MEFANET report 02

Information technology and e-learning in medical education

Editors:
Daniel Schwarz
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Masaryk University

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Chris Paton

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Institute of Biostatistics and Analyses,
Masaryk University
phone: +420 549 49 2854, fax: +420 549 49 2855, e-mail: schwarz@iba.muni.cz

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CONTENTS

PREFACE

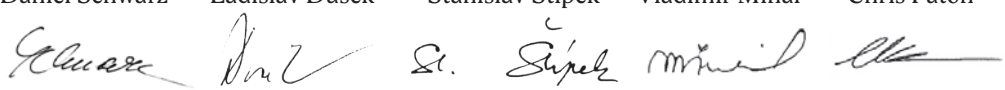
Dear colleagues and students,

We are very grateful that you have decided to read through the MEFANET Report II, a publication which has been compiled to look back at the MEFANET 2008 conference. This report highlights the many interesting issues discussed at the 2nd conference of teachers at Czech and Slovak medical faculties, dedicated to information technology and e-learning in medical education. We had not anticipated that the first conference (MEFANET 2007) would be as successful as it was; therefore, as we planned the MEFANET 2008 conference, we had our doubts about whether the second year could meet with even greater success. We are very well aware that the MEFANET project would not be successful at all if you were not interested in it; and we particularly appreciate your conference contributions documenting your activity in the development and sharing of teaching materials.

As the MEFANET conference and this report also serve as a retrospective of the activities of the MEFANET project, you might be interested in a very short recapitulation. The origin of the MEFANET project dates back to mid-2006, when three medical faculties (LF MU Brno, 1. LF UK Prague and LF UP Olomouc) launched a common initiative aimed at the development and sharing of teaching materials. The MEFANET project was officially launched in July 2007, when representatives of six Czech medical faculties met and agreed to constitute the so-called Coordinating Council of the MEFANET project (Medical Faculties NETwork). Today, all ten medical faculties in the Czech Republic and Slovakia participate in the MEFANET project, joined in a common effort to develop an extensive background for electronic teaching materials and tools, and to integrate its contents into a common platform.

The MEFANET 2008 conference also saw the launch of the MEFANET Central Gate. This is an enormous success for all of us and for all Czech and Slovak medical faculties, as we finally realized the original idea of the project: to establish a barrier-free educational network which would mutually interconnect all teachers and students at medical faculties. Let us hope that this is not the final result of the MEFANET project; quite the opposite, we anticipate the Central Gate to become a real start of the project.

Daniel Schwarz Ladislav Dušek Stanislav Štípek Vladimír Mihál Chris Paton



01 MEFANET 2008 INTRODUCED MODERN TEACHING METHODS APPLIED AT MEDICAL FACULTIES

L. Šnajdrová, D. Schwarz

Institute of Biostatistics and Analyses, Masaryk University

Abstract
The second conference MEFANET, which was focused on e-learning and health informatics in the education of medical disciplines, took place in Hotel Voronez (Brno, Czech Republic) on 20–21 November 2008. Apart from general topics related to modern methods of education, the last year's conference (MEFANET 2008) concentrated on the specialties of dentistry, stomatology and maxillofacial traumatology.

Keywords
conference, e-learning, medical faculties

Introduction

Just like the previous year (2007), the last year's conference was primarily aimed at lecturers working at Czech and Slovak medical faculties. The last year's programme and the composition of participants, however, were much more varied than they were in 2007. This is a result of a successful cooperation among medical faculties, which started in 2006 with the aim to share educational materials and experience among medical schools in Prague, Brno and Olomouc, and expanded within two years to include all ten of Czech and Slovak medical faculties.

The MEFANET project

The MEFANET 2008 conference was arranged with the primary aim to become a meeting for the supporters of the inter-faculty project MEFANET (MEdical FAculties NETwork, http://www.mefanet.cz). This educational network project is based on an equal cooperation among all ten of Czech and Slovak medical faculties, who have agreed to make joint effort in the introduction of modern information technology into the education, particularly in the areas of creation and sharing of electronic teaching tools. The MEFANET project does not involve any directive measures to be adopted by the participating faculties; quite the contrary, it is based on a fully voluntary cooperation of those faculties. The project focuses primarily on the creation of methodical materials and recommendations in order to facilitate a wider cooperation among teams of teachers. The target group of the MEFANET project involves teachers and students from all medical faculties, thus involving over 20,000 potential users at the present time.

Conference opening

The conference was opened by the Chairman of the Coordinating Council of MEFANET project, Assoc. Prof. Ladislav Dusek, PhD., from the Institute of Biostatistics and Analyses at Masaryk University (MU), who also introduced present guests: Prof. Jan Zaloudik, MD (Dean of the Faculty of Medicine at MU), Prof. Eva Taborska (vice-dean for 1st stage of master's degree programme at the Faculty of Medicine at MU), Prof. Stanislav Stipek, MD (member of the Dean's Council and Chairman of the E-learning Commit-

tee at the 1st Faculty of Medicine at Charles University in Prague), Prof. Jiri Vanek, MD (vice-dean for stomatology and Head of the Department of Stomatology at the Faculty of Medicine at MU), and Assoc. Prof. Lenka Roubalikova, MD, PhD., representative of the Czech Dental Chamber.

Prof. Zaloudik gave a speech to stress the importance of the MEFANET project for the education of today's generation of medical students. He also said: "This inter-faculty cooperation is excellent, although it is not very well known among the public. The project is based on three basic pillars which are essential for MEFANET to run properly:"

1. "Professional competence of everyone involved. Authors of modern teaching tools are mostly teachers with many years' experience. However, a number of high-quality students' works have emerged recently and have been published on the official educational portals of individual medical faculties.
2. Big motivation of everyone involved. Many teachers have already realized that an on-line published work is much more easily available – and can have much bigger impact – than printed textbooks or monographs. Forward-looking teachers are forthcoming to meet the requirements of students who might possibly not acquire the printed textbooks at all.
3. Continuity of education at the participating faculties. The creation of modern educational materials follows their many years' traditions. The only change that has occurred is the way in which educational material are published."

Plenary session, launch of the central MEFANET gate

The plenary session was introduced by the lecture of Prof. Dusan Mesko, MD, PhD., from the Jessenius Faculty of Medicine in Martin (Slovakia), entitled "The vision of digital education in medicine". Prof. Mesko said: "Many lecturers working at medical faculties nowadays give the impression of being rather backward as regards the usage of modern technology – in comparison with their students. As a result, the communication between teachers and students is rather poor, which is a pity." During his engaging lecture, Prof. Mesko gave many examples from his position as a teacher and father, and called upon all lecturers to learn from their students and to adopt the modern technology as a useful communication tool.

Modern technology, however, also brings new questions and issues to be solved. For example, the creation of electronic materials at medical faculties has many ethical and legal aspects. The second plenary lecture was given by Jitka Meklesova, an expert on the Copyright Act from the Czech Ministry of Culture, and met with enormous success.

The following plenary lecture, entitled "The uniform solution to share and supply educational content in the MEFANET network", was given by Daniel Schwarz, PhD., and also met with very favourable response. Dr. Schwarz provided details on the function of educational portals which have been put into operation at all Czech and Slovak medical faculties. Such a portal maintained by a medical faculty allows the academic staff to publish their electronic materials; this activity is nowadays called e-publishing and in fact, it is equal to "classic" publication activities – i.e., printed on paper. Apart from this, educational web portals facilitate the communication among authors of multimedia teaching tools and their users, help to people involved in the lifelong education of doctors and health care professionals, and finally, facilitate the navigation of students and teachers in the complex system of tools for the electronic support of education and study. On the contrary, an educational portal does not aim to replace e-learning applications themselves: these applications typically run on a separate server, the portal of a medical faculty being used as a publication platform. In this way, authors of teaching tools let their colleagues and students know about their work.

Figure 1: The central gate (http://portal.mefanet.cz) interconnects educational web portals of all involved medical faculties.

Dr. Schwarz described in detail all aspects of this uniform portal solution for all participating faculties, and concluded his lecture by providing the URL of the so-called "central gate" which interconnects educational portals of all involved medical faculties: http://portal.mefanet.cz. The users can search for educational materials by simply entering a relevant expression into the search box, or by browsing the contents of central gate using the map of medical specialties. This map presents the only unifying element of educational portals of all involved faculties.

Electronic support for the education and study in the specialty of Dentistry and Stomatology

The second session of lectures was introduced by the speech of Prof. Jiri Vanek, MD, vice-dean for stomatology and Head of the Department of Stomatology at the Faculty of Medicine at MU. Prof. Vanek pointed out that starting from the academic year 2004/2005, the study programme of Dentistry and Stomatology was shortened from 6 years to 5 years, resulting into significant modifications in the curriculum. In this context, e-learning tools are very welcome: firstly, the issue of printed materials would be much more time-consuming; and secondly, electronic educational materials are much more flexible and can be updated at any time, as needed. Prof Vanek pointed out the low numbers of students and graduates in the study programme of Dentistry and Stomatology, and informed the audience on a joint development project which had been submitted by medical faculties in Brno and Pilsen, entitled "Creating the conditions for the increase in number of students in the dentistry study programme".

Most of the following lectures were closely related to the proposal of the development project cited above, and their authors were mostly from the Faculty of Medicine at Masaryk University. Tomas Sojka, MD, introduced his software application for the education of dental indices and for the processing of clinical data in stomatology. Pavlina Cernochova, MD, PhD., and Sonia Bartakova, MD, PhD., acquainted the audience with their use of e-learning tools in the pregradual education of orthodontics and dentistry, respectively. Representatives of other medical faculties also shared their experience: Prof. Tatjana Dostalova, MD, MBA (2nd Faculty of Medicine at Charles University in Prague) presented examples of several e-learning courses of stomatology in the Moodle system, run by the Charles University Computer Centre. Prof. Andrej Jenca, MD (Faculty of Medicine at the Pavol Jozef Šafárik University in Košice) explained the benefits of documentation of rare cases treatment in the field of maxillofacial surgery.

Telemedicine is not the stronghold of radiologists only

Telemedicine is an interdisciplinary field which currently undergoes a turbulent development. In brief, telemedicine deals

with the transfer of clinical images, videos or other data from the place where they were recorded to any other place on Earth. This technology can be readily applied not only in the education of medical students, but also in the consultation of complex clinical cases with more experienced colleagues. Although live transmission from operating theatres was already common in the 20th century, modern technology has brought many improvements and new possibilities.

Depending on the medical specialty, there are many branches of telemedicine, such as telepathology, telehaematology, telegynaecology, etc. In his lecture, Michal Jurajda, MD, PhD. (Faculty of Medicine at MU) demonstrated the advantages of telepathology: microscopic sections are scanned and digitized using a special instrument, allowing the student (or clinician) to assess these sections whenever and wherever, as he/she only needs an ordinary computer instead of a microscope. Jamila Kissova, MD, from the Faculty of Medicine at MU explained the principles of telehaematology, which has similar advantages as described above. The following lectures pointed out the importance of direct transmissions from operating theatres, which are frequently used in the education of ophthalmology, gynaecology and other specialties.

Metodical aspects of e-learning

Two lecture sessions and two workshops were dedicated to the methodical aspects of the creation of e-learning courses and other electronic teaching tools. This topic attracted much attention, giving the conference participants many occasions to learn how their colleagues dealt with the creation of educational materials. The first workshop on this issue was lead by Dr. Jana Vejvodova (University of West Bohemia in Pilsen), who explained specific procedures to be applied when dealing with different forms of e-learning. Dr Vejvodova also compared the effectiveness of various didactic strategies that can be applied in e-learning. Participants of this interactive workshop were given many specific examples to decide whether a given approach was correct or incorrect when preparing a specific course. The second workshop was focused on the effective use of information sources, and was lead by Prof. Vladimir Mihal, MD, and Jarmila Potomkova from the Faculty of Medicine at Palacky University in Olomouc. The workshop was specifically dedicated to the application of evidence-based medicine (EBM) principles in the pregraduate and postgraduage education of doctors, and the organizers invited Dr. Otmar Mueller from the European subsidiary of UpToDate in Budapest. The workshop participants learnt how EBM tools can be used when searching for answers to two example questions, regarding serious childhood diseases in this case.

Methodically oriented lectures were focused on various procedures and specific software applications which can be used in the creation of e-learning tools. The multimedia Atlas of Physiology and Pathophysiology designed by Jiri Kofranek, MD (1st Faculty of Medicine at Charles University in Prague) won particular recognition of the audience: this extensive work is being developed by joint efforts of doctors, programmers and graphic designers. On the other hand, Milan Dvorak (Faculty of Medicine in Pilsen at Charles University) demonstrated that even authors-beginners can very well embark on less spectacular projects, which still have a very representative look.

Videoconference

The next day of the MEFANET 2008 conference started with a videoconference which attracted those interested in the progress of medicine lecturers in the English-speaking world. Within a few minutes, a live communication was established with Dr. Chris Paton from the University of Auckland, New Zealand. Prof. Stanislav Stipek, MD (1st Faculty of Medicine at the Charles University in Prague) took the word to intro-

duce Dr. Paton as a recognized expert on e-learning, who had gained experience in Nottingham City Hospital in the UK, at the Cambridge University, and had worked in many other renowned institutions.

In his videoconference lecture, Dr. Paton outlined the huge possibilities offered by the current technology Web 2.0. While Web 1.0 was based on static, mostly text-based information administered by a single webmaster, the current Web 2.0 is basically an interactive network of hundreds of millions of users who actively contribute to the contents of internet. Text-based and image-based information are in fact outdated, being progressively replaced by audio- and videorecordings, more advanced technology and more complex applications, although the interface to control these applications is increasingly user-friendly. At this point, Dr. Paton mentioned several applications widely known to the community of internet users all over the world, including YouTube, Facebook, Wikipedia etc.

However, most lay internet users have no idea of internet applications intended for doctors or medical students which are based on similar technology as popular web portals mentioned above. The KevinMD.com blog ranks among the best known: 16,000 users have until now subscribed to receive news from this webpage run by Dr. Kevin Pho, a general practitioner living in the United States. The project MedPedia.com is another example: this analogue of the very popular Wikipedia will be launched in the end of 2008. Dr. Paton himself established the web portal NewMedia Medicine, which not only focuses on the creation of 3D biomedical animations and e-learning courses, but also serves as a community network – in a similar fashion to the much-loved Facebook – but dedicated primarily to medical students.

Dr. Paton also highlighted strengths and weaknesses of the Web 2.0-based e-learning. The advantages of modern technology are obvious, including the biggest one: students can actively participate on the learning process, far from absorbing the encyclopaedic knowledge, as it was common in the last century. There are also a few disadvantages, such as the easy manipulability of the contents: for example, anyone can change anything on Wikipedia, which makes this source of information less trustworthy.

Figure 2: Dr. Chris Paton (University of Auckland, New Zealand) outlined the possibilities of technology Web 2.0 for the education of medical students.

Another problem which is frequently dealt with is the question how to respect the patients' right to privacy, and to ensure an effective teaching process at the same time. These and other issues, however, can be effectively addressed by adopting certain rules which will leave everyone satisfied.
The videoconference met with an enthusiastic response of audience, and there were several questions from listeners which might have surely set off a very exciting discussion. However, due to the very tight schedule of the conference, Dr. Paton could only reply briefly and referred those interested to his website www.chrispaton.org.

Educational web portals

Building a common on-line platform for e-publishing of educational materials developed at individual medical faculties has been one of the main objectives of the MEFANET project. Therefore, particular attention was paid to the implementation of educational portals, and one conference session was dedicated uniquely to this issue. The first lecture was given by Jaroslav Majernik, PhD. (Faculty of Medicine at the Pavol Jozef Šafárik University in Košice) who talked about his own experience with the installation and operation of the common portal solution (see http://portal.lf.upjs.sk). Although the Faculty of Medicine in Kosice has not yet published as many e-learning materials as have other medical faculties, the administrators of its portal have shown a lot of enthusiasm, which is so needed to convince local teachers of the usefulness of this innovative solution.
Other two lectures were given by medical students from Bratislava, informing the audience about an innovative solution of a students' web portal which is entirely independent of the official management of the Faculty of Medicine in Bratislava (Slovakia). In the end of this session, Bohdana Rehakova (Faculty of Medicine at the Palacky University in Olomouc) introduced a very successful project of e-learning support for pathophysiology at the Faculty of Medicine in Olomouc. This progressive project has resulted into a publicly available web portal (http://pfyziol.upol.cz), containing digitized videorecordings of lectures, synchronized with powerpoint presentations. These virtual lectures are equipped with a powerful searching tool and self-learning tests.

Panel discussion and open-door session of the MEFANET Coordinating Council

This year's conference programme was enriched with a panel discussion, dealing particularly with the question “how to fill the educational portals with satisfactory and high-quality contents in a short space of time?” The administrators of educational portals at some faculties often face the same problem: teachers at the respective faculty have such a heavy workload that they often do not have enough time or motivation to create electronic teaching tools to be published on the portal. The panel discussion was chaired by Prof. Stanislav Stipek, MD (1st Faculty of Medicine at the Charles University in Prague) who outlined some other reasons for the teachers' unwillingness to cooperate. Some teachers assume, for example, that it is not worth spending their time on lengthy preparation of educational materials, as there is allegedly nobody to appreciate their work apart from students. Assoc. Prof. Ladislav Dusek, PhD. (Faculty of Medicine at MU) objected that electronic textbooks can be awarded by the academic community in the same way as printed textbooks – and moreover, there is high probability that much more people learn about the author's work thanks to the modern technology. Participants of this discussion have finally agreed that individual faculties need to establish stable teams of people to provide technical support to the teachers

Figure 3: Chairmen of the panel discussion (left to right): Assoc. Prof. Ladislav Dusek, PhD. (LF MU), Daniel Schwarz, PhD. (LF MU), Dr. Cestmir Stuka, MBA (1. LF UK), Martin Vejrazka, MD, PhD. (1. LF UK), Prof. Stanislav Stipek, MD (1. LF UK).

and to help them with the digitization of their educational materials. In many cases, students can be also engaged, as they are very well acquainted with modern technology (often better than their teachers) and can be very enthusiastic to create these educational tools.

A public session of the MEFANET Coordinating Council took place after the end of the official conference programme. The representatives of individual medical faculties made complimentary remarks on smooth running of the conference and on its programme, and suggested some minor improvements for the next year. A good news is that over its two-year existence, the MEFANET project has already won a very favourable position in the field of education of future doctors: when searching for medical terms (particularly in Czech), the search engine Google offers links to the central MEFANET gate (http://portal.mefanet.cz) – or to individual educational portals – among the first positions. Some other subjects would also like to join the MEFANET project, such as the Ternopil State Medical University (Ukraine) or the Faculty of Health and Social Studies at University of South Bohemia in Ceske Budejovice. Decision on the admission of these subjects will be made later on.

In the end of the session, the Coordinating Council agreed that the MEFANET conference will be held also next year: the conference MEFANET 2009 will take place on 26–27 November in Hotel Voronez, Brno, Czech Republic. Until then, we wish a lot of success to all participants of MEFANET 2008 and to all supporters of the MEFANET project and modern educational methods, and we will be hoping to see them again in 2009.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A DIGITAL EDUCATION IN MEDICINE

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02

DIGITAL M-EDUCATION ERA

D. Meško

Jessenius School of Medicine, Comenius University, Martin, Slovakia

Abstract

Paradigm shift of medical education is highly influenced with digital era. Today reality means the end of walls, time, distance, unavailability and costs. The requirements of the medical workforce are changing – employers need physicians with mastery of the basics+. Autonomic medical practice and digital literacy needs creativity, multidisciplinarity, flexibility, intercultural communication and problem-solving skills. Everyone on medical education scene benefits by sharing information via network. Today world of medicine is different, tools and communication are different, work is different, education and learning are different, information is different, medical students are different. There is a must for the information-age mindset, for all people on the medical education scene. One of the very key challenge is: How to teach medical teachers to teach with new media? Today students are visual + kinesthetic multi-taskers/hyper-text thinkers, learners by discovery, team players. The substantial expansion of ICT over the past two decades years initiated medical educators to find innovated applications for computers in medical training. ICT confirm the essential and core role of the main player – the medical educator on the scene of medical education: be the mediator/facilitator between knowledge and the student; a lifelong learner, partner for students.

