ONLINE EDUCATION IN MINIMALLY INVASIVE ORTHOPAEDIC SURGERY

Slavka Tzanova
TeLearn Laboratory
Technical University of Sofia

Nevena Mileva
ECIT Department
Plovdiv University
Bulgaria

Abstract

The new developments in biomedical engineering and information and communications technology raised the needs of training on modern aspects of computer-assisted surgery in the health care sector. In this paper a European project on transfer of innovative approach and courses for training and disseminating the new approaches to diagnosis (image processing and analysis) and minimally invasive orthopaedic surgery (arthroscopy) is presented.

Introduction

The European eHealth strategy is continuous and sufficient education of healthcare specialists on information and communication technologies (ICT) usage and building working telemedical applications, etc.:

> The expansion of the knowledge base is accompanied by an unprecedented speed in transformation of frontier scientific inventions into practical use and products. . . .As probably the most promising of the frontier technologies, life sciences and biotechnology can provide a major contribution to achieving the European Community's Lisbon Summit's objective of becoming a leading knowledge-based economy (Zolfo et al., 2006).

The European Council reconfirmed the strategic goal for the European countries to become the most competitive and dynamic knowledge-based economies in the world and enforced the accelerated development of Information society and ICTs. The implementation of e-Health is an important component of the information society and was acknowledged as one of the main priorities in the European development plans. The new initiative of the European Commission i2010 places a significant role on the introduction of electronic health cards and unified information system as an integral part

of the modern healthcare (i2010). So, there is a need of new environments for predictive, individualised, evidence based, more effective and safer healthcare and the physicians and the other staffs in health sector need to be trained to work with them.

In this paper a European project on transfer of innovative approach and courses for training and disseminating modern aspects of computer assisted surgery in the public health care sector is presented.

Why was this Project Designed?

One of the main principles of electronic healthcare is evidence-based medicine and the online education of physicians. Evidence-based medicine de-emphasizes intuition, unsystematic clinical experience, and pathophysiologic rationale as sufficient grounds for clinical decision making, and stresses the examination of evidence from clinical research. Lack of access to information remains one of the major barriers to evidence-based medicine. Limited access to computer facilities, to literature databases and to continuing medical education programmes are just some examples out of the full range causing disparities in universal access to health care information (Zolfo et al., 2006).

Physicians need training in the skills necessary for practicing evidence-based medicine. There is a need for e-learning courses with demonstrations, simulation of the cases for predictive, evidence based planning and intervention and they will be more useful for the doctors in remote regions.

In order to decrease the barrier to evidence-based medical information and to train the higher order skills of medicine doctors this project will transfer the positive results from the use of Performance Support Systems for training informatics, microelectronics, mathematics, sciences to the sector of medicine as well as the outcomes of the EPICUROS project ("A Virtual Learning Environment for Medical Doctors in Remote Areas") which developed e-learning courses in orthopaedics.

Other European Projects Aimed at Training E-skills in the Healthcare Sector

The PEDITOP project (www.peditop.com) was aimed at developing a pilot format for a comprehensive online education and training system, with the relevant interactive facilities, and exploiting continuous feedback from paediatric professionals. By concentrating on online delivery and interactivity, there was full potential for continuous update. Along with the development of teaching materials, the project is concerned with the creation and integration of appropriate software and platform for online education in this field. The continuation of this project was MEDITOP-EU - International Virtual Classroom for Health Care Professionals.

Two projects, “Improvement of the Quality, Effectiveness and Efficiency of Healthcare Services" and “Vocational education and training for quality of life through e-healthcare & well-being” (Improhealth) target healthcare managers and administrators, healthcare and social health personnel, doctors who want to master management in healthcare. They were aimed at collaborative quality function deployment of the Virtual HealthCare Quality Centre. Development of VET modules on “e-Healthcare Organisation and System management” and “Healthcare Economy,” and one module for training of general public, “Quality of Life and Well-Being” (EU EBM Unity) tended to improve transparency, efficiency of practice and health outcomes across the European Union (EU) healthcare sector through the promotion and pilot of a EU qualification in evidence-based medicine (EBM) for medical practitioners. A core EBM curriculum that is integrated into clinical practice combining work based and classroom/home training will be developed. The project aimed to establish a pan-European assessment of current medical training (at Foundation level 2) and the already described European Qualification, which addresses training experience and accreditation issues for one of the potentially highly mobile employee groups in the EU. There is seen transferability by slightly adapting the curriculum towards other healthcare staff and other sectors as such as the medical technology sector.

