Implementing EU interactive teaching of electromagnetism

at al-Farabi Kazakh National University

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**Abstract**

In many research pursuits the importance of the affective domain in learning is underscored at the expense of the cognitive development: this regards also students in science, in particular, physics. Following this thesis we propose a structured, pedagogically and technologically integrated contents and forms of teaching, based on equal basis on internet learning and direct laboratory experience, using rather simple interactive experiments, but forming cognitive paths. The contents are based on implementing the EU-developed interactive teaching of electromagnetism and has been introduced at Kazakh National University: we show how the integrated approach contributes to increasing the quality of students’ educational level.

**1. Introduction**

Nowadays the current National Policy on Education of Kazakhstan gives great emphasis on technology education as an integral part of national development strategy. The teaching methods are transferring to the new technological media, which help to exchange experiences in developing mental skills and take advantage of direct access to foreign educational resources.

For the present study we choose the branch of Physics at the intermediate level of difficulty, namely, the Electricity and Magnetism.

It is well-known that students of various ages have problems in understanding some basic concepts of electricity and magnetism; they hardly conceptualize phenomena like magnetic fields, electromagnetic induction, bi-directional flow of charge carriers, and so on. These facts has been verified repeatedly by conceptual tests like CSEM (Conceptual Survey on Electricity and Magnetism, Maloney et. al., 2001), BEMA (Brief Electricity and Magnetism Assessment), DIRECT (Determining and Interpreting Resistive Electric Circuit Concepts Test) and others, see [1] for a comprehensive study.

**2. Contents**

We enriched the traditional, text-book teaching, with elements of on-line material, like experiments with electrostatics [2], electromagnetic induction [3] and other videos. As hand-on experiments we proposed both simple objects from Polish “Physics and Toys” collection [4] as well as discovery paths developed within EU educational projects [3, 5]. The advantage of these simple experiments is that they can be constructed directly by students, with the use of every-day objects, like anti-theft labels mounted in clothes sold in supermarkets, magnetic fridge stickers, pieces of wires and neodymium magnets, and so on, see details in [6].

Additional lessons are also conducted using the information technology that allow, in the case of conceptual and numerical exercises, the interactive, step-by-step approach, see ref. [7]. The advantage of this tool (available in Czech, English and Polish) is that students can independently choose proper level and subjects of interest, no particular registration is needed and navigation tools are simple.

**3. Results**

The main purpose of the laboratory class is to involve students in conducting experiments, analyze the results and make own conclusions. At each laboratory studies, the students must set goals, such as learning all theories about an experiment, know the rules for working with instruments, do the work and calculate, plot and find the most convenient way to present exactly these experiments again.

To maximize laboratory-based practice time in an undergraduate course at the Electricity and Magnetism, the theoretical topics were transferred to a flipped classroom format, via the production of explicative videos. Preliminary results show that videos achieve the objectives being well accepted by the students. The students watch the video after the class having already been given tools and instructions. The creation of the videos enhanced the possibility of maximizing the laboratory-based practice time, enabling the syllabus to adapt to the flagging concepts. It is necessary to the students to reflect the previous and post-lecture tasks at learning of basic principles of experimental work and data analysis techniques also for the practice teamwork. It contributes the acquisition of paramount skills such as critical thinking, communication and documentation.

The knowledge has been measured prior to the intervention and two times afterward. In spite of the novelty of this blended approach (and also the very preliminary experience of the teachers) we observed a substantial rise of the emotive involvement of students. They not only follow the written scenarios but also perform experiments freely, inventing new, frequently quite funny exercises. Ex-post evaluation shows also an increased, positive attitude to Physics, in general.

**4. Conclusions**

Concluding, the application of interactive teaching methods and simple experiments leads to a substantial increase of the quality of students’ educational level. The choice of electromagnetism as a starting branch proved to be very fruitful, as various educational resources developed within EU projects are available on-line. A part of these resources has been already translated to Kazakh. Educational tools used and details of results will be presented at the Congress.

**References:**

1. V. Koudelkova, L. Dvorak. (2014). High schools students ́ misconceptions in electricity and magnetism and how to diagnose them. ICPE-EPEC 2013 Conference Proceedings. Prague 2014. ISBN 978-80-7378-266-5. p. 898-905.
2. K. Służewski, G. Karwasz (2015). Four experiments in electrostatics (in Polish), ZDF UMK, http://dydaktyka.fizyka.umk.pl/nowa\_strona/?q=node/443
3. A. Karbowski, K. Służewski, G. P. Karwasz, M. Juszczyńska, R. Viola, M. Gervasio, M. Michelini. Discovering Electromagnetic Induction: Interactive Multimedia Path, Int. Work. on Multimedia in Physics Teaching and Learning, 14th Edition , Europhys. Conf. Abstract Booklet, 2009, p. 48.
4. G. Karwasz et al. (2005) Physics and Toys, CD-Rom, ZDF UMK, <http://dydaktyka.fizyka.umk.pl/zabawki1/>
5. G. Karwasz, A. Karbowski, M. Michelini, R. Viola, W. Peeters (2008). MOSEM: Teaching minds-on experiments on electromagnetism in secondary schools, GIREP 2008 International Conference, “Physics Curriculum Design, Development and Validation, Book of Abstract, p. 142.
6. G. Karwasz and MOSEM Consortium (2009), Set of experiments on electromagnetism, <http://dydaktyka.fizyka.umk.pl/nowa_strona/?q=node/679>
7. Z. Koupilovà, D. Mandìkovà, et al. (2015) Interactive problems in physics, Univerzita Karlova v Praze, [www.physicstasks.eu](http://www.physicstasks.eu)
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