculty but also at other faculties, universities and high schools. We keep in mind its usability also for high school students with a deeper interest in physics. Because we want to enlarge the usability of the collection, simpler high school tasks as well as junior high school tasks are also gradually inserted into the database.

A structure of 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. All tasks in the collection contain detailed commented solutions, various hints, notes and other tools to help users with self-study and to lead them to active thinking about presented physics problems.

Nowadays the database contains about 750 tasks in physics and 350 tasks in mathematics in Czech, more than one hundred tasks in Polish and more than 120 tasks in English. Because of expanding number of the tasks in mathematical subjects the Czech section of the collection was divided into physical and mathematical part. In Poland, the printed version (2014), exclusively on mechanics, received very high reference notes, particularly for the cognitive approach.

New tasks are still being added. Apart from creating new tasks, we prepare a new function that allows teachers to create worksheets and assignments of written exams compiled from the tasks in the electronic collection. Highly appreciated is the retrieving system: by the branch of physics, by the level of difficulty, by the type – graphics, calculations, formal etc.

We present ideas lying behind the database, the technology used, structure of problem solutions, experience with using it in introductory university courses and in high schools. The continuous monitoring on the database use, students' opinions and didactical outcome will be discussed.
The database is available at the website http://www.physicstasks.eu/.

Keywords
solved problems in physics, structured help, web-based learning

No 5

Planning simple experiments as a way to learn science by inquiry

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Abstract
Project Academic Centre of Creativity (Akademickie Centrum Kreatywności, ACK) has been established by Ministry of Science and Higher Education for development and implementation of innovative teaching methods at all levels of schooling in Poland. ACK are going to become institutions which work on raising standards of pre-service teacher education based on new trends in didactics. They act in a few areas of knowledge (i.e. exact sciences, natural sciences, social sciences, humanities, healthcare sciences). From the area of exact sciences only the Faculty of Physics, Astronomy and Applied Computer Science from Jagiellonian University was qualified to get founding in 2014.

Based on knowledge gained from SECURE (Science Education Curriculum Research) project funded by the European Union under the 7th Framework Programme [1] we decided to propose implementation of the inquiry-based (IB) method in teaching science in grades 4-6 of primary schools. This age group was selected based on the results showing that the positive attitude and motivation of pupils between the age 8 to 11 towards maths and science is considerably decreasing [2]. IB method was chosen to be implemented in science classes on