Keywords

digital literacy, information-communication technologies, medical education

Introduction

"If knowledge is the engine of development, then learning is its fuel."
(Takeushi)

I personally belong to "B.G." generation ... who am I in the eyes of young people? ... my medical students ... immigrant/invader to their life? ... today I am an analog player in a "their" digital world? ... and ... "inventor of PC?" To whom I addressed my questions "Before Google" being university student (1975–81)?
Digital medical education is not digital analogues of past didactic principles, stone lecture and seminar rooms and teacher using 1,000 USD pen, reading a static one-way information displaying even through tomorrow media.

Today reality means the end of walls, time, distance, unavailability and costs. Today world of medicine is different, tools and communication are different, work is different, education and learning are different, information is different, medical students are different. Medical education is changing in a way that may seem like science fiction to some people. Goes in unpredictable spectrum of possibilities. Tools like virtual reality devices, robotics, on-screen "personalities" that talk back, 3D anatomy, and computer simulations are not virtual, but real.
Low-power computers were firstly replaced by mobile devices and then by wearable and pervasive devices consuming low energy and having high autarchy extended with invisibility. The software for pervasive applications has taken the bun of classical graphical user interfaces and implicates natural human forms of communication

such as handwriting, speech, pen-based or free-form interaction and sensors attached to computational devices so as to provide management and manipulation in physical ways. [2, 6]

"What has become abundantly clear is that the availability of information is the key to overcoming virtually all of the barriers we now face to improving personal and public health. Think about it. If we could always get the right information to the right place at the right time for the right person to use, there is no reason why we couldn't: kindle widespread adoption of healthy lifestyles; maximize people's adherence to proven preventive practices; make much more timely diagnoses; render far more accurate prognoses; select the most appropriate treatment every time for each individual; eliminate the unaccountable variations we now see in practice patterns across the country; improve dramatically patients' compliance with medical advice, and reduce by orders of magnitude the alarming number of errors the system now produces." [3]

Change of the world

"The inventor of this system deserves to be ranked among the best contributors to learning and science, if not the greatest benefactors of mankind."
(J. F. Bumstead, 1841. Speaking about the invention of the chalkboard)

The world is completely changing, from analog to digital, from attached to mobile, from isolated to connected, from closed to open. We are living in information and knowledge society and medicine. Familiar to users, computationally powerful, and often wirelessly networked, such devices routinely travel with students and educators into academic environment. [7] The world, information, medicine and education are flat. The Web doubles every 60–65 days, internet usage is increasing at the rate of about 140 persons a minute – almost 72 million a year, 3.6 milliards txt messages were send a month/2007. It is estimated that today learners will have 10–14 jobs by their 40th birthday. Hopefully it will not be a true in medicine.

The ability to see, to sense, to visualize, is one way the thread of information technology wraps around and draws the sciences together. Information technology may be able to revolutionize the way we teach and the way we learn. [4]

Change of students

Young people naturally gravitate to variety kinds of interactive, input/output communication devices. They make the devices work without a manual, without the instruction set, as if the device is hardwired into their (brain-disc) psyche. [10] Yet as we think about the next decade, we are looking not only at continuing to change the way we work but also at changing the way we live, play, and learn. Some of the most exciting things happening in the networking market are aimed at recognizing that potential. But to do that, we have to change our whole mindset. [11] The technology is just the means to the end. It is the content that matters. And we know, information is everywhere, devices are cheap and the result is – most of students are receiving information – outside the school.

Information-Communcation Technologies (ICT) are playing increasingly important roles in biomedical training. The substantial expansion of ICT over the past two decades years initiated medical educators to find innovated applications for computers in medical training. Medical training programs in the form of computerized lectures, online electronic learning modules, and patient simulations. Many medical educators feel that today's medical students prefer, or even demand, that their educational material would be online. Most of medical students today own two principal electronic appliances, the mobile phone and iPod or equivalent tool. New generation of students are using multitasking, receiving

music downloads, instant messaging, and using phones as ubiquitous instruments for internet access and animation, pictures, photography and video in addition to communication. ICT increases also the efficiency of the medical educational setting by automating evaluations and assessments. Medical students like to be pulled into learning, not pushed into training. In the daily medical practice multiple dynamic development in ICT have changed the way clinicians can obtain access to the information of all aspects needed for clinical practice. These enhancements include: high-speed internet access; portable media players; dramatic decrease in physical size of mass storage devices, with a simultaneous increase in their capacity. Barriers exist to the widespread use of internet-based technologies in the delivery of educational materials for medical students, health care providers, clinicians, including a lack of understanding of computers and the internet. The internet is already transforming medical education. You can link to essays on demand, degrees for sale, virtual campuses. And what is more, today medical students entering medical schools are "native speakers" (digital natives, born cca 1985+) of the digital language, speaking e-speranto. They have spent their entire lives surrounded by and using computers, ICT and all the other toys and tools of the digital age. So it is clear and reality, today students think and process information substantially differently from their predecessors. Young generation prefer teamwork and network, technology, engagement, excitement, experential activities, audio and video before text, many of students are technology savvy. And many times they prefer games to "serious" work. [8]

Challenge for medical educators

Teachers generally are mostly "digital immigrants", persons not born into the digital world, but have adopted many of aspects of the new technology. However they retain an "accent", a foot in the past. Today teacher should have many hats: online conductor and negotiator, moderator, tutor, observer, organizer, expert, helper, facilitator, finder, reviewer. But if today is "young students" web 2.0 reality, are we – teachers – using the new WWW to teach our students – whatever, whenever, wherever? Even web 2.0 is here, came also thinking 2.0, content 2.0, context 2.0, teaching 2.0 and learning 2.0? Since our students already know how to use communication technologies, why are not we – teachers – using them to teach more modern? Or – if we cannot beat them, join them! For these reasons total rethinking and rethinking pedagogy is essential. School is no longer a key means/space of education and digital learning processes. But teacher/facilitator remains a key player in distant + face-to-face education. So who should change? Who should upgrade themselves? Who should put near a student mind, attitude, dreams, thinking, creating? So what is the reality of today mission of medical teacher in the era of "information flood"? Challenge for medical teachers – management of information at their hands. Not ICT is the key player of education, but teacher is, and his pedagogy, forever, leaving message, motivating medical students and using ICT, preparing them for life-long learning, continuing medical education. Key challenge for medical education is not to do it with ICT, but "how" and a principal shift from content to context medical education, or, at best, individualized education.

The primary implementation barriers for the adoption of new learning devices are neither technical nor economic, but psychological, organizational, political, and cultural. [5] Medical education paradigm shifts ... daily ... principal needs going along = "massive investment" into systemic change and shift of teachers for new thinking and teaching methods (levels up approach); shift from "service ICT literacy" to teachers/students interactive, didactic and creative digital skills and competencies. ICT confirm the essential and core role

of the medical teacher: be the mediator/facilitator between knowledge and the student ... the face-to-face relationship between the teacher and the medical student ... face-to-face communication between medical student and patient remain essential.

New educational universe reality

"Have a healthy disrespect for the impossible."
(Larry Page)

"With last year's momentous transition from the second to the third millennium, we not only have crossed an irreversible temporal threshold, we have crossed a threshold of irreversible, fundamental transformation in the way doctors interact with their patients and in the way their patients interact with them and with the rest of the health system. How could there be a more exciting time to begin a career in medicine? But so far, I've spoken only of the awe-inspiring upside of this transformation. Is there also a dreaded downside to digital medicine that could vitiate its benefits? The answer, I'm afraid, is yes; that is, if we allow ourselves – and our patients – to be lulled into the misguided notion that the doctor-patient relationship is based on nothing more than the transfer of information." [3]

Medical education exists in a global networked reality. We need to take into account: new knowledge in medical sciences; access to medical knowledge; communication in a network; new medical teaching/learning; new tools, resources, pedagogies in medicine; new space/time; new medical teachers preparation; new reality in medical society and medical backgrounds.

Medical student is in the centre and pedagogy goes:

WITH technology – infrastructure – ICT tools, network...
WHO teacher
WHAT content
HOW holistic approach, best practices, methodology, context, vision.

New tools for new times on the scene of medical education today and in the future (but who can predict?): handhelds, PDA, laptops, smart phones, netbooks, e-books; student response systems; micro-digital projectors; audiosets; WiFi environments; interwrite schoolpads; documentation microcamera; VoIP; IPTV; videokonferencing; digital examination tools; HiFi-PerFi tools/manikins; micro SIM + modeling; sensors and robotics; interactive whiteboard; portable nano- and DNA-computers; artificial intelligency and ???

Medical education in present digital era is supported with: e-Learning (LMS), e-Portals, Pod-Web-Video-Vod-Screen-Casting, RSS Readers, 3D-Chat, Search Engines, Google Docs/Books/Scholars, videoconferencing, blogosphere, images-slide-video-collections, second life and virtual-blended-augmented reality/worlds, simulations and exercises.

Web-based applications can be accessed anytime, anywhere worldwide from any platform. Virtual patients can test the knowledge of students/physicians, give the possibility to study and work in students/physicians own pace (whenever, wherever), give more realistic situation than paper-based cases. Also it can motivate students/physicians to learn, getting immediate feedback. Creating the creative environment easy to use. Last but not least virtual patients environment provides the space for fun and engagement.

Over the next several years, it is critical that all medical educators think broadly about educational principles and practices and how they can be improved and modified to take advantage of the marvels of our changing technological world.

ICT projects examine the exploitation of common devices such as multimedial projectors, microphones and cameras in recording of educational sessions in real time and to allow and trying to integrate the traditional activities within a classroom with the tele-education ones. [1, 9]

Education vs digital reality vs human being

"It is possible to store the mind with a million facts and still be uneducated."
(Alec Bourne)

As educational ICT continue their rapid evolution, it is attractive to become trapped with technologies and forget that the technology is fundamentally dependent on the underlying pedagogy and learning principles. In the online medical learning and education, the course material and its content is still more important than the technological media. Making use of active, just-in-time learning is difficult in these situations and it is here that clinical simulations, sophisticated electronic mannequins, and virtual environments may be particularly helpful ("learning by doing"). Simulations also allow learners to practice their individual and team skills by teaching and working with others in collaborative environments. [12]

"First of all, doctors with the skills the MDs among you have acquired are not passive conduits of information. Doctors deal not with generic classes of abstract patients but with unique individuals. As a doctor, you will be expected to gather all the relevant facts about one particular individual at a time; analyze and sift those facts to extract the nuggets of real meaning; synthesize those nuggets into a coherent representation of that patient's reality; and, most important, make a discretionary judgment about the best course of action for that one unique person. Discretionary judgment! Discretionary judgment – the ability to make fine distinctions among alternative possibilities, to draw valid conclusions from a unique set of circumstances, to combine intelligence, reason, understanding, and intuition to discern the likeliest path to a successful outcome. Discretionary judgment cannot be digitized. But even that's not all that real doctors do. We know that when people get sick they want someone to care for them – to care for them as human beings. Which means more, much more than having someone provide accurate information on a computer screen. It means yielding to the security of a human relationship. It means tapping into the genuine concern of a trusted professional, not tapping into an anonymous chatroom. It means experiencing direct physical contact with someone who cares, someone we can rely on and in whom we can entrust our well-being. I hope you'll always remember Francis Weld Peabody's most famous admonition: 'The key to the care of patients is caring for the patient.' Caring, like judgment, cannot be digitized. I concede that people who 'grow up digital' – most of your patients will have done – may be more comfortable operating in cyberspace than previous generations were, and they may even have a preference for health information delivered by bits and bytes. But growing up digital does not mean growing up in silicon. A mere generation of immersion in the virtual reality of electronic communication cannot eradicate our need, especially when we are ill, for human contact, for a trusting relationship, and for a caring physician." [3]

And the future? The military has funded MIT to come up with internet implanted in the brain by 2018. If MIT perfects, there will be wireless communication from one brain to another. If these will happen, what will be the principle of education, teaching and learning, including medical education? Firewalls, antiviruses and other protectors will be needed? Pandorra box will open?

"The future is not about what older people think but what younger people do." *(Nicholas Negroponte)*

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03 PROJECT MEFANET – A NEW KIND OF COLLABORATIVE SPACE FOR ELECTRONIC SUPPORT OF MEDICAL AND HEALTH CARE EDUCATION

L. Dušek [1], D.Schwarz [1], S. Štípek [2], Č. Štuka [2]
on behalf of the MEFANET Coordination Council

[1] Institute of Biostatistics and Analyses, Masaryk University, Brno
[2] First Faculty of Medicine, Charles University in Prague

Abstract
Development of e-learning tools is current challenge of teaching at any thinkable level. Medical faculties in the Czech Republic and Slovakia have established a new functional network contributing to this field. Instead of a centrally organized consortium, they created the network from the bottom up by joining existing portals already in daily use. Authors from the contributing faculties are able to determine the user access privileges to particular learning objects. Centralized support for web-based user-driven learning solutions is open for other partners, both universities and other academic institutions interested in medical education. Only two conditions are obligatory for current and new active members in the network; they are required to accept (1) the uniform taxonomy of medical disciplines and (2) the Shibboleth system of authentication. Currently, the network serves to approximately 4,000 teachers and to almost 22,000 medical and health care students, providing them with electronic learning objects from all 11 participating schools. In 2008, the network launched its central gate as a new valuable component integrating the information presented in all the portal instances. The entry to the gate, as well as all project information and results, are available on the MEFANET website: www.mefanet.cz.

Project MEFANET

The MEFANET project (Medical Faculties NETwork) is aiming to develop and to strengthen the cooperation among Czech and Slovak medical faculties, as regards the progress in education of medical and health care disciplines using modern ICT. The primary objective of the MEFANET project is to facilitate the cooperation among teams from different faculties, and to ensure a horizontal accessibility of electronic teaching tools for both teachers and students. The network had been initiated as an inter-university project since 2006. In its current form, the network was finally established in June 2007 at the constitutive meeting of the Coordinating Council in Prague.

Faculties involved in the MEFANET project and size of the community

The network was built stepwise from the initial cooperation among three founder faculties. In just one-year time, it spontaneously expanded over the two countries; currently, it serves to approximately 4,000 teachers (potential authors of multimedia education objects and scenarios) and to almost 22,000 medical and health care students, providing them with electronic learning objects from all 10 participating faculties *(see Tab. 1)*. The network has thus reached hundred per cent coverage over all medical faculties in both countries and can implement nationwide standards in electronic-based education in medical and health care disciplines.

Medical faculties involved in the MEFANET project

- Faculty of Medicine at Masaryk University (Brno)
- Jessenius Faculty of Medicine in Martin at the Comenius University in Bratislava
- Faculty of Medicine at the Comenius University in Bratislava
- Faculty of Medicine at the Pavol Jozef Šafárik University in Košice
- Faculty of Medicine at the Palacky University in Olomouc
- 1st Faculty of Medicine at Charles University in Prague
- 2nd Faculty of Medicine at Charles University in Prague
- 3rd Faculty of Medicine at Charles University in Prague
- Faculty of Medicine in Hradec Kralove at Charles University in Prague
- Faculty of Medicine in Pilsen at Charles University in Prague

Other faculties involved in the MEFANET project

- Faculty of Health and Social Studies at University of South Bohemia in Ceske Budejovice

Scope and main added value of MEFANET activities

The MEFANET project is focused methodically; its main objectives involve strengthening the cooperation among medical faculties as regards the application of modern

Table 1. All seven Czech and all three Slovak medical faculties are joined in MEFANET (http://www.mefanet.cz/)

Faculty (City)	Czech / Slovak students	Students in English language	Lecturers and teachers	Total number of students
Czech Republic				
Faculty of Medicine at Masaryk University (Brno)	2637	327	775	2964
Faculty of Medicine at the Palacky University in Olomouc (Olomouc)	2355	291	529	2646
1st Faculty of Medicine at Charles University in Prague (Prague)	3060	389	1238	3449
2nd Faculty of Medicine at Charles University in Prague (Prague)	1142	172	400	1314
Faculty of Medicine at the Pavol Jozef Šafárik University in Košice (Kosice)	2230	160	297	2390
Jessenius Faculty of Medicine in Martin at the Comenius University in Bratislava (Bratislava)	1527	201	200	1728
Faculty of Medicine at the Comenius University in Bratislava (Bratislava)	2649	360	494	3009
Slovakia				
3rd Faculty of Medicine at Charles University in Prague (Prague)	907	250	234	1157
Faculty of Medicine in Hradec Kralove at Charles University in Prague (Hradec Kralove)	1150	200	365	1350
Faculty of Medicine in Pilsen at Charles University in Prague (Pilsen)	1400	300	305	1700
Total	19057	2650	4837	21707

ICT in the teaching process, standardization of related procedures, and securing the compatibility of resulting materials. The primary objective of MEFANET activities is to promote the application of modern ICT in the education of medical disciplines. All outputs of the MEFANET project are intended to enhance the quality of teaching materials and to make them easily available for students of involved faculties. At the same time, a considerable attention is paid to copyright protection, and to incentive programmes for the authors of extensive educational works.

The MEFANET project brings the following benefits to the participating faculties:

- horizontal cooperation and sharing the results of work from authors of multimedia teaching tools and on-line educational resources,
- unification of methods to create and publish multimedia teaching tools and on-line educational resources, in order to assure availability of these materials to students of all involved faculties,
- putting together human resources and potential to develop complex technological solutions in an effective manner, and to solve possible problems with creation and/or publication of multimedia teaching tools and on-line educational resources,
- a more effective usage of acquired financial resources, possibility of inter-university cooperation on awarded grants.

Principles implemented in the network organization and activities

The basic principles of coordination and activities within the MEFANET project are stipulated as follows:

- The MEFANET project is a voluntary initiative which promotes an equivalent cooperation among medical faculties.
- The MEFANET project is open for cooperation with other subjects, particularly academic institutes involved in the education of medical or health care disciplines.
- All activities of the MEFANET project, including the way of solving common projects, respect the independence of individual faculties.
- The MEFANET project promotes an entirely academic cooperation, where financial resources need to be acquired in the form of educational and/or research grants. Activities of the MEFANET project do not generate any expenses which could affect internal budgets of participating faculties. It is expected that one-shot expenses associated with optional activities within the MEFANET project would be covered from own resources of the respective faculty. The MEFANET project does not have central finance resources.
- The project is overseen by the Coordination Council, which consists of 2-3 representatives from each participating medical faculty. These representatives are appointed by the Dean of the respective faculty. If a common decision has to be made, each faculty has a single vote to be applied. The Coordination Council is convened and presided by the Chairman, who is elected by representatives of the participating faculties for the period of one academic year.
- The Coordination Council establishes the priorities of MEFANET activities, decides on generally acceptable standards for individual types of outputs, and helps to define and solve common projects.
- The Coordination Council does not intervene in the system of education at individual faculties: the participation in specific initiatives and/or standards is subject to approval by the management of individual faculties.

Main tools forming open collaborative environment in the MEFANET network

Although the autonomy of individual faculties is fully respected in all project activities, there must be some generally implemented and obligatory rules that keep the project consistent and manageable. MEFANET is not only a platform aimed to generate learning objects at participating faculties; it is rather a community with numerous priorities which require centralized support and universal tools, namely:

- mutual communication among participating subjects, teams, teachers and also students and users of e-learning materials,
- sharing the learning and teaching objects, methodical issues and experience,
- coordination of hardware and software investments into computer-assisted learning and teaching, harmonized purchase of licences,
- centralised support and coordination of applications for grants.