This project was followed by **“**Evidenced Based Medicine: Training the trainers across the healthcare sector” (Evidence Based Medicine) the product of which is a complete e-learning package. E-learning sessions were designed to allow learning in the workplace during short breaks within clinical activities, with the option to interrupt and restart learning flexibly. The learning objectives and outcomes were to help participants learn how to identify their trainees’ knowledge gaps related to current clinical practice and to use these to initiate EBM teaching. Each module includes an e-learning course that outlined the basic prerequisite EBM competencies to be acquired by participants. The clinical setting is described taking into account the variation in practice between different healthcare systems. Practical advice is provided on facilitating teaching of the various EBM steps with videos demonstrating EBM teaching in action.

Project Objectives

The Online Ortho project aim is to improve the quality and attractiveness of medical training systems by adapting and integrating innovative approach and results from previous Socrates/Minerva (Tzanova & Mileva, 2006) and Leonardo da Vinci projects (Mileva, Tokmakov, Milev, & Stoyanova, 2007) to the needs of Bulgarian and Irish medical training systems with courses in orthopaedics to serve as a pilot in an improved system of learning using the approach of performance support systems.

To this overall aim, the project will work toward achieving the following specific objectives:

- identifying and analysing user requirements of orthopaedists, surgeons, medical and technical staff in Bulgaria, Ireland, Greece;

- selecting and analysing innovative content to meet these requirements;
- transferring the performance support system approach in medical training and developing an intelligent medical performance support environment for surgery training; and
- pilot test of the system with physicians, medicine students and students in medical electronics.

The preliminary need analysis showed that there is a need of training physicians and medical staff in using and developing eHealth.

Target Users

Target groups, which will benefit directly from the outputs/products and activities of the project, are the physicians (specialists in orthopaedics, anaesthetists, surgeons), teachers and students in medicine, medical managers and the doctors from remote regions particularly. They all need courses for continuous (lifelong) training on the use of ICT for their specific purposes, e.g. systems targeting specific clinical needs such as prediction of diseases, early diagnosis, disease quantification, surgery planning, treatment and training.

With the new developments in biomedical engineering and information and communications technology raised the needs of training on modern aspects of computer assisted surgery in the public health care sector. In particular, new developments in applications ranging from image processing to robotics lead to new approaches to diagnosis (image processing and analysis) and minimally invasive surgery (arthroscopy).

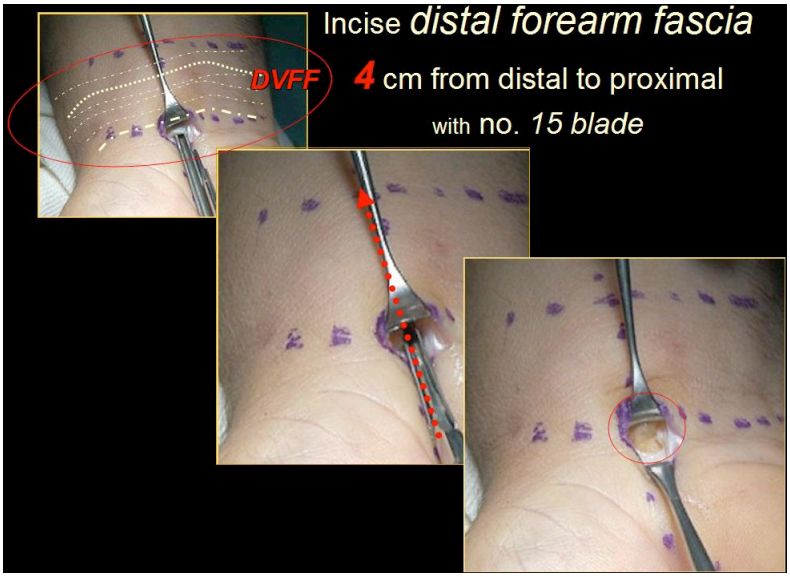
The students in medical electronics and their teachers are also target group in this project. They need courses providing knowledge about the subject of the devices they are developing. They can not assist at real surgeries, so the virtual courses will correspond to their needs.

Potential users are physicians in all specialities, medical managers, and students in medical high school (colleges) who need to be prepared to use and work in the eHealth environment. They could benefit from the results of this project which courses in orthopaedics will serve as a pilot for developing an improved system of learning using the approach of performance support systems. The experiences gained and the lessons learnt within the project would be useful for the ICT experts developing eHealth systems, e.g. the Bulgarian National Health Information Foundation.

