PHYSICS EDUCATION

Model of teaching University introductory physics course.
supervisor: doc. RNDr. Zuzana Ješková, PhD. (zuzana.jeskova@upjs.sk)
study form: full time
Annotation: At University level there are mostly traditional teaching methods based on lectures used. However, after the implementation of curriculum reform there is a significant decrease in the level of students' knowledge and skills that enter University. The current situation calls for changes in education, concerning the first physics courses that students take part, in particular. These changes should lead to higher students´ engagement in their own learning implementing interactive methods even during the lectures shifting the traditional way of teaching to more active learning environment. The thesis is aimed at analysis of students' level of understanding and skills before they start their University study, development of activities based on interactive approach, their implementation and analysis of their efficiency.
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Adaptation of Young Physicists Tournament problems for upper secondary school level.
supervisor: doc. RNDr. Marián Kireš, PhD. (marian.kires@upjs.sk)
study form: full time
Annotation: Each year there are interesting and unconventional problems solved within the Young Physicists Tournament (YPT). Students solving these problems develop their knowledge and inquiry abilities. There is a limited number of schools involved into the competition within afternoon activities. The problems as solved by students who present and discuss their research project changing the roles of presenter, opponent and reviewer. This system offers great opportunities to implement some elements also in regular physics education. The main goal of the thesis is to implement selected YPT into upper secondary school level in the form of laboratory exercises. The PhD student is expected to select problems for specific topics that are suitable for development of inquiry skills, adapt them into the guided inquiry level and design educational materials both for students and teachers. Consequently, the pedagogical research will be designed to test the developed activities and materials at schools.
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Interactive methods and technologies in teaching physics of the microworld.

supervisor: doc. RNDr. Jozef Hanč, PhD. (jozef.hanc@upjs.sk)
study form: full time

Annotation: The thesis is focused on physic education research in the new curriculum (content and approaches) in teaching physics using the latest interactive teaching methods and digital technology. The new curriculum should more reflect the current scientific knowledge and technological progress as traditional. At the same time, it should provide the necessary foundation for future natural scientists and engineers, who will be working on such problems as the design of new conductive materials, data storage of high density and access speed, new communications technologies, nanoscience and nanotechnology, alternative energy sources, quantum computers, computer drug design, and modeling of complex systems involving extreme climatic and geophysical phenomena.

The work of a Ph.D. student will be concentrated on a study, selection, and preparation of educational activities in physics of the microworld, supported by experiments. The main goal will be the research dealing with the implementation of the new content in the micro-world physics in the school curriculum with subsequent analysis of the impact and effectiveness of selected methods and technologies.

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Visualization of modeling in physics education using modern digital technology.

supervisor: doc. RNDr. Jozef Hanč, PhD. (jozef.hanc@upjs.sk)
study form: full time

Annotation: Developing the skill to model real phenomena around us is nowadays one of the key tasks of science and physics education. Open free modern digital technologies and didactic tools such as, for example, interactive dynamic documents (Jupyter technology with VPython, CAS system Sage, CoCalc cloud technology) allow simple and meaningful interconnection of visualization, qualitative, numerical and analytical approaches in real physical phenomena modeling. Such interconnection should not only lead to a deeper physical thinking, conceptual understanding, and perceptions of students but also to their motivation to positively grasp and study physics.

The focus of the Ph.D. thesis will be the selection and preparation of educational activities with the support of appropriately selected digital technologies in modeling natural processes. From the research point of view, the main objective will be the research of implementation possibilities of new didactic tools and approaches in modeling and its visualization, with subsequent analysis of their influence and effectiveness in teaching.

References:

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