The framework for collaborative environment in the MEFANET network is formed by the following set of tools and activities:

1. The MEFANET Coordination Council. Juristically the MEFANET is based on the mutual agreement signed by deans of the all participating faculties. The deans appoint two or three representatives to the Coordination Council, where each faculty has just one vote. The Council monitors the activities and initiatives of the individual members and organizes preparation of common projects, author teams etc.
2. A Uniform solution to offer and share multimedia education content. Sharing of educational resources is one of the elementary goals of the project. It was decided to develop an original and uniform solution for educational web portals which are used to offer and share digital educational content in MEFANET. The portals are implemented at all involved medical faculties. Students can benefit from the portals by looking at multimedia content from other medical faculties. A wide accessibility of presented content gradually increases its quality and motivates authors to cooperate. The criteria for web usability and accessibility as well as modern search-engine-optimization techniques were considered in the design of the underlying data model as well as in the subsequent development of the system environment. Furthermore, the so-called “backoffice” administrative tools were implemented in the modular form with a high level of scalability, in order to make any instance of the portal available for an involvement in a local structure of information systems.
3. Universal taxonomy of medical disciplines serves as a dominant filter unifying access to learning objects from any point of the network (http://portal.mefanet.cz/index-en.php). The taxonomy consists of clearly categorized disciplines implemented as key words in searching tools. The categorization of disciplines respects commonly adopted standards and compromises it with teaching curricula of involved faculties.
4. MEFANET central gate, launched in November 2008 as a new valuable component of the portal solution. The gate integrates the information presented in all portal instances. The solution was completed by the federated single-sign-on authentication framework with the use of Shibboleth inter-institutional web resources sharing.
5. Standards for quality assessment and quality control. Each faculty is responsible for the quality of shared learning objects provided as a contribution to the network. There are two different procedures for the quality evaluation: 1) “signatures” of guarantees and 2) reviews. Both ways of evaluation can be combined. In the first case, the dean nominates one guarantor for each of the disciplines in the portal taxonomy. The guarantor is then automatically and permanently informed about new submissions on the

portal; using the backoffice application, he/she can mark the object as accepted or refused. Furthermore, the object may be recommended for a review. The editorial committee of the faculty considers the recommendations and arranges the review procedure. Successfully reviewed objects are marked by the faculty logo and considered as a recognized pedagogical work.

6. Copyright. Each faculty is responsible for the copyrights according to the local rules of the author country. Creative Commons licences are currently a hot topic in the MEFANET network and their utilization is considered.
7. The common website of the network: www.mefanet.cz. It works as the official presentation and communication platform for MEFANET members.
8. MEFANET annual conference. The conference is organized as a key event for all participating subjects as well as other academic institutions and partners. The core of its program deals with e-learning in general, one part of the conference is focused on one specific field of medicine and its strategy in the implementation of information technologies in teaching. Programme overviews, reports and proceedings of past conferences are available on the website www.mefanet.cz.

A key to success: respecting the independence of participating subjects

The MEFANET project is certainly not meant to affect or to control teaching activities at individual faculties: all targets of the MEFANET project fully respect the independence of individual faculties. The project is primarily focused on the creation of methodical materials and standards, which would subsequently facilitate the cooperation of participating teams of teachers. Each participating faculty is expected to follow its own priorities of development, while the cooperation will only consist in mutual awareness, methodology standardization and sharing the works of authorship. If one faculty uses educational materials and tools of another faculty, owner's rights and copyright of the latter faculty must be respected. These rules will also apply to other Czech and Slovak universities which would possibly join the project later. Key activities of the project are secured by mutual contracts among participating subjects (e.g. contracts between university hospitals and medical faculties on the usage of database of clinical images etc.).

A key to progress: searching for incentives to e-learning in everyday routine

The growing community of Czech and Slovak medical faculties in the MEFANET network already offers a wide range of incentives: open accessibility of learning objects, fast progress in individual projects, standardization of outcomes. However, our experience shows that even modern technological background and progressive central management are not enough to maintain the activity of all points in the network. Individual faculties typically have a different spectrum of study programmes within their own priorities, and not all aspects can be easily supported from just one dominating centre operating with a specific type of learning objects repository. In order to reach a collaborating environment, educational networks should also ensure a certain kind of distribution and implementation pathways, which would be accessible for each participating faculty, even if it participated only passively. This refers to the already mentioned standardization of local educational portals and gates. Another barrier which could obstruct any centrally driven innovation is the resistance of teachers and lack of time capacity. Successful network must therefore create some added value which makes e-learning attractive. For this reason, the MEFANET network visibly supports e-learning or multimedia tools of

recognized scientific value (atlases, comprehensive electronic textbooks) which can be stimulating for leading experts in study programmes. Although this is not the main objective of the community, many potential authors can be attracted by such type of outcomes; subsequently, they come into contact with "standard" e-learning and are willing to support it in their departments. The MEFANET network develops standards which allow transparent assessment of the outcomes by a broad scientific community. In this way, e-learning will gradually acquire a valuable position which will finally stimulate the required feedback from participating teachers or teams.

Long-term objectives and challenges of the MEFANET project

The project MEFANET has built a well-stabilized and functional network of faculties and other academic partners involved in teaching process. Principles and concepts of the MEFANET allowed it to be opened for all national medical faculties which obtain parallel instructions and use its own educational portals in daily pedagogical practice. Therefore, future efforts of the participants should be oriented more on the content and methodical issues. Long-term objectives of the project can be listed as follows:

- To unify and to standardize methods for the creation of multimedia teaching tools and on-line educational resources.
- To support the production of electronic teaching tools, to ensure their compatibility and availability for students of participating medical faculties.
- To ensure a professional leadership and to establish an inter-faculty group of experts ensuring a common methodological development.
- To develop a common database for the incorporation of telemedicine in the education of medical disciplines.
- To develop organizational synergies by ensuring a certain level of redundancy between faculties, having a resource pool that supports inter-faculty production of learning objects and tools.
- To encourage teams of authors to cooperate more closely when creating multimedia teaching tools and systems for on-line education. To develop procedures for the introduction of e-learning for lifelong learning of physicians and health care professionals.
- Securing an educational platform which will ensure that the central logistics team will develop competencies using common tools accessible to all participating points.
- To support web-based user-driven learning solutions with potential to address the present problems of information oversupply in medicine that mostly remains underutilized; to attract teams of health care professionals and to keep them in contact with e-learning production in the faculties.

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B ICT AND INFORMATION RESOURCES

mefanet

04 A COMMON PORTAL PLATFORM FOR DEVELOPING AND SHARING DIGITAL CONTENT IN THE MEFANET PROJECT: CONCEPTS, FUNCTIONALITY AND THE STATE OF IMPLEMENTATION

D. Schwarz [1], L. Dušek [1], S. Štípek [2], V. Mihál [3]

[1] Institute of Biostatistics and Analyses, Masaryk University
[2] First Faculty of Medicine, Charles University in Prague
[3] Faculty of Medicine and Dentistry, Palacky University in Olomouc

Abstract
The project MEFANET (MEdical FAculties NETwork) has initiated international, effective and open cooperation among medical faculties in the Czech Republic and Slovakia. One of the elementary goals of the project is to advance medical teaching and learning with the use of modern information and communication technologies. As an instrument for that, MEFANET has decided to develop an original and uniform solution for educational web portals which are used, together with a central gate, to offer and share digital educational content. In this way, a unique collaborative environment, which is full of shared resources, is growing.

Keywords
medical education, computers in medicine, e-publishing

Introduction

Rapid developments and advances in information and communication technologies (ICT) must take effect in undergraduate as well as postgraduate education of physicians and other health care professionals. Although ICT allow to make the creation of electronic study materials more effective, availability of these technologies for medical education is still rather poor. These facts have been frequently confirmed in conclusions of the conferences focused on the ICT use in medical
education [1–3], where the medical faculties from the Czech Republic and Slovakia participated. Although a wide range of e-learning courses or modules exist, they are mostly focused on the pre clinical courses. There are several specific aspects in the clinical phase of medical education, as patients and health care providers naturally enter into the relationship between teachers and students. Many ethical as well as legal questions remain still unanswered.
The idea of cooperation of medical faculties on sharing their educational digital content appeared in 2006 for the first time. Early after that in 2007 all seven Czech medical faculties as well as all three Slovak medical faculties have formally joined the brand new network, see *Fig. 1*. The MEFANET (Medical FAculties NETwork) project aims under the auspices of the faculty deans to develop and strengthen the cooperation among the medical faculties as regards the progress in education of medical and health care disciplines using modern ICT by means of a common platform for sharing the educational digital content. The primary objective of the MEFANET project is to facilitate the cooperation among teams from different facul-

ties, and to ensure a horizontal accessibility of electronic teaching tools for both teachers and students. The MEFANET project is certainly not meant to affect or control teaching activities at individual faculties: all targets of the MEFANET project fully respect the independence of individual faculties.

browsing. The educational web portal of the Medical Faculty at Masaryk University http://portal.med.muni.cz [4] has been accepted as the ground for the solution of the common portal platform in the initial phase of the project. The educational web portals have no ambitions to replace well-

Figure 1: All seven Czech and all three Slovak medical faculties are joined in the MEFANET project (http://www.mefanet.cz).

The common portal platform in the MEFANET

The whole MEFANET project consists not only from the activities around the web portals. There are many other topics to solve. Three of them are however closely linked to the common web portal platform: 1. ethically and legally correct relations among students, teachers, patients and health care providers; 2. procedures for digital content quality evaluation. 3. author appreciation with respect to the academic-scientific potential of their electronic works. The current list of the topics and priorities in the MEFANET project can be found [5], [6].

There are two particular goals concerning the common portal platform in the MEFANET project: 1. to unify faculty educational web portals such that the published educational content is accessible horizontally, 2. to build a common central gateway enabling easy and comprehensible content

established learn management systems (LMS) at the faculties – they should complement each other in a suitable and favorable manner.

It was decided that standalone instances of the educational web portal should be implemented at the individual faculties beside their existing local information systems, whereas a development of a centralized system, hosted for the whole network, was refused. Another valuable component of the designed platform is a central gateway which should integrate all the information presented on the portal instances into one common place on the web. All these portals and the gateway compose the e-publishing platform in the MEFANET.

Fundamental elements in the MEFANET e-publishing platform

Scalability and extensive customizations are important and desired properties of the MEFANET e-publishing system. On the other side, there are also several legitimate requests for particular common conventions which should be followed on the parts of local administrators.

There are three basic structures which can be used to sort and categorize the published items on the portals, *see the Fig. 2:* 1. content sections, 2. types of educational materials and 3. a medical disciplines linker.

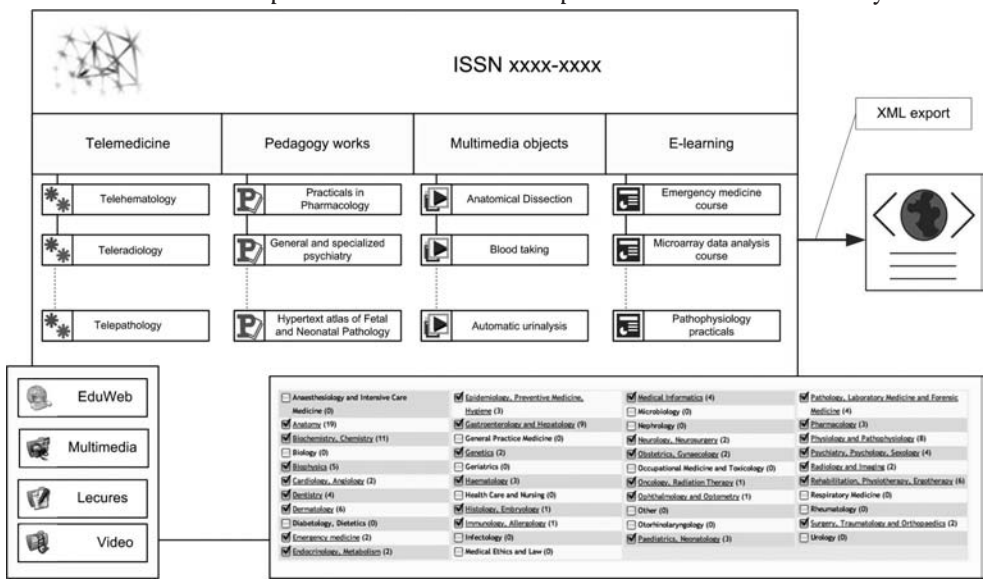

Figure 2: The structure of an educational web portal as a part of the common e–publishing platform in the MEFANET. There are three means for subdividing the content, marked yellow: according to contents (horizontal), to types (vertical) and to medical disciplines (filter/linker). There is a communication interface between a portal and the gateway which is based on XML data exchange.

Medical disciplines linker

Titles and topics of the content sections as well as the types of the educational materials are arbitrarily configurable for each portal instance, whereas the medical disciplines linker is the only obligatory element for all the portal instances and the central gateway too. At the beginning single-level or multilevel list of medical specializations were considered as well as the possibility to adapt an existing scheme from the National library of the Czech republic, which is based on the standard Conspectus method [7]. However, the medical disciplines mapping according to the Conspectus method showed to be inapplicable for MEFANET purposes. Thus, an own medical disciplines linker was composed, based on various taxonomies adapted from significant medical publishing houses. Since its first release the linker has been reedited many times, see the current version in the *tab. 1*.

Authentication / authorization framework

The access to portal itself is not restricted anyhow. All pages and contributions at the portal are accessible for anyone who searches the portal (or its contents, respectively). Therefore, everyone interested can get an overview of educational materials available on the given medical faculty. The educational content consists in a system of articles which describe the educational contents in detail, particularly by its title and a short annotation. The educational contents itself included with an attachment or a hypertext link. Each attachment and/or link contains information on a group of users who have access to these materials.

Table 1: The list of medical disciplines for basic categorization of the educational content in the MEFANET.

Anaesthesiology and Intensive Care Medicine	Anatomy
Biochemistry, Chemistry	Biology
Biophysics	Cardiology, Angiology
Dentistry	Dermatology
Diabetology, Dietetics	Emergency medicine
Endocrinology, Metabolism	Epidemiology, Preventive Medicine, Hygiene
Gastroenterology and Hepatology	General Practice Medicine
Genetics	Geriatrics
Haematology	Health Care and Nursing
Histology, Embryology	Immunology, Allergology
Infectology	Medical Ethics and Law
Medical Informatics	Microbiology
Nephrology	Neurology, Neurosurgery
Obstetrics, Gynaecology	Occupational Medicine and Toxicology
Oncology, Radiation Therapy	Ophthalmology and Optometry
Other	Otorhinolaryngology
Paediatrics, Neonatology	Pathology, Laboratory Medicine and Forensic Medicine
Pharmacology	Physiology and Pathophysiology
Psychiatry, Psychology, Sexology	Radiology and Imaging
Rehabilitation, Physiotherapy, Ergotherapy	Respiratory Medicine
Rheumatology	Surgery, Traumatology and Orthopaedics
Urology	

The authors of the educational contents (published attachments) can choose from the following user groups, in order to permit/deny access to their materials: 1. non registered anonymous user, 2. registered anonymous user, who accepts the terms of use within his registration, 3. user of MEFANET network, i.e. student or teacher from any Czech or Slovak medical faculty, 4. user of local university, whose affiliation to that university has been verified at the portal via the local information system of that university, 5. user of local medical faculty, whose affiliation to that faculty has been verified at the portal via the local information system of the respective university or faculty.

If the user's home institution (university / faculty / hospital) is member of the czTestFed federation (provided by CESNET), the user's identity can be verified without his previous registration, using the service called Identity Provider operating at the side of that institution: the user is only required to enter his login and password to confirm his affiliation to that institution. In particular, this option is available to users from five faculties at Charles University in Prague, Masaryk University in Brno and Palacky University in Olomouc. Apart from authentication / authorization via Shibboleth, these institutions provide the user's attribute MEFAPERSON, which determines the user's identity within the MEFANET network.

Digital content quality evaluation

There are three ways, how to evaluate quality of a contribution presented on the portal:

1. An opponency action. In the case of a pedagogy work which meets basic criteria set by an academic board of a faculty, the work is reviewed and then published with an icon of an editorial committee or another authority of that faculty. Besides the logo, there is also other information added, which give full contacts to the author as well as to reviewers.
2. Guarantee signatures. There are guarantees defined for each of the medical disciplines in the linker described in *tab. 1*. They are allowed to express their opinions and objections for each contribution assigned to their disciplines. Their voice can be of three meanings: a. Accept – the contribution will be signed by a positive icon with an alternate text identifying the guarantee; b. Reject – the contribution will be signed by a negative icon with an alternate text identifying the guarantee. The portal's administrator should discard this contribution from the medical discipline. c. Undefined state – the contribution is not signed by any icon. Either it has not been read by the guarantee or there are some insignificant objectives which do not imply discarding the contribution.
3. Open discussion of users, who can response to the presented contribution. The discussion can be moderated or even disabled if there are no human resources to keep the discussion polite and presentable.

Common portal platform implementation

Until the April 2009, there were four stable versions of the portal platform released: ver. 1.2, ver. 1.3, ver. 1.4 and ver. 1.5. From the ver. 1.5 the portals communicate with the central gateway which was officially released in November 2008. Each time a new version is released, the source codes for a new installation as well as for an upgrade are sent to each medical faculty involved in the MEFANET. The source codes are completed by documentation files both for administrators and editors.

Each instance of the portal is in fact a standalone application which has to be installed into an allocated space on a web server supporting PHP and MySQL. Following human resources are necessary at each faculty for running the portal instance:

1. server administrator who is well-skilled in Linux;
2. backoffice administrator, who is responsible for configuration of the web application and has a good knowledge about the activities in the MEFANET project; he or she keeps advised the academic staff at the particular faculty about the medical disciplines linker, about the procedures for the digital content quality evaluation etc.; he or she is also able to formulate special requirements and communicate them with the central development team;
3. editors who are responsible for particular sections and for their contents administration.

Fig. 3 shows numbers of staff and sum of their part-time jobs which were available at the medical faculties in the end of 2008. It should be mentioned that the desired resources are much higher. Another measure of implementation is in *Fig. 4*, which shows the average knowledge of the portal platform in the local faculty teams.

The central gateway portal.mefanet.cz

After the portal instances have been implemented in the version 1.5 at all the faculties in the Czech Republic and Slovakia in Novemeber 2008, the central gateway to the network was launched. It is another web-based application which collects all metadata from the eduacational web portals in the network. A complete image about the available digital content is constructed in this way. Students and academic staff can

browse the objects sorted by medical disciplines, authors, schools or quality evaluation criteria. There is a sophisticated tool for searching in the complete database. Titles, keywords, abstracts other metadata and fulltext indexes are searched and the results are given to the user in the relevance-order. For details, see http://portal.mefanet.cz/index-en.php and the screenshot in *Fig. 5*.

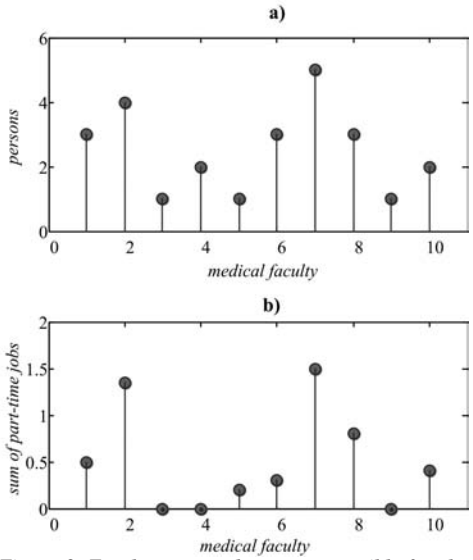

Figure 3: Faculty teams who are responsible for the local instances of the educational web portal.
a) Number of persons, b) sum of their part-time jobs.

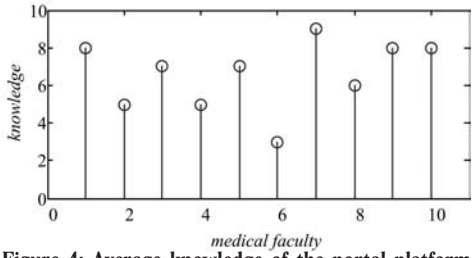

Figure 4: Average knowledge of the portal platform functionality in the local faculty teams. The knowledge is expressed by a number from the interval <0;9>, where zero corresponds to ignorance and nine corresponds to a perfect knowledge of all the properties and functions of the portal platform.

Figure 5: A screenshot of the central gateway of the MEFANET e-publishing platform.

Conclusion

The basic ideas of the MEFANET project were explained here and the fundamental elements of the solution for the common e publishing platform were described. One of the portal platform benefits for students is the possibility to access and view the offer of electronic study materials also at other medical faculties, what should gradually improve the quality of the content and motivate authors to work in joined interinstitutional teams.

