E-LEARNING ON PRACTICE OF MEDICAL BIOPHYSICS

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Abstract

Multimedia support of experiments in practice of medical biophysics (MB) and e-learning courses determined for self-study and testing were launched at 3rd Medical Faculty of Charles University in Prague. E-courses and on-line support are now undergoing pilot testing in MB practice of first year medical students in the winter semester of 2010. On-line support was opened at Moodle portal, a free open-source PHP web application for producing modular internet-based courses. E-courses focused on theory related to practical experiments from MB were integrated into basic education of MB at our faculty. The Biophysical practice was completely rebuilt using new devices and setups for Physiotherapy, Ophthalmology, Electrophysiology, Ergometry and Thermo vision. Whole practical exercises of MB are now realized in different experiments on thermal effects of ultrasound therapy coupled with thermo vision imaging technique, Ergometry with special focus on ECG and blood pressure measurement, biosignals recording, electro-therapy with focus on recording of rheobase and chronaxy, optometry and ophthalmology, spectrometry of gamma radiation and half-thickness of materials in radiology, audiometry and bioimpedance measurement. After implementation of pilot test outputs, the whole on-line support of biophysical practice will be shared with all medical faculties in the MEFANET network.

Keywords: multimedia, practice, biophysics

Introduction

Biophysics education at 3rd medical faculty follows advanced trends in education. The emergence of modern, well equipped classrooms and a comprehensive integrative medical biophysics practical training with theoretical knowledge gained by using multimedia study materials and e-learning courses on "Medical Biophysics" moved 3rd medical faculty of Charles University in the quality of teaching this course to the front of others. Master Degree Students 'General Medicine' not only get a chance to try to work with modern medical equipment, but due to the form of multimedia learning materials for practical tasks they will be able to understand the function, use of medical devices and limits of contemporary medical practice.

Contribution to the development of the faculty will be thus better prepared graduates on the use of medical instrumentation in practice and potential of better qualified medical doctors. Students of 'General Medicine' get through the practical tasks supported by multimedia web-accessible teaching materials, courses and e-skills needed in medical practice.

Thus, multimedia and distant study of the function, use and limits of modern medical equipment will facilitate the acquisition of practical skills of future physicians and reduce the risk of patient harm.

Multimedia support integrated teaching and classroom equipped with modern instruments as the basis for a comprehensive upgrade of exercises Medical Biophysics. A fundamental change in the quality of practical training is completed with following the development of multimedia study materials and e-learning courses for each experiment in practice.

The aims of the project were to achieve the state where (1) each of the problems of biophysical practice has own support available on-line on the web; (2) the theoretical teaching of medical biophysics and practical exercises are closely linked with web content created in this project; (3) each practical course in medical biophysics is having an e-learning course from a practical point of view including with required knowledge and skills; (4) students can successfully prepare themselves for biophysical practice from the web material only, with use of interactive professional materials, including independent testing and evaluation of online access to full preparation for practice 24/7; (5) students will have an interactive web-accessible materials about the devices in the biophysical practices which they can meet later on in own career. Device related materials will include both specifications, methods and limits the use and risks of the devices respectively methods.

From the perspective of teaching medical biophysics, this means that an overall biophysical innovation practices. Custom multimedia support of practical problems in medical biophysics will be after the pilot testing phase and interior revision permanently located at: website of the Institute of Biophysics and Medical Informatics of the 3rd medical faculty of Charles University in Prague, and at the server MEFANET which is accessible to medical students outside of the school.

The target groups are students of these fields of study and subjects: 1) one year master's program General Medicine, 3rd Faculty of Medicine of the Czech and English curriculum - the subject of Biophysics and Medical Informatics; 2) one year bachelor degree programs: Physiotherapy, Public Health and Dental Hygienist - Medical Biophysics course.

Methods

Solution of the project carried out in two phases. In the first half of 2010 will create a multimedia support and eLearning courses (in LMS Moodle) for individual tasks in practice. In the winter semester of the academic year 2010-2011 will be created modules and courses tested in a pilot run, and finally adjusted. Thereafter, multimedia modules and e-course for internal peer review and then published MEFANET network as well. The creation module, teachers will participate in the Institute of Biophysics and Medical Informatics and where external expert on distance learning. Custom multimedia support any practical problems in medical biophysics are now in pilot testing phase, at the end of 2010 they will be permanently available on the website of the Institute of Biophysics and Medical Informatics of the 3rd Faculty of Medicine and the server MEFANET 3rd Faculty of Medicine, which is accessible to students outside of the 3rd University in Prague.