Work in Progress

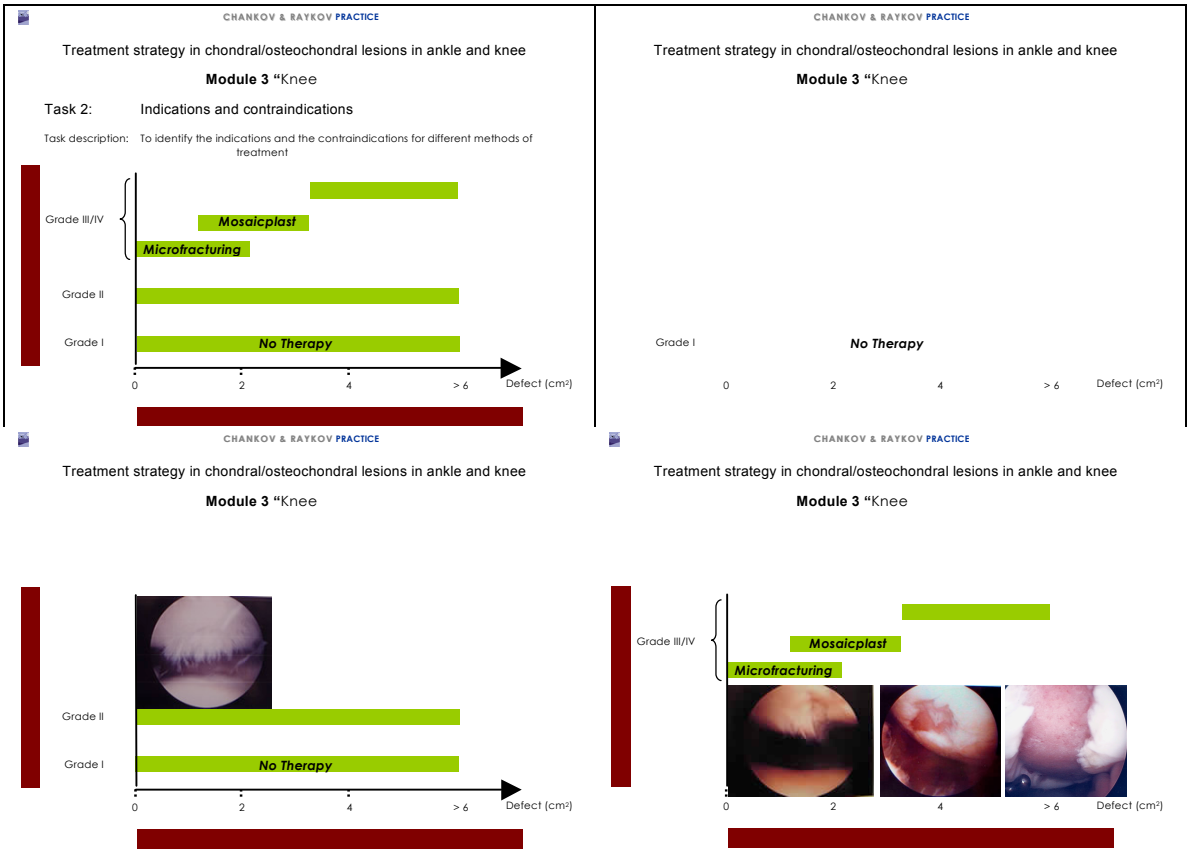
Within the project we have identified and analysed the specific requirements of orthopaedists, surgeons, and medical staff with regard to the stage of development of eHealth systems in each partner country. Based on the requirement analysis, orthopaedics specialists have determined the training content and have developed the presentation scenarios of the training courses with regard to the development of evidence-based medicine.

Figure 1: One screen of the course "Endoscopic carpal tunnel release" with animated steps showing the minimally invasive CTS with KnifeLight technique



The courses from the previous project could not be up-graded because both techniques: for minimally invasive surgery and for multimedia materials development have progressed so much that the previous materials became outdated. So, new learning materials on anaesthesia, knee, ankle, hand arthroscopy (Figure 1) and cartilage surgery (Figure 2) have been developed.

Figure 2: Guidelines "how to perform" in the performance support system. The course "Cartilage surgery"



The Intelligent Medical Performance Support Environment for Surgery Training includes a multilingual system of distance learning courses, implemented using advanced virtual reality technologies for the representation and simulation of the human body and its movements in three-dimensional space.

During the last stage of the project we are trying to realise the idea of the virtual surgery, e.g. a life video on Internet is available of a surgeon working in one hospital in Bulgaria and there is a videoconferencing with the other experts from Greece, Ireland and Bulgaria. See some shots from the first experiment on Figure 3. It will be implemented not only for training purposes but to allow through videoconferencing the online collaboration of doctors from different European countries before, during or after the surgery in specific medical cases.