The students and academic staff from the MEFANET network do not have to create new user accounts for each portal instance. The users are authenticated by identity providers which are running at their institutions and their affiliations are recognized by the portals. The access to the particular pieces of the digital content in the network is controlled only when files are downloaded or videos are watched. In these cases, the user access is set by the author of the particular teaching or learning object.

Future developments of the portal platform lie in the LOM (Learning Object Metadata) standard implementation, in order to enable a narrower cooperation with international repositories of reusable learning objects such as Ariadne or Globe. Other developments will be done according to the new

trends in Web 2.0 and Medicine 2.0. Web users expect an extensive amount of interactivity and support of their own creativity. Although the portal platform is not going to divert into the group of social networks, certain functionality such as tagging, users' rating will be implemented to keep the platform attractive in the MEFANET community.

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WEB 2.0 TOOLS FOR SELF-DIRECTED E-LEARNING FOR MEDICAL STUDENTS

05

C. Paton

National Institute for Health Innovation, University of Auckland

Abstract

Medical students now have access to a wide variety of web based tools that could help them manage their learning. These types of tools include Podcasts, Wikis, Discussion Forums, Blogs, Videos and Social Networks. These types of tools have been termed "Web 2.0" tools because they use advanced website features such as databases, Flash, Javascript and XML. A short review of the types of tools available and how these tools are used in medical education internationally is presented with a discussion of how these new tools can fit in alongside virtual reality simulations such as Second Life.

Introduction to Web 2.0

Web 2.0 is a buzzword that came to prominence around 2004 when O'Reilly Media produced a conference under the 'Web 2.0' name. Since then the term has come to be associated with websites that are seen to be second generation or an order of magnitude different from simple HTML pages. The follow table outlines some of the key difference between traditional websites and 'Web 2.0' websites:

Web 1.0	Web 2.0
Read Only	Read/Write
Webmaster	Community
HTML	XML
Files	Databases
Information	Applications
Text and Images	Video and Animation

Over the past few years, 'Web 2.0' websites have risen to become some of the most popular websites on the World Wide Web *(see Tab. 1)*.

Web 2.0 in Medicine and Healthcare

Many of these websites are used in healthcare. For example, YouTube is used for hosting educational videos for medical students and health information for patients. Facebook is used by researchers for connecting with each other and exploring research activities. Google Docs is a common collab-

Table 1

YouTube	Video sharing website	www.youtube.com
Facebook	Social Networking website	www.facebook.com
Wikipedia	Collaborative Encyclopaedia	www.wikipedia.com
Flickr	Photo sharing website	www.flickr.com
Digg	Community news rating website	www.digg.com
Google Docs	Web based word processor, spreadsheet and presentation applications	www.google.com/docs
Twitter	Micro-blogging website and social network	www.twitter.com

Table 2

Type of Site	Example	Description
Blog	KevinMD.com	Blog by a US primary care doctor
Wiki	MedPedia.com	Encyclopaedia of Medicine
Social Network	NewMediaMedicine.com*	Community for doctors and medical students
Podcast	NEJM Podcast	Subscription to audio versions of NEJM articles
Second Life	The Long White Cloud	Auckland University's virtual medical centre in S.L.

oration tool used both in medical education and medical research. And Twitter is used by many doctors and health professionals for communicating with their patients and colleagues.

There are also a range of medical-specific 'Web 2.0' websites, *see Tab. 2*.

KevinMD (www.kevinmd.com) is a blog, or online journal, written by a US family physician called Dr David Pho. The blog has become extremely popular and has over 16,000 regular subscribers.

MedPedia (www.medpedia.com) is a wiki written by medical experts from some leading US medical institutions. A wiki is a website where the pages can be edited by the users instead of just the webmaster. As MedPedia has a hierarchy of editors and authors who update the content, they might not be considered a true Wiki such as Wikipedia where any visitor to the site can update pages.

New Media Medicine (www.newmedia-medicine.com) is the author's own social networking website for doctors and medical students. The site offers a discussion forum where users have made over 600,000 postings.

Many medical organisations now produce Podcasts, of which the New England Journal of Medicine's is one example. Podcasts are audio recordings that are distributed through the Apple iTunes application. Users can subscribe to regularly download Podcasts onto iTunes and synchronise them with their MP3 players (e.g. an Apple iPod).

Second Life is a virtual reality simulation where users can connect to an online virtual world. The University of Auckland has developed an island in Second Life with a virtual medical centre complete with wards, medical equipment and ambulances. The University is studying how Second Life can be used to run simulations of medical scenarios using actors and educators taking the roles of virtual patients.

Research into Web 2.0 in Medicine and Healthcare

The International Medical Informatics Association (IMIA) has formed a Web 2.0 Taskforce to bring together researchers and produce ideas on how Web 2.0 can be used and identify some of the challenges Web 2.0 presents in healthcare.

There is also now an international conference called Medicine 2.0, held in Toronto Canada and sponsored by IMIA and the Journal of Medical Internet Research. The conference will be held for the second year in September 2009.

Web 2.0 in Healthcare Education

Web 2.0 brings many potential pedagogical benefits to medical education, in particular in terms of Social Learning, Professional Development, introducing students to publication of their work and helping them learn how to learn.

McGee et al (2008) identified a number of challenges of using Web 2.0 in medical education including:

- Biased and manipulated content
- Unclear learning objectives
- Referencing
- Legal responsibility and liability
- Patient privacy
- Copyright
- Closed vs open communities

Sanders and Schroter (2007) conducted a survey of 3,000 medical students and 3,000 doctors to investigate usage of Web 2.0 technologies. They found a high awareness of Podcasts and Web 2.0 technology but low usage in education. They concluded that training was needed, especially for postgraduate students.

Conclusion

Web 2.0 allows students to explore and learn in their own time and in their own workspaces. It also gives them the opportunity to interact with the global scientific and medical communities through the use of public blogs, social networks and discussion areas.

In the near future, simulation technology will combine some of the social learning aspects of Web 2.0 with virtual reality simulation to allow medical student to practice the art and science of being a doctor in a realistic fashion. One method of doing this is being explored at the University of Auckland through the use of the online virtual world, Second Life.

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06 FROM EDUCATIONAL WEBS, THROUGH DIGITAL REPOSITORIES TO WIKIS – THREE EXAMPLES OF STORAGES OF EDUCATIONAL OBJECTS

Č. Štuka, S. Štípek, M. Vejražka

First Medical Faculty, Charles University in Prague

Abstract

Storage of educational materials moved through different phases from educational webs, through digital repositories, and now it is heading to open, participating technologies Web 2.0 as for example wiki.

Educational portals are usually collections of educational materials gathered for needs of pedagogic process. Materials are converted into html or another form sharable on the web and then offered to students as a list on the web page.

Digital repositories store educational materials in a form of reusable learning objects (RLO). Typical characteristics of RLO are their detailed structure and peculiar description by metadata. Digital libraries can effectively share their RLOs if their interoperable standards are kept. Thus, new networks are founded which enable searching or more sophisticated services such as integration of learning objects into LMS or to other applications.

Wiki technology is a dynamically developing form of cooperative production and storage of educational materials. Here, we can find new impulses for creation and sharing of learning materials and challenges for new development of this technology.

Necessity of having knowledge of information technologies and laboriousness of preparation of educational materials form a threshold which limits the authors in creating educational materials. Especially in case of medicine, this threshold seems to be very important for a big amount of materials which are produced by different technologies. From this point of view, we compare different ways of storing of educational materials.

Keywords

educational portals, digital libraries, RLO, wiki

Educational portals

Educational portal is defined as a collection of educational lessons, courses, documents, multimedia atlases and video sequences, which is available on the net and which can be also partially organized in LMS systems.

A student searching for an alternative to classic paper information source is a typical user of such portals. A limiting factor for their reusability in other context is that materials presented in portal are available in bigger blocks.

An advantage of low structuralized educational materials is their low production costs, as they are similar to classical educational sources.

A large amount of materials produced and offered in this way is compensated by a low extent of their sharing and by high laboriousness of their continuous updating.

Examples of educational portals are e.g. educational webs MIT (http://ocw.mit.edu) or educational portals LF MU (http://portal.med.muni.cz) and 1. LF UK (http://portal.lf1.cuni.cz).

All Czech and Slovak medical faculties are associated in Mefanet (Medical Faculty Educational Network) and share their online educational resources. Mefanet network

puts together human resources allowing to develop and share valuable teaching materials in an effective manner (http://portal.mefanet.cz).

Digital repositories

In contrast, digital repositories are collections of educational lessons, courses, documents, multimedia atlases and video records, which are organized in databases allowing easy reusability. Learning data in repositories do have low amount of interactivity, there are no tools for self-testing, etc.
Data are characterized by fine granularity – i.e. educational material is structured into small compact sets that can also be used in other contexts. Data are accompanied by metadata for easy searching and they are set up free of author rights. Examples of RLO in medicine can be seen at CETL pages [1].
A typical user of educational data from digital repository is a teacher. He/she can find pieces of text or other objects here, which can be used for preparation of different educational materials.
Reusability of materials that are stored in this way, is significantly higher but the production costs are also higher. Entering metadata for each paragraph of text and each picture is extremely laborious and time consuming. An advantage is a very high value of these materials for teachers and their reusability in other contexts.
Examples of digital repositories are Ariadne (http://www.ariadne-eu.org), Merlot (http://www.merlot.org), or Globe (http://globe-info.org). The name Globe is an abbreviation of "The Global Learning Objects Brokered Exchange". Globe is a global alliance to make shared online learning resources available to educators and students around the world.
We will discuss Ariadne now, as an example of digital repository, in more details.

Ariadne – an example of a digital repository

Ariadne is a European Association for Knowledge Sharing and Reuse. The name ARIADNE is an acronym from The Alliance of Remote Instructional Authoring and Distribution Networks for Europe.
The institutional members of Ariadne are important European (continental) universities. (The name Ariadne comes from the Greek myths – it was the name of a daughter of king Minos on Crete. She helped Theseus to find a way in from Labyrinth.)
The digital repository Ariadne has three-layer architecture. The lowest layer is a repository allowing searching, acquiring and publishing of learning objects.
A higher layer is API (application programming interface) which creates a binder to web services, allowing sophisticated usage of data from the lowest layer.
The highest layer is formed by applications which make knowledge base accessible for other third parties applications.
As an example of API created in the project Ariadne, is a module for LMS Moodle which allows searching, downloading and inserting of learning objects into various Moodle projects. A module ALOCOM allows even broader use – it can be used for searching and inserting contents into MS Word [2] and MS Power Point [3].

Data storage interoperability

Interoperability of digital libraries of learning objects is the ability of exchanging describing information and using the exchanged information by two or more systems. Lack of interoperability in real life can be seen as an isolation of applications and their data and as the necessity to create the same data in duplicity.
Interoperability should make it possible that data once entered into one application would be automatically available also for other applications. The most important principles of interoperability are defined standards.

Metadata are the most important part for interoperability. They are used, when a search among learning objects is performed, in a similar way as paper file cards in classical libraries. Metadata can be divided, according their use, into descriptive, structural and administrative metadata.

Descriptive metadata are used for digital object description, so that it can be searched and identified. Structural metadata describe an object form, its structure and its size. Administrative metadata are used for example for authorization and access rights. Several standards of metadata such as Dublin Core, IEEE LOM, or SCORM are used in daily practice.

Digital libraries respecting interoperability standards can use centralized search services among themselves allowing concurrent search in different information sources at the same time. A certain disadvantage is lower selectivity of a search. This is a reason why scientific papers can appear among popularizing articles when a search is done.

Although digital repositories offer plenty of different options for sharing and educational materials reusability, real life can be different. You can enter a medical term into a search in meta repository Globe (http://globe-info.org) as a test of this assertion. The search is done concurrently in ARIADNE, edna Online, LORNER, MERLOT and NIME repositories.

For example having entered the term "kidney stone" we find out that for a big amount of non-relevant results we have to exclude Japanese network NIME from our search. And then, there is no more reference for our searched term in the remaining repositories. When we generalize our search term into "kidney" only, we get several relevant references from Australian edna Online repository.

Learning objects and wiki technology

Wiki is a label for webs which allow users to add content similarly as in internet discussions, but they also allow users to change current content; software which is used for creation of such webs can be also called as wiki.

An internet browser is a sufficient tool for creation and modification of wiki pages. Many wiki webs do not even require a registration for deleting and modification of pages. This is one of the reasons why complete history of changes is kept. Thus, any change can be later found and the content of pages can be revoked if necessary. Creation and modification of wiki pages require a knowledge of a special language (wiki markup), but it is so simple that it does not constitute a knowledge threshold even for beginners. These properties make wiki an ideal technology for cooperation of more authors on one project. Furthermore, there is one more bonus: it has been proved that such open systems are also self-regulatory.

The idea of wiki is a continuation of the work of philosopher and liberal economist – F. A. Hayek. He showed already in 1945 in his known work "The Use of Knowledge in Society" that information spread among individuals had better quality than information which could have an expert in a center.

The importance of information decentralization can be shown on a story about Nupedia. Nupedia was an ancestor of Wikipedia. Entries in Nupedia were edited by "expert volunteers" and the editing was a process with several steps. After three years, when the project was concluded, the Nupedia had 24 entries. The new encyclopedia – Wikipedia, which is totally open, had 20,000 entries in the first year of its existence [5].

On April 28, 2008 we founded "wiki-lectures" [6] dedicated to sharing of educational materials for pre-gradual medical students at our Medical Faculty. During first eight months the wiki comprises of more than 100 articles created by 109 registered authors in national language version and 11 articles created by 15 authors in English version. As our wiki-lectures are still in their beginnings, our aim is especially establishing rules for next period, so that worthful

educational material is created. There is an important condition which must be fulfilled in order that synergic and self-correcting effects occur – critical amount of users and articles must exist. This justifies our effort to find financial support, especially at the start of the project.
Wiki-lectures would form foundations serving as a basis for a wiki of all the medical faculties in the Czech Republic under the auspices of Mefanet network.
There are several similar projects in English-speaking countries. We are aware of 69 of them [7]. The majority is highly specialized but you can also find more generalized ones, which cover the whole area of education in medicine, e.g. WikiMD or AskDrWiki [8].
Similarly, as in our digital repository test, when we put "kidney stone" into a general search engine (Google), the first displayed reference would be the most visited link to a several page long article on Wikipedia. It has many figures and references and, paradoxically, it is the best material which can be found to this topic on internet.

Discussion

Educational portals and digital repositories have their specific roles. Educational portals allow working with materials in a form which is very close to their native style. This makes them more accessible to a broader sphere of authors. The most critical aspect is difficult actualization and general rigidity. Digital libraries have advantage of easier reusability of learning objects. Their disadvantage is laboriousness during structuralizing and metadata creation. An interesting question is "Why digital repositories include so small amount of medical materials?". If we do not take in account question of competition, it can be derived that it relates to laboriousness of consistent structuralization and methodology of description .
A concept of creation and storage of educational materials by using wiki technology seems to be very perspective. Absence of metadata is compensated by searching by context. Easy way of material actualization in the form of wiki prolongs its lifetime and increases the probability of its reuse. Thus in fact it is very similar to requirements for reusable learning projects.
A limitation is text oriented environment which does not allow objects (figures) copy pasting, but it seems that despite these complications, it is the best among the possibilities which are available nowadays.

Conclusion

As a conclusion I would like to cite P.R. Tumpati, MD, a founder of Wiki [9]: "In a case of wiki technology, a reader is the winner. The competition is replaced by cooperation. You do not have to read fifty papers about bird flu from fifty authors. It is enough to read one, where the best facts are included".
"For writers, Wikipedia offers neither authorship, recognition, reward. The motivation for writing is love of information and a desire to share it. I say a variant of Wikipedia for medicine is the future – and it's good."

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EXPLOITATION OF INFORMATION RESOURCES TO SUPPORT TEACHING EVIDENCE-BASED MEDICINE

07

V. Mihál [1], J. Potomková [2], J. Strojil [1], P.Langerová [1], O. Mueller [3]

[1] Palacky University Faculty of Medicine, Olomouc
[2] Palacky University Medical Library, Olomouc
[3] UpToDate CEE, Budapest, Hungary

Abstract
The paper is based on 3-year-practical experience with introducing principles of evidence-based medicine (EBM) into undergraduate curricula at Palacky University Faculty of Medicine in Olomouc (Czech Republic).

Keywords
teaching EBM, graduate medical education, information retrieval, e-learning

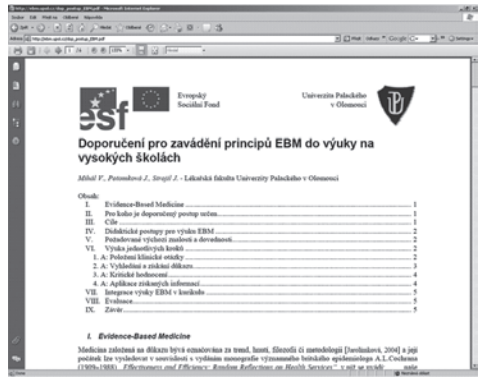
Introduction

Definition

Evidence-based medicine is the application of scientific research within a healthcare setting. It improves the quality consistency of healthcare by putting the most current knowledge about the effects of different diagnostic and treatment options into practice, alongside healthcare profesionals' experience and expert opinion.

Project

In 2008, an ESF project was completed at Palacky Universityx Faculty od Medicine, whose outcomes comprised a guideline on different forms of teaching EBM, in particular live pediatric scenarios supplemented with information retrieval, critical appraisal of journal articles and their implementation to patient care *(Fig. 1)*. Searching for pediatric best evidence is taught through interactive hands-on sessions supported by online tutorials available at: http://knihovna.upol.cz/lf (Vzdělávání – Pediatrie). Special attention is given to students' feedback and evaluation.


Evropský Sociální Fond

Univerzita Palackého v Olomouci

Doporučení pro zavádění principů EBM do výuky na vysokých školách

Mihál V., Potomková J., Strojil J. - Lékařská fakulta Univerzity Palackého v Olomouci

Obsah:

I. Evidence-Based Medicine 1
II. Pro koho je doporučený postup určen 1
III. Cíle 1
IV. Didaktické postupy pro výuku EBM 2
V. Požadovaná výchozí znalosti a dovednosti 2
VI. Výuka jednotlivých kroků 2
1. A: Položení klinické otázky 2
2. A: Vyhledání a získání důkazu 3
3. A: Kritické hodnocení 4
4. A: Aplikace získaných informací 4
VII. Integrace výuky EBM v kurikulu 5
VIII. Evaluace 5
IX. Závěr 5

I. Evidence-Based Medicine

Medicína založená na důkazu bývá označována za trend, hnutí, filozofii či metodologii [Jarošíková, 2004] a její počátek lze vysledovat v souvislosti s vydáním monografie významného britského epidemiologa A.L.Cochrana (1909-1988): *Effectiveness and Efficiency: Random Reflections on Health Services* – v níž se mimo

Figure 1. A Guideline for introduction of EBM principles into undergraduate curricula. Available at: http://ebm.upol.cz (in Czech).

Context

EBM requires skills to find and critically appraise medical literature to get and apply the best evidence to clinical decision-making. Evidence-based medicine has a crucial role in medical education, as students need to learn how to: recognise the value of evidence in improving health care – interpret and respond to a lack of evidence – evaluate patient symptoms in context – work together with patients to select appropriate treatments. In the past decades, many undergraduate medical curricula were criticized for not adequately preparing graduates

to master the art of clinical and published evidence evaluation. There is an increasing trend worldwide to incorporate this sophisticated strategy into medical school curricula. [6, 7]

Materials and methods

Information Resources: "MEDLINE Phenomenon"

Undergraduate medical students – future doctors – should understand that MEDLINE/PubMed will long remain a "gold standard" for biomedical and healthcare information retrieval [2], but also, they must be aware of a variety of other resources offering appraised, in some cases the best evidence. Under our conditions, the training begins with a powerpoint presentation demonstrating a framework of practical aspects of evidence-based medicine during pediatric clerkship. It is followed by an elective participation in medical librarian-guided training in PubMed searching. If appropriate, the students are offered critically appraised topics from medical knowledgebases, such as CLINICAL EVIDENCE, DYNAMED and UPTODATE.

