Multimedia Technology in Engineering Pedagogy

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Every year, numbers of universities invite new instructors to teach various courses in engineering. They are typically young post-graduates who majored in engineering and science. As specialists in their respective engineering fields, these individuals do not possess the appropriate educational skills and teaching experience. To help them to become professional educators, Prof. Melecenik (Klagenfurt University, Austria) published his textbook “Engineering Pedagogy” [1].

The authors of this paper are taking participation in creation a course, based on Professor Melecenik’s work, with the objective of improving the quality of engineering education in Russian and Ukrainian universities through the use of multimedia technology. This work was conducted in the context of the European TEMPUS project which supports the modernization of higher education, with the collaboration of the Bauhaus-University Weimar (Germany), the Moscow Automobile and Road Institute (State Technical University, Russia), the Tambov State Technical University (Russia, Tambov), and the Kharkiv National Automobile and Highway University (Kharkiv, Ukraine). The course materials include an electronic manual on DVD, as well as two accompanying methodology documents [2, 3].

The use of multimedia technology in education has dramatically increased over the last two decades and certainly will continue to accelerate. Because multimedia technology is interactive, instructors can create an environment in which students can learn by doing, receiving feedback, refining understanding, and building knowledge and skills. Prospective instructors need to know how to make effective use of multimedia technology to impart skills, to assess student achievement, and to collect statistics that enable continuous improvements to course materials and teaching methods.

The first unit reviews basic principles in engineering education, Russia’s and Ukraine's state policies, principles of innovative education, perspectives on participation in various international programs, a description of the goals of the International Society for Engineering Education, and the role of educators in engineering.

The second unit of this course describes the principles of Engineering Pedagogy, course objectives, methods of teaching, sociological and psychological aspects of communication, oratory, peculiarities of human perception and creative thinking, instructor’s ethics, discovery learning, methods of teaching, and student evaluations of pedagogy.

The third unit describes the various technical tools and other resources that can help professors to improve the effectiveness of their teaching. There are discussions of different approaches to teaching students using computer simulations, animations, java applets, handouts, labs, projects and presentations. In this unit we present advice on how to facilitate meaningful discussions among students, how to enable students to conduct hands-on experiments, how to provide multiple representations of the same processes and phenomena, and how to provide evidence that enables students to test their conceptual models. There is a discussion of pedagogical research that teachers can conduct to improve the quality of their teaching: how to collect, compare and analyze student performance data with and without use of multimedia technology, how to analyze student performance at different colleges and determine the reasons for disparities, how to determine how much time students spend practicing with multimedia simulations or on-line experiments, and how to conduct a comparative study of multimedia courses from different technical Universities to determine their advantages and weaknesses.
The fourth unit of the course describes the state's educational standards in Russia and Ukrain, subject content, description of students’ future qualification, and how to develop curriculum material for specific engineering disciplines.

The fifth unit focuses on ways in which instructors can test students' knowledge and understanding of the material being taught. Prospective instructors are familiarized with formative and summative assessments, strategies for designing projects, and ways to program Java applet tests, quizzes, and homework. This unit describes a feedback strategy which helps students to reflect on what they are studying in lectures and labs, helps professors to better understand which concepts their students are having trouble with, and to enable them to adjust their instruction to meet the students’ needs.

The last chapter contains instructions for creating multimedia tools, as well as advice on how to find, extract, and incorporate the best teaching materials in the classroom environment. The chapter is designed to provide instructors with on-line experiences in order to enable them to evaluate and develop educational materials for the World Wide Web. Students will become informed, dynamic professionals by developing proficient in knowledge, skill application and value development, as evidenced by: an understanding of how the World Wide Web works, knowledge of history and statistics of WWW usage, the ability to search, explore, and evaluate and the use of computer/technology-based materials on the internet, knowledge of uses of the internet for data collection, information management, communications, presentations, decision making, evaluation, and the ability to design and develop student learning activities that utilize the internet and other technology for a variety of engineering tasks. The chapter presents examples of well-designed interactive on-line courses that can be tailored by the instructor. As a prototype, chapter consists of on line educational Interactive course of physics with Flash tutorials, animations, simulations, java applet tests, demonstrations etc. This multimedia course helps students to conduct discovery learning by inquiry and demonstrates the abilities of computer based on line courses.

Using multimedia technology, course instructors can facilitate their teaching by following three steps [4]. During the first, Elicitation Phase, the instructor asks students to make observations based on multimedia simulations. These allow the students to change various parameters that affect the outcome of observable processes. The first phase also can include
virtual or paper-based labs, computer modeling, animations, etc. During this phase students are familiarized with phenomena and processes, and observe the influence of different parameters. The second phase, development is conducted by the instructor who asks appropriate questions to lead his students to a qualitative understanding of the material. At this time, the instructor introduces the terminology, equations and theory that help students to conduct quantitative calculations and make predictions. The third phase, the Conceptual Testing or Application phase, gives students the opportunity to apply acquired skills and knowledge to solving new tasks. This final project demonstrates what the student has learned, as well as their ability to apply their newly acquired knowledge.

The course is currently being implemented at six Ukrainian and Russian colleges to prepare a new generation of instructors in Engineering Pedagogy [6].