Results

The project aim was to make electronic on-line support for the practical problems of Medical biophysics for following practical tasks:

1) Ultrasonography - the use of ultrasound in medical diagnostics. Used instruments: medical therapeutic ultrasound, probe for ultra-sonography. Tasks: [1] - measure size of objects using ultrasound, [2] - measure speed of model liquids by ultrasound, [3] – find out biophysical properties of ultrasound reflection and absorption.

2) Ergometry – the capture and analysis of vital functions during exercise. Used devices: Phantom for training intensive care and monitoring of

physiological functions, ergometer, monitor of vital functions, ECG, pressure gauge, pulse oxymeter, computer. Tasks: [1] - measure and analyze 12-lead ECG at rest and after physical activity aiming to find the rhythm, frequency, waves and oscillations (P, PQ, QRS, QT); [2] - measure blood pressure and oxygen consumption during physical activity, [3] - carry out a comprehensive stress test analysis of measured data.

3) Electrophysiology - bio potentials measurements. Used devices: multi-sensor and transmitter physiological bio potentials, computer. Tasks: [1] - set and justify the conditions of action potential in a computer model of the neuron; [2] - measure and myopotentials analyzed at different stages of muscle.

4) Electro-therapy - measuring the parameters of electric current irritation. Used devices: electro-therapy device, computer. Tasks: [1] - determine a threshold intensity of electrical current that causes irritation (rheobase) [2] - determine the time needed to elicit responses when exposed to more than 2 rheobase (chronaxy), analyze the dependence of intensity on the duration of the stimulus (I/t curve).

5) Optometry - measuring the optical power of lens and composition in the human eye. Used devices: optometric system, models of colour vision, computer. Tasks Exercise: [1] - measure the optical power of selected lenses and demonstrate various visual malfunctions, [2] - create the desired colour on the model of colour vision.

6) Thermo vision - infrared imaging in medical diagnostics. Used devices: scintillator, photomultiplier, gamma radiation detector. Tasks: [1] - measure temperature and its gradient of model elements using thermography, [2] - compare selected parts of the body using thermography measurements.

7) Spectrometry of gamma rays - the physical properties of gamma radiation. Used devices: scintillator, photomultiplier, gamma radiation detector. Tasks: [1] - detect radiation spectrum of the three sources, [2] - identify unknown radionuclide by energy spectrum measured by two known radionuclide.

8) Material half-thickness - material properties in gamma radiation. Used devices: scintillator, photomultiplier detectors and gamma radionuclide. Tasks Exercise: [1] - measure / calculate material half-thickness of three different materials [2] - draw graph absorption of gamma radiation on the material used.

Conclusion

The form of realized solution is different in several aspects from original proposal. Each practical experiment consists from three parts: Theory, Tasks, Test. Theory part is focused on physical background necessary for understanding experimental phenomena and to accomplish the tasks. Two tasks along with detail method / procedure description are written in one page format so that students can orient easily in practice in it. Test includes 60 questions is multichoice with four randomized answers. Students can do that test freely over internet on our Moodle server. Students suppose to train themselves prior practice aiming accomplishes entrance practice examination which usually includes 3 of those 60 questions.

The output of the project is not only a fundamental change in the form of teaching theory, training practice and preparation for it, but also 24/7 availability of multimedia support and e-learning courses on medical biophysics what represents a qualitative change in the concept of practices in biophysics.

Literature

[1] Gangur M., Kvašňák E., „Use of programmed learning principles to construction of educational activities in on-line course‘‘, *Technologia vzdelavania*, ISSN 1335-003X, pp. 10.XII, 2007.

[2] Polley D.B., Kvašňák E., Frostig R.D., „Naturalistic experience transforms sensory maps in the adult cortex of caged animals“, *Nature* 429(6987): 67-71, 2004.

[3] Šuta D., Kvašňák E., Popelář J., Syka J., „Representation of species-specific vocalizations in the inferior colliculus of the guinea pig. *J Neurophysiol* 90(6): 3794-808, 2003.

[4] Kvašňák E., Šuta D., Popelář J., Syka J., „Neuronal connections in the medial geniculate body of the guinea pig. *Exp Brain Res* 132: 87-102, 2000.