Information Resources: "Beyond MEDLINE": CLINICAL EVIDENCE

http://www.clinicalevidence.com

Clinical Evidence is an EBM knowledge database produced and maintained by BMJ Evidence Centre (http://group.bmj.com/evidence-centre). Its goal is to provide sufficiently robust, consistent and transparent evidence to report on all the benefits, harms, compromises and alternatives associated with diagnosis and treatment options. The information is systematically updated to ensure that it is as accurate and relevant as possible. The process of knowledge assessment involves the following steps: question clarification – search development – finding the evidence (studies identified from over 6,500 medical resources, key international guidelines, drug databases and safety alerts) – synthesis of evidence. The philosophy is based on asking a well-built (mostly therapeutic) question and offering one or more options how to solve the problem.The options are classified as: beneficial – likely to be beneficial – trade off between benefit and harm – unknown effectiveness – unlikely to be beneficial – likely to be ineffective or harmful. These parameters can be obtained from the Intervention Page of the database.

Information Resources: "Beyond MEDLINE": DYNAMED

http://www.dynamicamedical.com

Dynamed is a clinical reference tool created by physicians for physicians, other health care professionals and medical students. With clinically-organized summaries for nearly 2,000 topics DynaMed is the only EB reference to answer most clinical questions in practice. It is updated daily and monitors the content of over 500 medical journals and systematic evidence review databases. Each publication is reviewed cover-to-cover, and each article is evaluated for clinical relevance and scientific validity. The newly created evidence is then integrated with the existing content. Through this process of systematic literature surveillance, the best available evidence determines the content of DynaMed.

Information Resources: "Beyond MEDLINE": UPTODATE

http://www.uptodate.com

UpToDate is an electronic resource offering evidence-based synthesized medical information. It is comprised of original topics written, reviewed, and continually updated by a faculty of physician experts to anticipate and answer clinical questions. All topics are written by experts and extensively peer-reviewed; recommendations are evidence-based; topics include differential diagnoses with key details helping distinguish between conditions; medical literature is continually monitored for important new findings; updated versions are released every 4 months; thousands of topics answer

nearly all the questions of both primary care clinicians and subspecialists.

Results

Teaching EBM through Live Case Scenarios

In the academic year 2006/2007, EBM concepts were being introduced selectively into preclinical and clinical courses of the general medicine curricula. Medical library staff was integrated in the direct EBM teaching in terms of literature searching, location of EBM documents in multiple resources and basics of critical appraisal of the literature. The librarians worked in a close cooperation with medical teachers to define information gaps in textbooks, in particular topics with clinical uncertainty, to demonstrate online searching strategies across multiple resources, and to provide interactive group or one-on-one training.

"Patient-Oriented Evidence that Matters"

Until 2005, the core clerkship in pediatrics was a 4-week teaching block for the 5th-year students (3 groups of up to 25) in the University hospital setting. It was designed to introduce students to a wide range of clinical problems in pediatrics, including history taking, physical examination, diagnostics, and management skills. The pediatric curriculum was modified to comply with the fundamental principles of EBM, and includes now the following new components:

- ***Introductory formal lecture***
  It covers main EBM issues given by medical teachers and librarians. Students learn the role of asking well-built clinical questions, importance of information retrieval using multiple resources followed by thorough critical appraisal before implementation of the best evidence to an individual pediatric patient. For demonstration, we selected a controversial topic – Crohn's disease in adolescents, non-compliance and a role of psychotherapy – to show the complexity of current research results documented in the literature dealing with the above foreground clinical question. A model evidence-based clinical scenario is available from: http://mefanet.upol.cz.

- ***Evidence-based assignment***
  The students spend 4 weeks in the University Hospital Pediatric Department under guidance of their tutors. They are presented clinical cases; their main task is to elaborate an EBM case report. They are encouraged to pay individual visits to the library to get one-on-one training in search skills and/or perform critical appraisal of the literature with respect to their individual patient.
- ***Group presentation of case reports*** followed by discussion and final assessment.

Discussion

Based on the recent studies [1, 3–5, 8–13] the role of highly qualified librarians and information specialists in the process of teaching evidence-based medicine is undoubted. In accordance with other findings [12] our preliminary results have confirmed that medical librarians could act as equal members in a team of University teachers on the condition that they move beyond their routine library activities, eg. co-operate in selecting attractive clinical questions to perform sample searches; assist in finding research papers for teaching sessions; ensure that question formulation and finding quality evidence discussions are included in any teaching sessions; teach searching sessions to smaller groups and/or work one-on-one with students to offer extra searching help; are flexible in terms of dynamics of the group and different levels of students' searching experience. It has been proved practical to prepare illustrative and high quality handouts and other pre-course mate-

rials, both in printed or web-based format. The training is much more efficient if the students are well informed about the prerequisites for the workshop. Many authors [1, 3, 8, 9] emphasized the significance of feedback and teaching skills evaluation. Palacky University EBM pediatric clerkship is followed by standard teaching quality evaluation *(Fig. 2)*. A recent systematic review [3] that compared the effects of standalone and clinically integrated teaching in EBM found that knowledge improved with both teaching methods, but the results of our evaluation of EBM pediatric clerkship clearly demonstrated students' preferences towards integrated teaching. Most of the respondents declared that the pediatric clerkship was the first opportunity for them to feel like real doctors. Some students reported they had needed more time for self-study than expected, that was actually the only negative attitude towards the newly modified pediatric curriculum.

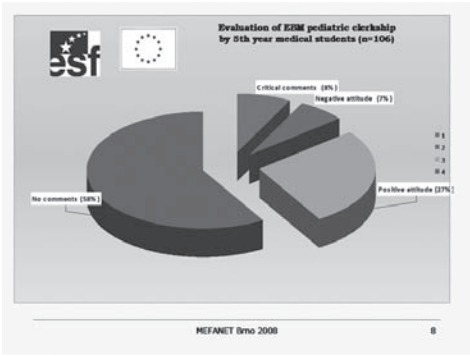


Figure 2: EBM pediatric clerkship as evaluated by medical students in 2008.

Conclusions

Our first attempt to incorporate EBM principles into undergraduate medical curricula seems to be a success. During case presentations, most students obviously demonstrated their understanding why to search for current information to answer specific clinical questions in addition to background information found in textbooks. Informal interviews as well as formal teaching quality assessment showed that the new educational model of teaching EBM was enthusiastically received by participants of pediatric clerkship. Other clinical departments have been working on introduction of EBM principles in a close cooperation with medical librarians. Web technologies provide significant educational opportunities and web based education services are spreading. In this context, the external learning environment and learners'mentality must be taken into consideration10. Online learning is changing medical education, but teaching on the web must involve more than putting together a „colorful webpage“ [4]. Collaborative learning is the best model to describe the interactions between the learner and the learning environment, which includes tutor agents, other learners and basic knowledge resources.

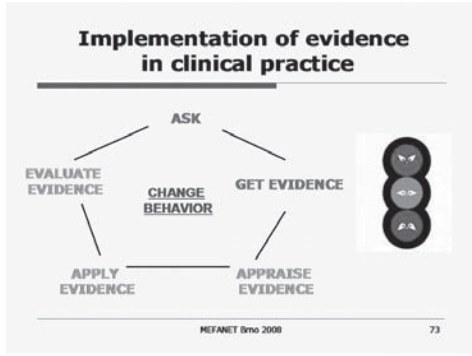


Figure 3: Implementation of evidence in clinical practice.

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C GOOD PRACTICE, CASES, EXPERIENCE

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08 SCHOOL AS A (MULTIMEDIA SIMULATION) PLAY: USE OF MULTIMEDIA APPLICATIONS IN TEACHING OF PATHOLOGICAL PHYSIOLOGY

J. Kofránek, M. Mateják, S. Matoušek, P. Privitzer, M. Tribula, O. Vacek

Laboratory of Biocybernetics, Institute of Pathological Physiology, First Faculty of Medicine, Charles University in Prague

Abstract
Nowadays, the old Comenius's motto – "schola ludus" ("school as a play") has found its modern use in interactive educational programs using simulation games. Connection of the Internet and a multimedia environment serving as an audio and visual user interface with simulative models makes it possible to have a graphic feel in the virtual reality of the problem currently studied, upon connecting to the magical Internet network. By means of a simulation game it is possible to test, without any risk, the simulated object's behaviour – e.g. trying to land with a virtual airplane or to heal a virtual patient. Through the simulation game we can test the behaviour of individual physiological subsystems, both under normal conditions and in the presence of a disorder. The Atlas of Physiology and Pathophysiology (http://www.physiome.cz), designed as a multimedia-teaching tool, which helps to explain the function of individual physiological systems, causes and symptoms of their disorders in a visual way through the Internet is one of the projects in which we want to utilize new opportunities of multimedia and simulation models. Development of the Atlas requires cooperation of many professionals: Starting from experienced teachers whose design provides the foundation of quality educational applications, system analysts responsible for creating simulation models for educational simulation games in cooperation with professionals in their field, artists creating the visuals, and finally up to programmers who "knit" together the whole application to achieve its final form. For the inter-disciplinary collective creation to be successful, specific development tools with sufficient technical support must be used in each phase of creation; such tools allow for component-based creation of simulation models, creation of interactive multimedia and their final interconnection into a compact unit based on the given design. Creative interconnection of the various professions is the key to success. The Atlas of Physiology and Pathophysiology is a freely available application. Any form of cooperation in its gradual development is welcome.

Keywords
internet, multimedia, simulation games

Schola Ludus in a Modern Garment

Multimedia programs with simulation components for educational purposes are not only a replacement of classical textbooks. They serve as an entirely ***new instruction aid*** making it possible to explore the studied problem in virtual reality through instruction simulation games, thus bringing quite new possibilities to explain complex problems – and this is precisely the point where the old credo of John Amos Comenius "Schola Ludus" (School as a Play), promoted by this European pedagogue as

early as in the 17th century, finds its modern application.

Many instruction-oriented ***simulators of individual physiological subsystems*** for free pedagogical use can be found on the Internet. Thus for example, the simulator ECGsim makes it possible to study the generation and spreading of electric potential in heart ventricles and to study the mechanism of origination of the ventricular complex QRS in various pathologies (from impulse conduction disorders to ischemias and infarctions) [14]. The heart simulator from Columbia University allows for observing the pressure-circulation curves in heart ventricles in various cardiac pathologies (valvular defects, left-sided or right-sided failure) [2]; anaesthesiological device simulators from the University of Florida provide the possibility to administer anaesthesia to a virtual patient [17] and to observe appropriate physiological responses (however, more complex simulators require paid access) etc.

Complex Methods of Integrative Physiology and Teaching

Complex simulators are of large importance for teaching of pathophysiology and study of pathogenesis of varied pathological conditions; such simulators include ***models of not only individual physiological subsystems but also their mutual connection into a more complex unit.***

Prof. Guyton was a pioneer of making these models. In 1972, he published an article [6] in the journal Annual Review of Physiology, whose form quite surpassed the usual forms of physiological articles of those times at the very first sight. An extensive diagram pasted in as an attachment was used as introduction, showing interconnection of essential subsystems that have an effect on circulation, by means of special symbols expressing mathematical operations.

Guyton's model was the first extensive mathematical description of physiological functions of interconnected subsystems of an organism, and it initiated development of physiological research, sometimes

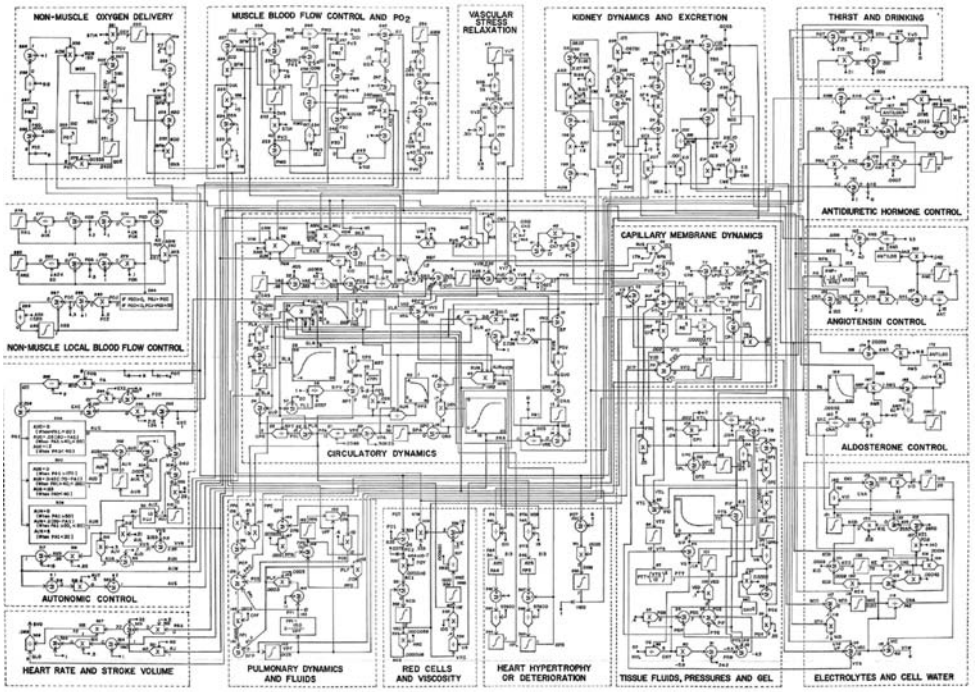

Figure 1: Extensive diagram of physiological circulatory regulations according to A. C. Guyton et al from 1972.

described today as ***integrative physiology.*** From this point of view, it was a certain milestone, which attempted at capturing the dynamics of relationships among the controls of circulation, kidneys, breathing, the volume and ionic composition of body fluids using a mathematical model, while applying a system view of physiological regulation. The Guyton's diagram (*Fig. 1*) was reprinted many times in various publications (even in recent years). However, in spite of that, none of the authors reprinting the Guyton's monumental diagram pointed out the fact that there were mistakes in the diagram. Provided that the classical Guyton's model is implemented using current simulation tools and accurately according to the graphic scheme, the model shall not work. However, such special tools were not available at the time this diagram was designed. The diagram was made only as a figure, the very program to implement the model was written by the authors in Fortran; however, the original source code is not available today.

As our aim was to apply the original classical Guyton's model in education of bioengineers, we had to correct the original diagram (*Fig. 2*). The correction required thorough revision of the entire model and system analysis of physiological regulations of the circulation system as well as numerous simulation experiments and their comparison with published results. A system of formalized physiological relationships expressed in the graphic form is the result; the system corresponds to the original model of Guyton et al [11] in its appearance but also behaviour. The model has been implemented as an interactive physiological diagram, making it possible, through simulation experiments, to understand better and deeper the physiological meaning of regulating bonds and their application in development of numerous pathophysiological conditions. We apply this diagram as an instruction teaching aid in education of physiological regulation systems for bioengineering specializations (*Fig. 3*).

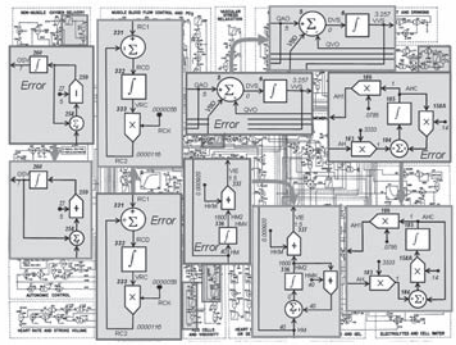

Figure 2: Corrections of the most significant errors in the graphic diagram of physiological circuit regulations according to A. C. Guyton et al.

However, the diagram is not very suitable for teaching of medical students – as they require simulators whose user interface looks more like interactive images of a physiological atlas than a control circuit diagram. Simulink implementation of the (corrected) Guyton's model created by us is available for download at www.physiome.cz/guyton. Our Simulink implementation of a much more complex version of the Guyton et al model from later years is available at the same address, as well. At the same time, very detailed description of all mathematical relationships, together with reasoning, is provided on the website.

Guyton and his disciples continued constant further development of the model. In 1982, Thomas Coleman, Guyton's disciple and collaborator, created the model "Human" intended especially for educational purposes. The model allowed for simulating numerous pathological conditions (cardiac and renal failure, haemorrhagic shock etc.), as well as the effect of some therapeutic interventions (infusion therapy, effect of some drugs, blood transfusion, artificial pulmonary ventilation, dialysis etc.) [4]. Recently, Meyers et al made the original Coleman's model available on the web using Java implementation [13].

The ***simulator Quantitative Human Physiology*** is the most recent result of Guyton's disciples and followers, representing probably the most complex and extensive model of physiological functions at present times.

Figure 3: Application of the physiological regulation model according to A. C. Guyton et al in education of bioengineers. However, the model is not quite suitable for medical education; an educational simulator should be designed for teaching of medical students, the user interface of which shall evoke images from medical textbooks and monographs rather than an interactive regulation diagram

The simulator is an extension of the original large circulatory system simulator (Quantitative Circulatory Physiology [1]) achieved by integrated connection of all important physiological systems. The model can be downloaded from the Internet [3].

We, too, created an ***instruction simulator "Golem"*** in the past, based on a complex model of integrated physiological regulations [8]. Our simulator "Golem" was focused on teaching of complex disorders of the internal environment [9].

Internet Atlas of Physiology and Pathophysiology: Explanation Using Simulation Games

However, experience in application of complex models (of the Golem or QHP type mentioned above) in teaching shows that large and complex models are connected with a disadvantage from the didactic point of view, namely their complex control. The large number of input variables as well as the broad scale of options of observing the input variables require rather thorough understanding of the very structure of the simulation model on part of the user, as well as knowledge of what processes should be observed in simulations of certain pathological conditions. In the opposite case, a complex sophisticated model seems to the user only as a "complicated and not very understandable technical play" (similarly as if the user should face a complex airbus simulator without a prior theoretical instruction).

Instruction models (and apparently not only complex ones with hundreds of variables) in themselves therefore are not enough for efficient use in teaching. They must be accompanied by explanation of their application – using interactive educational applications at best. The possibility of using all advantages of virtual reality to explain complex pathophysiological processes arises only upon ***establishing connection between explanation and simulation play.*** In order to link the possibilities offered by interactive multimedia and simulation models in medical teaching, we have designed the concept of an Internet computer project, the ***Atlas of Physiology and Pathophysiology*** [10], conceived as a multimedia instruction aid that should help to explain, in a visual way using the Internet and simulation models, the function of individual physiological subsystems, the causes and manifestations of their disorders – see http://physiome.cz/atlas. The Atlas thus ***combines explanation*** (using an audio and animation) with ***interactive simulation*** play with physiological subsystems models, all available for free from the Internet.

Simulation Models as "Live" Interactive Illustrations

The user interface of models used as the foundation for simulation plays rather evokes animated images from the printed Atlas of Physiology [15] or Atlas of Pathophysiology [16] than abstract regulation diagrams used in teaching of bioengineers *(similar to those in Fig. 3)*. Unlike printed illustrations, however, images forming the user interface of multimedia simulators are ***"live"*** and ***interactive*** – changes of the ***simulation model variables*** are manifested by ***changes of the images.*** Using interac-

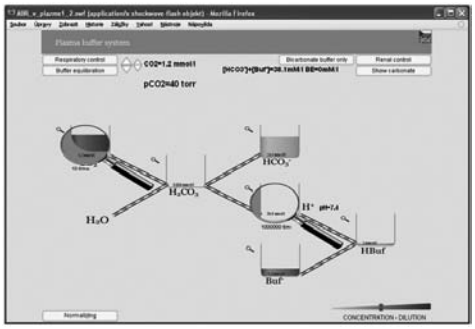

Figure 4a: Interactive educational model of the buffering plasma system. Fluid level values represent concentrations. Initial condition.

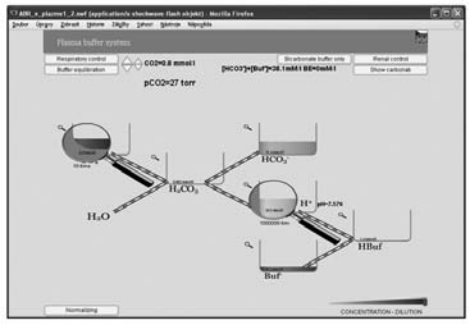

Figure 4b: Dilution can be invoked using the control slide; levels of all substances including CO2 concentration and hydrogen ions concentration shall become reduced.