Figure 3: Two shots of the video-recorded "online surgery" of and AMIC procedure with Hondro Guide as a part of the course "Treatment strategy in chondral lesions in ankle and knees joints"

The Added Value

In the presented project we are transferring the innovative approach of performance support systems in the medical sector. IPSS is one of the most advanced concepts in the domain of the educational e-learning initiatives (Tzanova, 2007). It is aimed at providing just-in-time, just enough and at the point of need support to learners in order to deal with complex authentic tasks in the context of problem-based learning. And it would be most useful for the doctors in remote regions in their daily practice.

Physicians need training in the skills necessary for practicing evidence-based medicine. There is a need for e-learning courses with demonstrations, simulation of the cases for predictive, evidence based planning and intervention. In order to decrease the barrier to evidence-based medical information and to train the higher order skills of medicine doctors this project transfers the positive results from the use of Performance Support Systems for training informatics, microelectronics, mathematics, sciences to the sector of medicine as well as the outcomes of the from the EPICUROS project which developed e-learning courses in orthopaedics.

The courses developed within the project are delivered in an IPSS system. So, we are combining the positive results of two European projects and transferring them in new countries and in a new sector (for the IPSS). There are three new courses in surgery and one in anaesthesia developed and the completely new for the Balkans life online surgery.

The added value of this project involves:

- innovative approach of a performance support system transferred in new sector — training in medicine,

- new products in response to existing needs: four e-learning training courses in computer assisted orthopaedics surgery and anaesthesia,

- virtual surgery theatre with life online operations upgrades the developed 3-D environment, and

- new forms of co-operation in the field of vocational training between partner organisations from medical, engineering and informatics sectors.

Evaluation and Exploitation

The purpose of the evaluation within the project is to serve decision making but its main goal is to help core developers and the new users in the improvement of the product and development process. It is more oriented to the end users, i.e. to obtain feedback to help developers to improve the products and services as well as to optimise the development process trough early diagnosis of defects, to reveal unforeseen circumstances in the learning environment, to insure better communication in the development team, to measure whether training objectives and trainees' needs have been achieved and that results could be used for decisions about the implementation and dissemination of the products and for new training modules development.

Expert reviews and design walkthrough in the early stages of materials design and prototypes production provided information and corresponding feedback to developers for ensuring the quality of content and usability aspects of prototypes, and to validate the efficiency of chosen methods and media as early as possible. In that way, during the first months of the project the assessment of the EPICUROS learning environment has proven not enough efficiency and it was evaluated as out of date. So a decision has been taken to develop a new one.

To meet the users' needs a prototyping approach was used in the environment and course adaptation/upgrade and a large audience will be involved in the pilot tests. The representatives of the decision-makers are being invited to all project meeting and in the pilot test. Trainees were involved in the evaluation process when the first versions of prototypes were ready. Interviews and questionnaires to gather data on learners' attitudes and opinions will be used.

It was very difficult for the doctors to work with the software, so every medical institution has been working with a partner institution in engineering or in information technology.

Quality assessment is based on a careful procedure of self-evaluation by the institutions involved in the project followed by external evaluation by peers. The external peers test whether the self-evaluation has been done carefully. They will report their own conclusions and recommendations.

After the pilot test and the final improvement of the environment and the courses, they will be incorporated in the regular training practices of the partner institution from universities and hospitals. To be used in the day-to-day practice in these institutions, the courses will be updated every 12 months correspondingly to the rate of technology development in computer-assisted surgery.

The Web-based training materials will be implemented in the regular courses in the medical schools at the University of Cork and in the lifelong training activities of practicing physicians in the hospitals.

Summary and Conclusions

A new European project on transfer of innovative approach and courses for training and disseminating modern aspects of computer assisted surgery was presented. Its aim is to meet the training requirements of medical staff which have arisen due to developments in biomedical engineering and information and communications technology. In particular, new developments in applications ranging from image processing to robotics lead to new approaches to diagnosis (image processing and analysis) and minimally invasive surgery (arthroscopy).

The project is on the stage of the pilot test planning. We will realise the idea of the virtual surgery, e.g. on Internet will be available the life video of a surgeon working in one hospital in Bulgaria and there is a videoconferencing with the other experts from Greece, Ireland and Bulgaria.

The Medical Performance Support Environment for Surgery Training includes a multilingual system of distance learning courses, implemented with advanced virtual reality technologies. The pilot test of the developed in the proposed project system will provide the physicians and surgeons as well the managers with data about the feasibility and effectiveness of the provision and use of an instant and on-site access (at hospitals, clinics) to information about the techniques and methods used in diagnosis and surgeries, being computer assisted or the best practices.

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