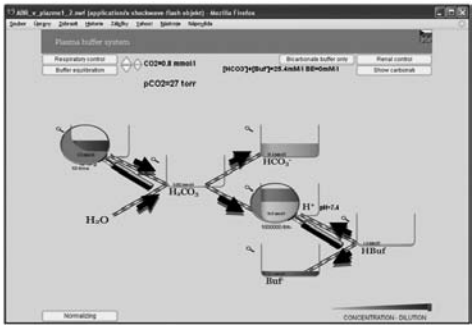

Figure 4c: Chemical equilibrium establishment in the buffering system can be engaged by pressing the button "Buffering Equilibration"; at the same time, plasma pH value returns to 7.4.

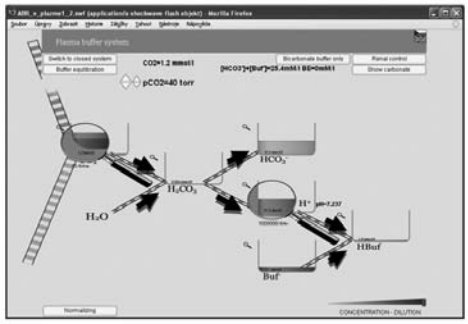

Figure 4d: Respiration increases (originally decreased upon dilution) the CO2 concentration value to the original level 1.2 mmol/L. Upon establishing new chemical equilibrium, hydrogen ions concentration increases and plasma pH value decreases.

tive illustrations thus conceived, it is possible to implement simulation plays which shall help to explain dynamic connexions in physiological systems, better than a static image or even a simple animation, and help especially to understand casual connexions in development of pathogeneses of varied diseases.

The ***model of acid-base equilibrium in plasma*** can be mentioned as an example of a "pictorial" user interface in an instruction simulation play, where buffering systems in the user interface are shown as interconnected containers displaying compartments of individual substances. The model can be downloaded from: http://www.physiome.cz/atlas/acidobaze/02/ABR_v_plazme1_2.swf.
The "level" in these containers represents concentration. Chemical reactions are shown as "flows of liquid" among the containers with individual buffering system components. Substances from/into metabolism, respiratory system or kidneys can "flow in or out" of the containers. Using simulation plays with this models, the development of various acidobasic equilibrium disorders can be visually explained. *Fig. 4a–d* shows application of this simulator in a simulation play to explain ***pathogenesis of dilution acidosis.*** Dilution of individual buffer components is shown as expansion of appropriate containers – as the amount of components in the containers remains the same, the level (representing concentration) drops. The level of hydrogen ions drops as well (*Fig. 4b*). By pressing the button "buffering equilibration", chemical reactions are started in the buffering systems, visualized as "flowing in/out" of individual components. Upon dissociation of carbonic

acid and weak buffering acids (denoted as HBUF in the model – represented especially by albumin and phosphates in reality), the hydrogen ions level settles on the original value again *(Fig. 4c)*. Nevertheless, the value of carbonic acid, just like the value of CO_2, remains reduced due to dissociation. However, respiration in the organism maintains the CO_2 level in arterial blood on a constant level (given especially by the alveolar ventilation value). By pressing the button "respiratory regulation", the CO_2 level increases back to its original value before dilution. By pressing the button "buffering equilibration", a chemical reaction takes place, establishing a new chemical equilibrium with increased concentration of hydrogen ions *(Fig. 4d)*.

The "Ceteris Paribus" Principle in Instruction Simulation Plays

From the didactic point of view, it is always necessary to proceed from simple to more complex things in explanations. According to this principle, it is therefore suitable to use rather simple aggregated models (with few variables) during explanation, explain essential principles using these models, and then start making the model (and described physiological reality) more complex gradually. Instruction simulation plays forming part of the Atlas need not be always based on a highly complex model demanding from the calculation point of view with hundreds of variables – ***even a simple interactive model can be a good helper in explaining pathogenic chains of development of various pathological conditions.***

From the didactic point of view, it is very efficient to ***disconnect regulation loops*** in the model at first and enable the students to ***study the responses of the selected physiological subsystem on changes of input variables*** in the simulation play (however, themselves regulated in a real organism). The dynamics of behaviour in gradual changes according to a single input are observed at first, while other inputs are set on a chosen constant value (the so called ***"ceteris paribus" principle***).

This shall enable the students to ***understand better the meaning of individual regulation circuits*** and to study the effect (of disconnected and manually controlled at first) regulation bonds on behaviour of the organism in various pathological disorders and responses to relevant therapy. Based on our experience, it is precisely this approach that leads to better understanding of the meaning of individual regulation loops and understanding of their task in pathogenesis of various diseases, as well as understanding of pathophysiological principles of relevant therapeutic interventions.

Thus for example, it is not suitable to start with a simulation play with a model when explaining physiology and pathophysiology of circulation as its complexity is approximately on the same or higher level compared to the Guyton's circulation model mentioned in the introduction *(see Fig. 1)*. It is more advisable to choose a simple aggregated model at the beginning, making it possible to demonstrate fundamental principles of the blood circulation structure and behaviour, as well as possibilities of its affection by means of regulation. The simplest ***circulation system model with disconnected regulation bonds*** as part of our Atlas is available at: http://www.physiome.cz/atlas/cirkulace/05/ SimpleUncontrolledSimulation.swf.

Its control *(see Fig. 5)* is very easy and serves especially to clarify fundamental relationships among individual variables of the circulatory system (i.e. pressures and flows in the pulmonary and body circulation) and essential variables affecting the pressures and flows (however, themselves regulated in neurohumoral ways). They are as follows:

- Peripheral resistances (system and pulmonary);
- Pumping function of the right and left ventricle – implemented using the simplest way in the model, namely as incli-

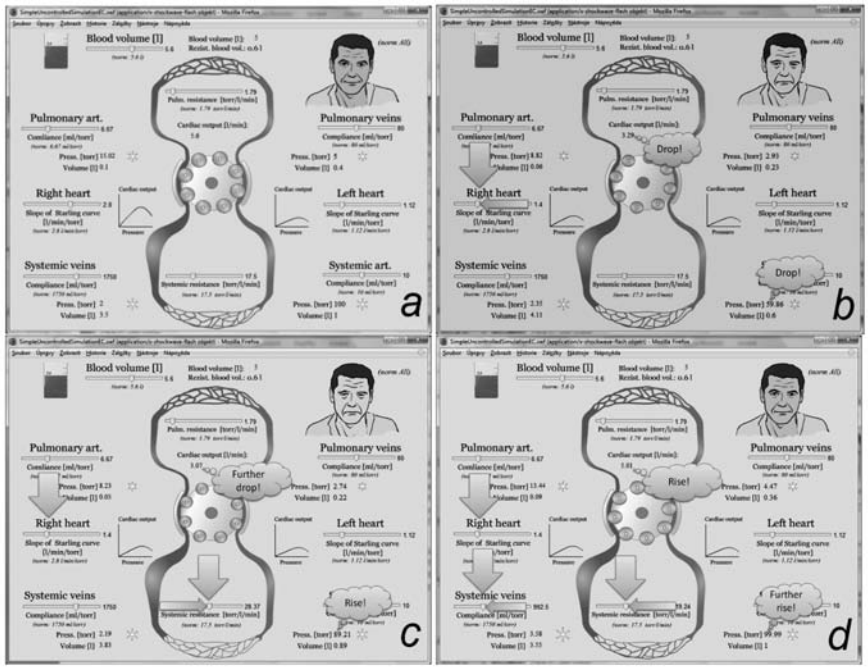

Figure 5: Use of a simple (non-controlled) circulatory system model to explain pathogenesis of right-sided circulation failure. See the text for more detailed explanation.

nation of the Starling curve (expressing dependence of the minute heart volume on filling pressures in the right and left atrium);

- Elasticity of arteries and veins (expressing pressure dependence on the vascular fill);
- Total volume of circulating blood.

The organism regulates the variables mentioned above (resistance is controlled by means of nervous and humoral regulation; myocardial frequency and inotropy modifies the shape of the Starling curve; venous tonus of large veins changes their elasticity; and the circulating blood volume is affected especially by renal activity, renin-angiotensin regulation etc.). However, these variables represent input (i.e. non-regulated) quantities in an aggregated model – the aim of the simulation play with the model is to obtain a clear notion of the meaning of these quantities for regulation of pressures, flows and distribution of the blood volume among individual parts of the bloodstream. Simulation play with this model makes it possible to explain the meaning of regulation of essential quantities of the circulatory system in pathogenesis of various circulatory system disorders to the students.

Figure 5 shows a ***simulation play of development of right-sided circulatory failure.***

The procedure is to reduce the Starling curve inclination in the right heart using the slide at first – this models reduction of contractility of the right heart upon acute right-sided circulatory failure *(Fig. 5b)*. Minute heart volume drops to the value 3.29 L/min; mean system arterial pressure decreases to 59.56 Torr. Sympaticus responds to the blood pressure decrease by distinct vasoconstriction especially in the splanchnic region, in order to preserve perfusion of coronary blood vessels.

The next step is therefore to increase peripheral system resistance by moving the slide right *(Fig. 5c)* – mean arterial pressure increases to 89.21 Torr; however, minute heart volume drops further from 3.29 L/min to 3.07 L/min! However, sympaticus does not affect only vasoconstriction of arterioles and subsequent increase of peripheral resistance.

It also increases the tonus of large veins, which is manifested by increased pres-

sure in them with the same blood fill – the venous tonus increase can be modelled by reduced elasticity of system veins *(Fig. 5c)*. Reduced elasticity increases the pressure in large system veins and thus also the filling pressure in the right atrium, leading to increased minute heart volume (however, at the same time, the increase of venous pressure leads to higher filtration in capillaries and to oedemas). Mean arterial pressure increases to the normal value and it is not necessary to maintain the resistance value in the system bloodstream too high in order to preserve the pressure value – therefore the resistance should be reduced using the slide from 28.37 Torr/L/min to 19.24 Torr/L/min.

The simulation play can be continued further by demonstrating the meaning of the total blood volume increase, which occurs due to activation of the renin-angiotensin-aldosterone loop (not shown in the figure). Upon increasing the circulating blood volume using the slide, it can be shown in the model that peripheral resistance as well as venoconstriction can be reduced further (i.e. elasticity of large veins can be increased) in order to maintain normal minute heart volume and normal mean arterial pressure.

The simulation experiment can be furthermore used to demonstrate the effect of therapy, as well: Administration of cardiotonics can be illustrated by increasing the Starling curve inclination, and administration of diuretics can be simulated by reducing the increased circulating blood volume – pressure in large veins decreases as a consequence with subsequent reduction of oedemas.

It was our intention to illustrate using the example above how simulation plays with a model ***shall contribute to better understanding of the meaning of individual regulation circuit application*** in pathogenesis of various pathological conditions and in subsequent therapeutic interventions.

The Atlas as a Web-Based Application

The Atlas of Physiology and Pathophysiology is currently designed as a web-based application that can be run in an Internet browser (a Flash player installed in the browser is a prerequisite). Some simulation models require Microsoft .NET framework installed on the computer (if this part is not installed, its installation is offered before installing the first simulator, which requires .NET).

Explanatory chapters of the Atlas are designed as audio lectures accompanied by interactive multimedia images *(see Fig. 6)*. Every animation is synchronized accurately with the explanatory text.

Figure 6: Audio interactive lecture in the explanatory part of the Atlas of Physiology and Pathophysiology. Every explanation is accompanied by animated images synchronized with the explanatory part. Explanation can be stopped in any moment, to have a more detailed look at the accompanying animation. Explanation including the synchronized animations can also be moved backward using the slide in the bottom part of the player.

However, the Internet-based Atlas of Physiology and Pathophysiology is much more than just an animated explanation with an audio track. The foundation of didactic efficiency is represented by ***explanation accompanied by a simulation games.*** Simulation models forming part of the Atlas are implemented as Flash applications and need not be installed separately *(such as, for example, simulators in Figs. 4, 5 and 7)* or (in more complex models) their separate installa-

tion is required directly from the Internet browser.

More complex models require somewhat more complicated control – a suitable scenario is therefore important, according to which the model can be used in the simulation play as an instruction aid to explain more complicated physiological relationships.

Some simulators combine the model as well as the explanatory part – ***simulator of mechanical properties of muscles*** *(see Fig. 7)* can be mentioned as an example.

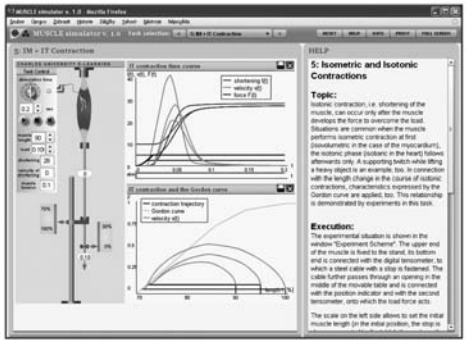

Figure 7: Simulator of the skeletal muscle mechanical properties is a Flash application designed as an explanatory chapter, which includes practical exercises with the model (accessible at http://www.physiome.cz/atlas/sval/svalEN/SvalEN.html)

Other simulators can be run separately and scenarios used in their control are designed as part of relevant explanatory chapters. The ***complex model of blood gases transport*** can be given as an example; this model shall be used as an instruction aid in explanation of physiology and pathophysiology of oxygen and carbon dioxide transport. Examples of using this simulator in explanation of consequences of ventilation-perfusion relationships disorders are shown in *Figs. 8a–8e*. The simulator can be downloaded from our Atlas using the link: http://physiome.cz/atlas/sim/BloodyMary/.

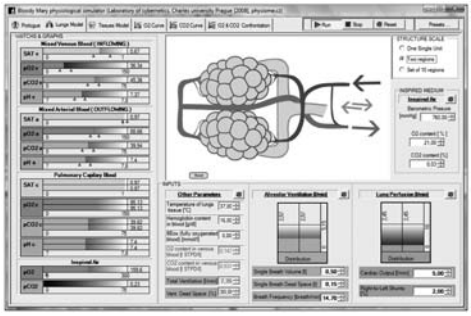

Figure 8a: Simulation play with the blood gases transport model to explain the consequences of ventilation – perfusion non-uniformity failures. Initial condition.

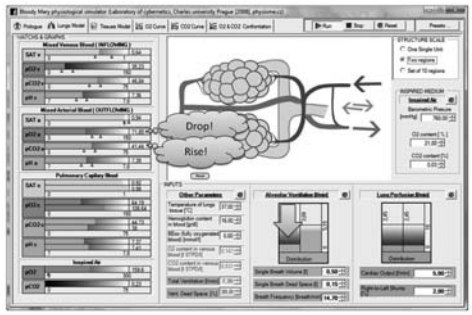

Figure 8b: Setting of different ventilation distribution shall cause decrease of PO2 and increase of pCO2 in mixed arterial blood.

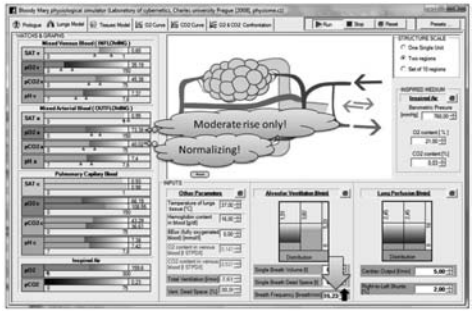

Figure 8c: Slight increase of the breath frequency means achievement of pCO2 normalization in mixed arterial blood; however, PO2 still remains low. Different shape of O2 and CO2 dissociation curves is the cause – see the following figure.

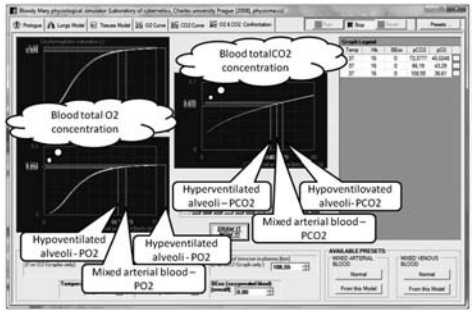

Figure 8d: Comparison of total concentrations and partial pressures O2 and CO2 in hyperventilated, hypoventilated alveoli and in mixed arterial blood.

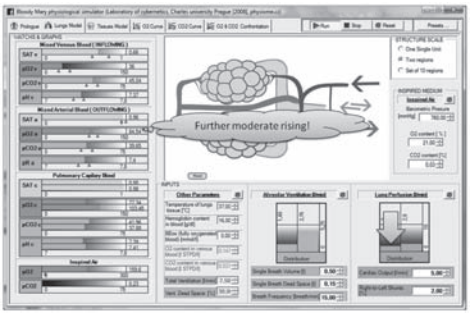

Figure 8e: Perfusion limitation by poorly ventilated alveoli limits admixing of hypooxygenated blood from hypoventilated alveoli, thus causing increased partial pressure of oxygen in mixed arterial blood. However, another consequence is also represented by increased resistance of the pulmonary bloodstream and development of precapillary pulmonary hypertension.

Beyond the Atlas of Physiology and Pathophysiology Curtain – Creation Technology of Instruction Simulators

The creation process of the Atlas takes the form of a joint work made by ***creative specialist's team encompassing various professions*** *(see Fig. 9)*:

- Experienced teachers whose scenario is the foundation of a quality educational application;
- System analysts, responsible in cooperation with professionals of the given field, for designing simulation models for educational simulation plays;
- Artists designing the outside visual form;
- Computer science engineers (programmers) whose role is to "knit" the entire application into the resulting form.

For the interprofessional collective creation process described above to be efficient, each stage of the process should ***utilize specific development tools,*** with sufficient technical support, making it possible to apply component-based creation of simulation models, interactive multimedia preparation, and their final interconnection pursuant to a given scenario into a compact unit.

Creative interconnection of various professions and development tools is therefore a prerequisite of success.

A multimedia presentation available from the Internet, found at http://www.physiome.cz/atlas/info/01EN/index.htm discusses the technologies used in the building process; methodology of creating educational simulators is described in [12].

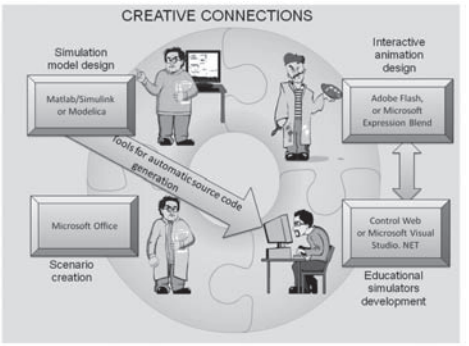

Figure 8e: Perfusion limitation by poorly ventilated alveoli limits admixing of hypooxygenated blood from hypoventilated alveoli, thus causing increased partial pressure of oxygen in mixed arterial blood. However, another consequence is also represented by increased resistance of the pulmonary bloodstream and development of precapillary pulmonary hypertension.

Foundation of an e-learning Educational Application – Scenario of Good Quality

The foundation of every explanatory chapter of the Atlas is represented by a quality ***scenario***, designed by an experienced pedagogue. High attention must be paid to preparing the scenario. According to our experience, underestimating of thorough scenario preparation is paid for dearly by the necessity of unnecessary iteration steps in development of the educational application and in subsequent extension of the development time.

The scenario must include a detailed proposal of assignment for the artist concerning the graphic appearance of every individual page, including animations, and the interactive behaviour proposal. The final graphic appearance is then up to the artist cooperating with the author of the given chapter.

At the same time, the scenario must include key points of synchronizing the audio track with beginnings of individual animations.
When the explanation is accompanied by a simulation play (in the form of "training" using the simulation model), the ***scenario according to which the students should manipulate with the model*** must be thought over carefully so that the model behaviour clarifies those relationships, which are rather difficult to explain without a simulation play with the model *(see the example of simulation plays application in Figs. 4, 5, 8)*.

Interactive Animations Built using the Threads of Simulation Models

The making of ***interactive animated images*** (interconnected with explanations and simulation models) is frequently and wrongly underestimated – the truth is that precisely the graphic appearance of an educational application is frequently the aspect which "sells" the e-learning product to potential users from the marketing point of view.
However, at the same time it should be noted that a professional artistic appearance of educational applications is demanding as for financial as well as human resources. Every image is an author's work of art. The number of artists on the labour market who have mastered making of interactive computer animations is not really excessive. Moreover, thanks to development of Internet media, digital television, computer gaming industry and other information technology branches, the demand for these professionals on the labour market is rather increasing.
We tried to resolve the lack of interactive graphics professionals years ago already by establishing narrow working cooperation with Václav Hollar School of Fine Arts where we have built our external workplace – Interactive Graphics Laboratory. Our activities focused on training the teachers at first (and later students, as well) of the school in the field of using modern computer graphics tools, and thanks to our joint efforts we have created a new, three-year specialization "Interactive Graphics" at this school (at present, there are graduates from two year-classes already). We provide especially teaching of "Interactivity Mastering" specialization at the Václav Hollar College of Fine Arts, as well as guidance of the students' practical experience. The students (and also graduates today) of this college are those who provide the prevailing part of artistic appearance of our educational applications.
Until today, we have used especially Adobe products in designing interactive graphics – especially Adobe Flash and Adobe Flex. Lately we have started to turn to the Microsoft development environment, which offers very suitable tools allowing for good cooperation between programmers and artists – Microsoft Expression Blend (on part of the artists) and Visual Studio 2008 (with the WPF framework on part of the programmers) [7].

"Brain" of the Educational Simulator – Mathematical Model

The core of the simulator consists in a mathematical model representing a formalized (mathematical) description of the physiological reality. Special development tools exist for development of mathematical models. In our laboratory, we have been using the environment Mathworks Matlab/Simulink on a long-term basis. We have developed a special library of formalized physiological relationships Physiology Blockset in Simulink, available for free on our website (http://www.physiome.cz/simchips).
Today, Mathworks development tools (Matlab and Simulink) rank among well-established industrial standards. As a rule, Simulink operates using connected blocks. Signals are transmitted through links between individual blocks; the signals serve to transfer values of individual variables

from the output of one block to inputs of other blocks. Input information is processed in the blocks to output information. ***Interconnection of blocks in Simulink*** therefore reflects rather the ***calculation procedure*** than the very structure of the modelled reality. This is the so called ***causal modelling.***
Recently, development of new, the so called "acausal" tools occurred, intended for making of simulation models. An essential innovation introduced by such tools consists in ***declarative (thus acausal)*** writing of models when ***individual parts of the model are described directly as equations and not as an algorithm to solve the equations.***
These tools operate using interconnected components in which equations are defined. The equations do not express assignment (i.e. saving of the calculation result of an assigned statement into a given variable) but a definition of relationships among variables (as is the custom in mathematics and physics). These components (representing instances of classes with equations) can be connected through exactly defined interfaces – ***connectors.*** The important aspect is the fact that by connecting the components, ***sets of equations in individual components become connected*** with each other.
A typical representative of acausal modelling tools is the new object-oriented programming language **Modelica** [5]. Originally, it was developed in Sweden and now is available both as an open-source version (developed under the auspices of the international organization Modelica Association, http://www.modelica.org/), and in two commercial implementations (Dymola of the company Dynasim AB and MathModelica of the company MathCore).
Mathworks, the producer of well-established Matlab/Simulink tools, responded to the new trends by designing a special Simulink library ***Simscape*** and related domain libraries SimElectronics, SimHydraulics, SimMechanics etc.
In accordance with modern trends, lately we have expanded the development tools used in making mathematical models (i.e. Matlab/Simulink) by tools ***using the acausal modelling language – Modelica.*** We are in the process of making our own development tool for this perspective modelling language, which shall make it possible ***to generate the resulting model in the environment Microsoft .NET,*** thus facilitating conversion of created and debugged models in the environment in which the very educational simulator shall be designed.

Development of the Very Educational Simulator

Development of the educational simulator is demanding programming work, linked to the results of the mathematical model development and to the created elements of interactive graphics. In accordance with the designed scenario, graphic elements of the user interface must be "knitted" together with the mathematical model programmed in the background.
In the past, we have used the development environment ***Control Web*** to create simulators; this environment was originally designed to make industrial applications (control, management, control centres design) using a PC. Control Web provides numerous tools to create a complex user interface, allows for connecting Flash animations to the interface and to control

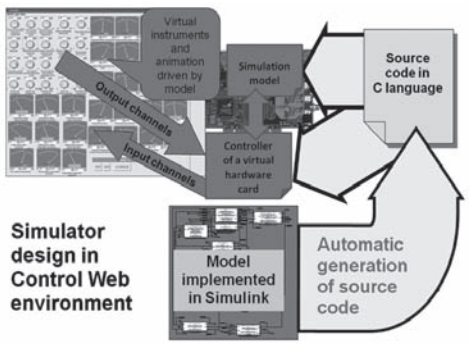

Figure 10: Simulator development in the Control Web environment, originally designed for visualization of control and measurement industrial applications. The simulation model is programmed as a software controller of a (non-existent) virtual card, and the application under development in Control Web communicates with the model as if it was a technological device.

it according to values of variables on the background. A Control Web application in its classical industrial deployment form communicates through a software controller of the hardware control and measurement card with the industrial technological device. Using the Control Web environment to create simulators, we have programmed a special software controller in whose core a simulation model is programmed. Control Web was thus "cheated": It did not communicate with some industrial technology through the relevant software input/output channels but with a simulation model in the controller *(see Fig. 10)*.

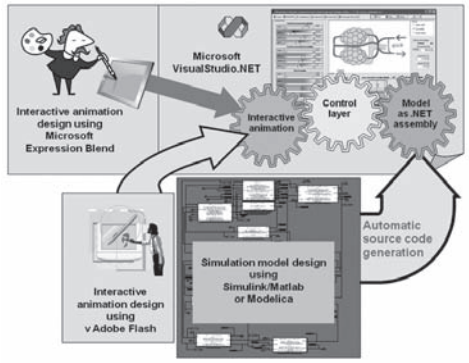

Figure 11: Making simulators in the .NET environment. The model is programmed as a component of the .NET environment (the so called .NET assembly) – preferably by means of automatic generation from models development tools (from the Matlab/Simulink or Modelica programming language environment). Graphic components are created in Adobe Flash or Microsoft Expression Blend. Creating animations in Expression Blend offers the advantage of creating both the animations as well as the simulator in the common .NET platform.

In order to facilitate development of "virtual measurement/control card" controllers containing a simulation model and not to have to write such a controller for each model "manually" in the C programming language, we have developed a special program that ***enables us to generate the source text of the relevant virtual controller in C directly from a Simulink diagram.*** This has allowed for simple and quick modification of the controller for Control Web upon making various adaptations and new versions of the simulation model.

For example, in Control Web we have created the simulator Golem [8] and as for the Atlas of Physiology and Pathophysiology, the kidneys simulator.

Currently, we are using classical programming tools to design the simulators. As far as simple Flash simulators are concerned, these are programmed directly in ActionScript, thus the programming language for Flash applications. As for the Atlas of Physiology and Pathophysiology, the simulator of mechanical properties of skeletal muscles is programmed in this language *(see Fig. 7)*.

However, the ActionScript language development environment is not sufficient for more complex simulators. Therefore we use the Microsoft Visual Studio .NET programming environment in our laboratory, which, especially its latest version, provides extensive possibilities for programming work. In this environment, we are no more limited by "preset" elements of the user interface as is the case of Control Web, and moreover we can use all the power of a modern software application development tool; however, on the other hand, we must program ourselves many elements of the user interface for the application under development.

In order to make writing of the simulators easier (and not to have to program an already debugged simulation model "manually" in Visual Studio .NET), here, too, we have developed a special software tool [12] to automatically generate the simulation model from Simulink in the form of a component for the .NET environment *(see Fig. 11)*.

To facilitate conversion of mathematical models from the Modelica language environment into .NET, we ***are extending OpenModelica compiler*** (as part of the international project ***Open Modelica***) ***to C# simulation code generation*** *(see Fig. 11)*.

Besides interconnection with the model creation tools, easy connection to graphic components of the user interface under development is important, as well. Flash components can be incorporated into the

simulator in the process of creation through an Active X component.

The new .NET environment version also introduces entirely new possibilities of creating graphic components. Thanks to the new WPF (Windows Presentation Foundation) technology, complex graphic components can be created directly in the .NET platform, which include animations, vector graphics, 3D elements etc. (similarly as in Adobe Flash or even with potentially greater possibilities). It is important that the graphic user interface under development is directly integrated with the .NET platform, which removes the need of bridging the heterogeneous worlds of .NET and Adobe Flash in the simulators development.

Besides the above, the development tool to create graphic components ***(Microsoft Expression Blend)*** provides considerable support of cooperation of artists and programmers [13] thanks to the interface, which separates (and connects) the work of an artists and programmer. An artist can create complex animations in this tool very comfortably (using a graphic user interface), and the animations can be controlled easily. The programmer specifies such control by connecting to relevant program modules (the animations can be thus controlled by the simulation model on the background similarly as puppets on strings). Currently, we have trained artists in using this perspective tool.

Moreover, the new tool ***Silverlight*** shall make it possible to develop simulators, which can run directly in the Internet browser (even on computers with different operating systems – it is only necessary to install the relevant plugin in the browser).

New development tools of Microsoft provide a very perspective environment for development of simulators, and for the future, they represent our main development platform.

Conclusion

Educational applications using simulation play, available through the web, represent a new educational aid, very efficient from the didactic point of view in explaining complex pathophysiological processes.

However, their process of creation is not very easy – it requires multidisciplinary team cooperation and use of suitable development tools.

Their making is a combination of research and development work. Research work consists in formalizing physiological reality by designing mathematical models, while development work is the very creation of multimedia simulators, which make use of the mathematical models designed.

As our contribution to making modern e-learning tools which combine multimedia explanation with simulation plays, we have established the ***Internet-based Atlas of Physiology and Pathophysiology project.***

The ***Atlas project*** is open-based – We shall make its results available in the Czech language for all those interested, and in the course of its development, we shall welcome cooperation with all who would like to take part in its gradual building process.

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09

CHANGE IN PREPARATION FOR PRACTICAL LESSONS – MSL E-LEARNING CONCEPT

T. Nosek, A. Bezrouk, J. Hanuš, J. Záhora, P. Svoboda

Department of Medical Biophysics, Medical Faculty in Hradec Králové, Charles University in Prague

Abstract

Thanks to modern technology, nowadays it is more and more important to find a valid piece of information than knowing it by heart. Notably, a novice student in the first year of medical school who is under permanent time pressure might easily loose the right heading in the information storm of our time. The role of a teacher has been shifted. The teacher has become a compass in the sea of knowledge. The MSL (Multiple Step Learning) concept of e-learning is an effort to create supportive materials for our practical lessons which reflect the previous knowledge of a student and contain valuable links showing the right way. We started a pilot study in order to find out whether this concept might be accepted by students. Another goal is to clarify the benefit of this way. The pilot project runs in Moodle LMS. For the evaluation of courses we used modified e-LSE methodology. The final comparison is based on strictly defined questions in end-term tests between two years (with or without MSL).

Keywords

e-learning, Moodle, education, practical lessons, biophysics

Introduction

Why are so many people calling for a widening of information sources? The reason is to obtain the least deformed picture of a certain topic. For a person, who is interested in the topic, Internet and today's information storm is something which previous generations would never have dreamt of. Ubiquity and speed of information, together with a variety of perspectives enables this person to work with high performance and quality.

On the contrary a first year student at medical school is in a completely different situation. The student is usually thrown into a completely new and nonlinear network structure of information channels and is usually overwhelmed by data. Medicine is without question very complex and today there is no human being that is capable of covering its whole latitude. According to Bauer, teachers lose their classical role of the only information authority. However, they are not displaced. They get a new role, sometimes even more demanding and indispensible than before, the role of a guide on the roads of knowledge [1].

At our faculty first year students are focusing mainly on Anatomy and Histology with embryology. The reason is simple: these subjects are really broad and the exam for both of them is at the end of the first year, which is unusual among other medical schools. That is why Medical biophysics is slightly out of their interest. On the other hand rapid development of new diagnostic machines, which are based mainly on physical principles, gives the reason for making this subject more attractive to students. Future physicians should be aware of the limits of available diagnostic machinery. Our goal is to raise students' profit from practical lessons using a new form of preparation based on modern e-learning technologies.

E-learning environment

For our needs we decided to use learning management system Moodle – Modular Object-Oriented Dynamic Learning Environment [2]. There were several reasons why we decided to use Moodle. We were looking for a multilingual system with sufficient flexibility and minimal financial expenses. Moodle is being developed as an open system and thanks to its philosophy and configuration options it is quite universal. Apart from the mentioned facts there is a fast growing Czech community [3] and another fundamental fact is also that Moodle has already been spread among Czech medical schools [4, 5]. Speaking of which, we can move the whole thing to another level when we realize that it is possible to transfer created e-learning courses with minimal effort.

There is a fact often mentioned in literature that in order to use e-learning system effectively, it is necessary to adequately prepare the teachers for teaching in the new environment. As far back as 2004 Prensky called in his work students aptly "digital natives" and teachers "digital immigrants" [6]. The fact that teachers have general IT knowledge (as text processing, Internet use and email use) says nothing about their ability to incorporate their regular teaching knowledge to online teaching [7]. That is why we use Moodle at the moment mainly as an extension to classical teaching – to get our teachers used to it.

MSL concept of preparation for practical lessons

According to Šimon ICT – information and communication technologies -attract students to educational process. ICT also individualize education and save expenses for paper materials [8].

From our point of view, using ICT is not only about the individualization of the education process and fund saving. If we recognize the previous knowledge of students we can omit the corresponding part in further explanation and this brings us to time saving which cannot be overlooked either.

Saving time might be very interesting especially for our first year medical students. For that reason we created the 3SL concept – three step learning concept. This concept divides the topic into three levels with different details. The first level explains the topic completely but assumes deeper knowledge and some details are omitted. Basically all further levels fill the information gap of the previous one.

As it has been shown during testing in practice the 3SL concept was not universal enough. That is why we have decided not to limit the number of detailed levels and the thought of MSL (multiple step learning) concept was conceived.

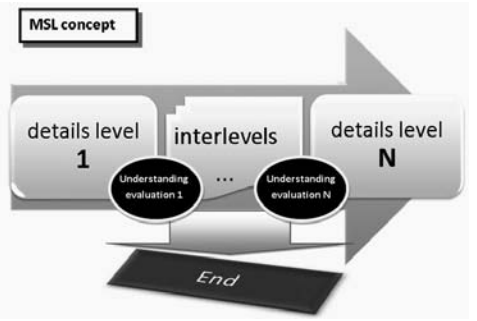

Figure 1: MSL concept

Basic scheme of the MSL concept can be found in the picture. The idea of implementation to the Moodle course is quite simple. Moodle enables to create an interactive lecture with an information flow controlled by answers to different kinds of questions. A student who enrols himself to the course will see thick summarized information as a first step. If he or she manages to understand this information and answers correctly to the questions, the course and preparation for the practical lesson is over. If he or she will not manage to answer all the questions, the more detailed level focused on the problematic part is viewed. This can continue until all the levels are viewed. If the student cannot understand even the most detailed level, the system tells him to consult a teacher during the practical lesson.

In the meantime we have been running pilot curses about principles of computer tomography, ECG and ultrasound imaging. Apart from the lecture the courses consist also of discussion forums, glossaries, links to sources of quality materials and last but not least practical XHTML webpage-style complex educational materials with possibility to show or hide different detail levels.

Conclusion

The quality of the whole concept has been evaluating using standardized eLSE methodology [9] which we adjusted to our needs [10]. As a next step we are planning to compare the e-learning way of preparation for practical lessons to the classical way. The scale will be results from strictly defined questions in end term tests. The comparison itself will be performed interannually. The final results should be available before the end of 2009. If this concept is successful and positively accepted by students, we are planning to use it for all the practical lessons we are currently running.

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METHODOLOGY MODIFICATION FOR MSL E-LEARNING EVALUATION

10

A. Bezrouk, T. Nosek, J. Hanuš, J. Záhora, P. Svoboda, J. Knížek

Department of medical biophysics, Department of Medical Biophysics, Medical Faculty in Hradec Králové, Charles University in Prague

Abstract

We have developed a new method of e-learning based on more individualized approach to a student. The method is called MSL – Multiple Step Learning. We are planning to use this method to create background materials for our measuring classes in Medical biophysics. To maintain the education standard we have, we need to check the quality of our new MSL based courses. There are many methodologies to evaluate e-learning materials. We chose and improved eLSE methodology from Italian authors Ardito et al. because it meets all our requirements the best. The indisputable advantage of eLSE is that you can perform a high quality evaluation even with normal users on the basis of abstract tasks prepared by experts. Our improvements are connected mainly with incorporation of the evaluation to a course and collection of answers from regular users.

Keywords

e-learning, Moodle, education, practical lessons, biophysics

Introduction

The question of e-learning is very complex. Every new method substituting a correspondence course in the part-time study is a big contribution. However, is there any difference of knowledge gain between the e-learning and the conventional way of studying? To answer this question properly, it is necessary to evaluate the quality of e-learning course first in order to prevent from degradation of whole e-learning. We use a couple of methods for this purpose.

The first method is based on studying of approaches of different users. Let us have a group of users. These users are asked to "think aloud"; it means that they are verbalizing their thinking while they work with the system. This allows evaluators to find weak or insufficient parts in the course conception and places of misinterpretation. The disadvantages of this method are high costs and time requirements.

Another method is heuristic analysis which is done by a group of experts. The disadvantage of this method is the big dependence on previous experiences of the evaluators. However, if the previous evaluators' skills and experiences are good, this method is considered to be the best cost-effective.

The last method is use of abstract tasks (ATs) which was brought by eLSE methodology [1]. An abstract task is a precisely defined description what to assess and how. It may be the same for many different courses and that is why the task is called abstract. The advantages of this method are low cost and the fact that it does not require special evaluator's experiences.

Improvement of eLSE to meet our needs

We were looking for a cost-effective methodology of evaluation and from the methodologies mentioned above eLSE meets our requirements the best. However, to use the original methodology would be too complicated in our case. That is why we had to make some improvements.

The **original methodology** consists of two fundamental phases – preliminary and procedural whose description in points follows:

Preliminary phase

- Creating a plan for the evaluation
- Rules definition for creating an library of Abstract Tasks
- The output can be shared with other departments which means that the evaluation can be easily reproduced

ATs are formulated precisely by means of a pattern template which provides a consistent format and includes five items:

- AT Classification Code and Title – univocally identify the AT and its purpose
- Focus of Action - lists the applications objects to be evaluated
- Intent – clarifies the specific goal of the AT
- Activity Description – describes in detail the activities to be performed during the AT application
- Output – describes the output of the fragment of the inspection the AT refers to

ATs are usually defined by expert evaluators and they are usually divided into two classes:

- Content lerneability
- Quality in use

Examples:
QU_01: *AVAILABILITY OF COMMUNICATION TOOLS*
Focus of action: *communication tools*
Intent: *verify the availability of communication tools*
Activity description:

- *Identify the offered communication tools*
- *Try to communicate with other learners or lecturers*

Output: *a description reporting if:*

- *The communication tools do not permit to cover all the medial channels*
- *It is not possible to communicate both with learners and lecturers.*

QU_01: *Availability of communication tools*
QU_02: *Graphical interface elements*
QU_27: *Availability and quality of the course evaluation tools*
QU_35: *Quality of the results of the evaluation tools*
AC_06: *Organization of a course*
AC_19: *Availability of exercises*
AC_24: *Organization of the module pages*
AC_28: *Validity of the feedback of the evaluation tools*

Procedural phase

- It is always done when the system is evaluated
- It consists of two parts: systematic inspection and user testing

Systematic inspection
It is performed by expert evaluators. During the AT inspection, evaluators use set of ATs and perform the activity as it is described for each AT. At the end of the evaluation session, evaluators provide designers and developers with an organized feedback. The evaluation report describes detected problems using the terminology provided in the AT for referring to system objects or interface elements, and for describing critical incidents. This standardized language increases the report precision and decreases the possibility of misunderstandings.

User testing
It is performed only if there is a disagreement in findings of some evaluators. The description of the concrete AT is used for a definition of a corresponding task for the user test. However, this task is not general but it is exactly created for the course part which is controversial.
During the user testing a sample of users is observed while the users are working on some concrete tasks. The data about activities, mistakes and times of users are collected in order to be analyzed in final step.
The result of the procedural phase provides the course creators with a structured feedback. The feedback is a structured report which, in a defined way, compiles found problems. This standardized process

of description improves the accuracy and decreases the risk of misunderstanding.

We improved the previously mentioned methodology in the following way:

- Evaluators are users themselves
- Evaluators' output report is a defined electronic questionnaire
- Every question answer means either positive or negative point for the evaluation
- In order to keep the compliance of students the evaluation will be done immediately at the end of the practical lesson

Questionnaire

The questionnaire is created in Feedback module of Moodle and it is based on the abstract tasks related to the actual course. Each abstract task is presented by series of questions. There may be two types of questions – *evaluative* and *determinative*.

- Evaluative questions are those which have only one possible answer. The answers of each question are created as positive or negative statements about a specific attribute. One ore none point is assigned to each answer.

Ex.: *According to your experiences, the communication tools are: sufficient (1 point), insufficient (0 points)*.

- Determinative questions are either those with more than one possible answer or users must create the answers themselves. These questions have no assigned points. Primarily they are questions quantifying users' opinions on the actual problem.

Ex.: *You were using the following communication tools: chat, discussion forum, wiki module.*

Apart from the abstract tasks the questionnaire can contain specific questions completing the feedback. The questionnaire can be saved as a template and used in a slightly modified form for different courses.

Our concept

It combines the systematic inspection with the user testing from the original eLSE methodology. The questionnaire is answered by students at the end of a practical lesson which belongs to the course. Special evaluators are need no more. The users become the evaluators. Thanks to our concept and Moodle software it is not necessary to have a third person to monitor activities of students.

Outputs, evaluation

To assume the course to be high-quality, the limit was arbitrary set to 60 % of all obtainable points. The Feedback module of Moodle enables to export structured data in form suitable for processing with e.g. NCSS.

Conclusion

Generally, the indisputable advantage of eLSE is combination of the expert evaluation and the user testing thanks to the predefined evaluation tasks. Based on standardized eLSE methodology [1], by improving it, we developed our own methodology which enables us to evaluate our new MSL concept of e-learning [2]. Thanks to the feedback provided by our evaluation methodology we are able to fix and enhance our courses and make MSL concept more efficient.

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11 TREATMENT OF TEMPOROMANDIBULAR JOINT ANKYLOSIS USING TOTAL ENDOPROSTHESIS

A. Jenča [1], J. Dráčová [1], J. Živčák [2], R. Dráč [1], J. Majerník [1, 2]

[1] Faculty of Medicine, Pavol Jozef Šafárik University in Košice, Slovakia
[2] Faculty of Mechanical Engineering, Technical University of Košice, Slovakia

Abstract
Temporomandibular joint ankylosis occurs as a synosteosis of lower jawbone and temporal bone, where no ability of temporomandibular joint movement is presented. Occurrence of such diseases relates usually to maxillofacial injuries that become mainly in childhood. Authors describe treatment process of pathological synosteosis based on total endoprosthesis. The maintenance of orofacial system functionality is emphasised here. Monitoring and documentation of such special treatment procedures, clinical cases and experiences is also highlighted as a useful and effective tool for further pre and post gradual education.

Keywords
maxillofacial surgery, treatment, ankylosis, temporomandibular joint

Multimedia support in education process

Today's educational tools increasingly depend on modern information and communication technologies. These offer more detailed explanations of clinical cases and the content equipped with proper audio comments and video sequences can be easily used for self education and/or for distance learning. Therefore, the multimedia support of education paves the way for better understanding of both normal and pathological patterns related to the health status of human beings.

Our aim is to follow the treatment procedures of rare cases, special surgery interventions as well as routine operations to prepare a multimedia documentation that can be easily used to improve education of dental medicine students. Using of such multimedia tools will help teacher to explain practical problems and students to be prepared for situations that they can meet in clinical praxis. Electronic educational materials are archived and accessed to students during lectures and/or exercises. Building of surgery interventions database starts with their recording and clinical documentation and uses two approaches. First is aimed to prepare a movie with comments of surgeons and/or other clinical professionals. The output is CD or DVD playable in any PC or DVD player or it can be accessed on-line too. The second approach extends the possibilities of digital presentation techniques and adds the educational text and other related scientific content to the output multimedia documentation. Then the interactive material contains text, audio and video to allow student to get the maximum information about the relevant topics. The advantage of both approaches is that the students and teachers have access to educational material that describes treatment procedures performed by professionals and are based on real clinical cases. Thanks to the multimedia support used in pedagogical processes the students can also see the long-time procedures as well as rare pathology. Educational material based on documentation of temporomandibular joint replacement represents one of the rare and unique treatment procedures in maxillofacial surgery.

Temporomandibular joint

The temporomandibular joint (TMJ) is the joint where the lower jaw bone is connected to the temporal bone of skull *(see Fig. 1)*. It is covered with a thin layer of cartilage and separated by a small disk. This joint is almost constantly in use even if we eat, speak and swallow.

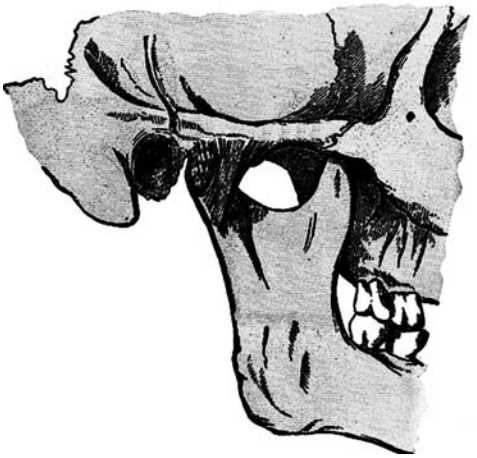

Figure 1: Temporomandibular joint.

TMJ specific innervations and vascularity surrounding the joint can often lead to the pathology. To describe medical and dental status is structurally difficult as it consists of many parts (bony, cartilaginous, fibrous, ligamental, joint socket, muscles). The function of TMJ is affected by stomatognathic system *(see Fig. 2)*.

Replacement of gnathic joint is indicated in patients with significant bone changes, with pain and dysfunction that essentially affect quality of life. There are several reasons that damage TMJ. The most frequently we meet:

- macrotrauma – contusions, fractures (and related bleeding into the in-joint area, avascular necrosis of condyle, cicatrices in soft tissues), thermal damage,
- microtrauma (leading to development of osteoarthritic changes),
- infection (osteomyelitis in childhood, transmission of epitympanitis),
- tumors,
- overall genetopathy (mainly rheumatoid arthritis),
- iatrogenic disorder (thoughtless surgical intervention into the joint structures).

Action of above mentioned reasons cause development of degenerative changes, formation of arthritis and osteoarthritis changes, creation of ankylosis etc. An example of TMJ ankylosis is shown *on fig 3*.

Patients with degenerative diseases suffer with intensive pain not only in the area of gnathic joint but also in the parts of forehead, temporal bone, ear, lower jaw, mandible and neck. Such pains expressively restrict the patients' normal life activities. They are very often forced to take psychop-

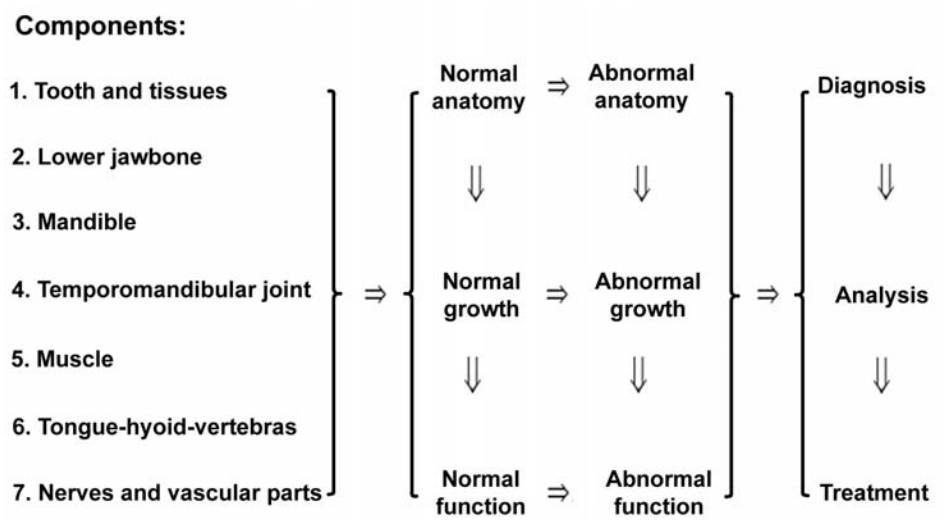

Figure 2: Stomatognathic system.

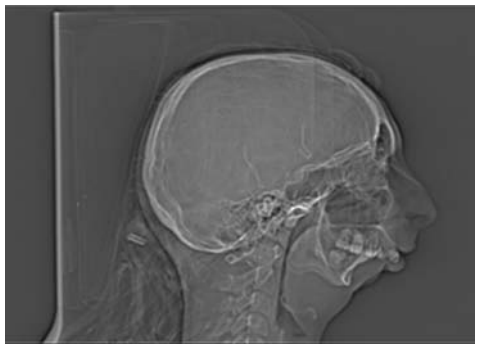

Figure 3: Projection of patient with TMJ ankylosis before surgical intervention where the lower jawbone was 4.5 cm shorter.

harmaceuticals and high amount of analgesics. Next evident symptom not only in degenerative diseases, but mainly in ankylosis is limited (completely impossible) lower jawbone mobility. This hypomobility and immobility makes the food intake, speaking and ability to perform sufficient hygiene of buccal caxity more complicated and/or impossible. When the ankylosis is generated during growth period, there are serious changes and deformities of soft and stiff tissues in oromaxillofacial system. The diagnosis procedure is bases on anamnesis data, objective aspeksis examination and palpation of static and functional activity of oromaxillofacial system, supporting RTG examinations like orthopantograph, CT with 3D projection, MR and thermovision of soft tissues.

Maxillofacial surgery

Maxillofacial surgery, its simulation and planning is extremely challenging scientific research area. It combines medical imagination, computer graphics and mathematical modeling. The abnormalities on the head skeleton in maxillofacial surgery are treated remodeling the skull. On the other hand the human face has an important and key role in interpersonal relations and the people are very sensitive on any changes in their visage. Therefore, planning of surgery interventions and reliable prediction of changes in the face parts are highly important. Lately, the surgical planning systems are based on 3D projection.

The treatment of advanced states is only surgical and may be classified as:

- conservative surgery treatment – arthroplastics with disc replacement (using dermis, fascia, muscle),
- radical surgery treatment – total joint reconstruction.

Success of arthoplastics with disc replacement by itself is according to the longtime studies really low. Because of this the TMJ reconstruction is preferred. Reconstruction of TMJ can be performed in two ways:

- using of autologous replacement – the advantages are bio-inert nature of material and minimal financial charges. The disadvantages are necessity of additional surgery – graft taking; continuation of degenerative changes development even after the replacement was applied and low efficiency in repeated joint surgery.
- using of alloplastic replacement – the advantages are that only one surgical intervention is needed, there is no continuing degenerative process noticed and previous surgical interventions have no influence on function of replacement. The disadvantage is higher financial charge.

Figure 4: Surgery intervention in TMJ.

TMJ reconstruction

The aim of TMJ reconstruction is to renew the joint function, to allow lower jawbone to be freely moveable so the quality of patients' life will be positively affected (better speaking, ingestion, oral hygiene), to improve functionality and growth of myofacial tissues, to create functional conditions for complex solutions of dento-skeletal anomalies of oro-maxillofacial area. Required properties of joint replacement are biological non-reactive, resistant, easily applicable material that doesn't require additional surgical interventions. The most important factor is then renovation of natural movement in joint. Considering less effective autologous replacements we prefer to use allogenic material in the form of total joint replacement and also for partial replacements as socket prosthesis, disc and condyle are. These partial prostheses work mainly as interpositional material, which hinder contact between joint socket and head. But using of total replacement has the best results.

The history of alloplastic material usage in therapy of TMJ started in 1840. At that time, Dr. Carnochan used a small wooden block inserted between the socked and mandibule to treat ankylosis. Risdon used a golden foil as interpositional material in 1933. In 1946 the tantalum foil was used by Eggers. Robinson applied steel joint socked as first in the history in 1963. Titan sockets were used by Jenča in 1985. The first operation with replacement of gnathic joint by full joint prostheses (artificial socket and artificial head) was made to Christensen in 1965. The highest progress and usage of total joint replacements occurred at the end of last century. Nowadays, prosthesis

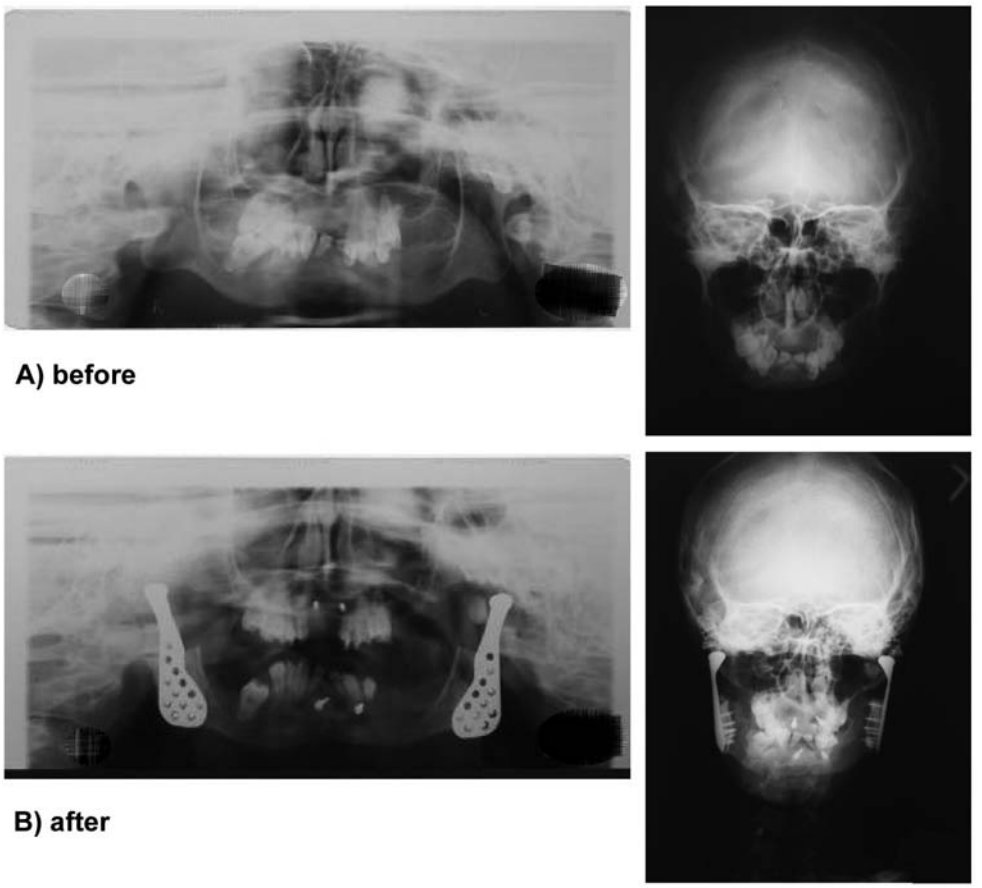

Figure 5: Projections a) before TMJ replacement, and b) after TMJ replacement in patient with ankylosis.

are constructed and used as chrome-cobalt joint head and polyethylene socked, where both components are fixed to the skeleton using screws.

Surgery intervention requires consistent planning and well skilled surgery team. Planning procedure includes:

- appropriate indication. Jawbone joint total replacement is indicated if the patient underwent surgery of TMJ persistently without evident and positive effect, after unsuccessful joint reconstruction using another materials, in destructive processes or in missing joint structures (after resection of joint head). It is not used as a treatment method of first choice or as a preventive solution.
- patient' clinical examination, RTG, CT, MRI, simulation of picture after 3D reconstruction on model of joint skeleton.
- collaboration of patient.

The surgery intervention is performed in general anesthesia using simultaneously two surgery approaches: prearticular and subangular. These approaches allow inspection of lower jawbone, face parts, joint socket and joint head. After the joint head and muscular parts of lower jawbone are removed (resection of bone block is performed in ankylosis) the joint headland and joint socket are cooled. If the disc or its parts are presented they are also removed. Then the new joint socked (screws into zygomatic arch) and joint head (screws into lower jawbone) are fixed. The key to successful intervention is correct position of new head in prosthesis socket. It must be centered in the socket to enable free joint movement. Post surgery care is based on early rehabilitation. It is important to realize that the difficulty of TMJ reconstruction consist of its complexity:

- enable bilateral movement,
- physiological joint movement consists of 2 movement types – rotational and translational,
- presence of mobile disc,
- limited anatomical area in the surrounding structure.

Conclusion

Effectiveness of total joint replacements reaches the values around 90 % in both improvement of motion and reduction of pain. This effective method also essentially improves the quality of patient's life. Replacement of TMJ using total endoprosthesis represents highly specialized standard in treatment of ankyloses, degenerative changes with large devastation of joint surfaces and also in persistently operated joints where no sufficient results were obtained. Reconstruction of both TMJs that enable mobility represents unique surgery intervention. However, total joint replacement is used only in mentioned indications and as a last feasible solution if there was no ability to return functionality of oromaxillofacial system by common conservative and/or surgical therapy.

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12 DIGITALIZATION IN EDUCATION OF ORTHODONTICS

A. Thurzo [1], J. Lysý [1], B. Suchancová [1], M. Makovník [2]

[1] Department of Dentistry and Maxillofacial Surgery of Medical Faculty, Comenius University and St. Elisabeth Oncology Institute, Bratislava, Slovakia
[2] 2nd Department of Internal Medicine, Medical Faculty, Comenius University, Bratislava, Slovakia

Abstract
Part of current education in pregradual orthodontics at Clinic of dentistry and maxillofacial surgery LFUK and OUSA in Bratislava is cephalometric analysis and plaster model analysis. Thanks to new analytic software Dolphin imaging 10. coofinanced by Oncological institute of st.Elizabeth and grants of Comenius University 108-2007 and 80-2008 we were able to transform the both manual analyses into digital ones. The digitalisation was supported by new professional digital camera and digital dental x-ray. Students are able to transpose profile photo with cephalometric x-ray image and simulate even the therapy on model virtual patients in 2D.

Keywords
orthodontics, maxillofacial orthopaedics, digital cephalometric analysis, digital analysis of models, therapy simulation, virtual patient

Introduction

In 2004, entitled "Sistema di analisi dell'Arco dentaria" Italians Mutineli P., M. Cozzani, Manfredi M. and Siciliani G. published an interesting study, which aimed to develop a computerized method that would allow researchers and orthodontists the analysis of variations of dental arches. System for analysis consisted of two parts: a database of pictures and software. Software is used to determine the specific points, as in cephalometrics. Software algorithms calculate and place curves crossing designated points and then calculate the dimensions. Computer analysis of collected data allows ortodontists to statistically analyse, further investigate, and compare differences in treated and untreated patients. Similarly, in published studies of doctor (Kublashvili 2004) built a software to analyze cephalometric x-rays the basis of research. A study of her research team has demonstrated excellent reliability of imaging information systems, such as Dolphin. Comparing digital and conventional analysis of soft tissues. The study includes a number of different methods, including already retiring phosphorus systems as one of the peripheral pseudo-digital radiographic methods. Unfortunately because of the large number of radiographic methods the study is relatively confused, however, it shows a statistically significant difference between manual and digital analysis as well as a surprisingly large gap between the digital analyses. Dolphin Imaging has been re-designated as the standard.

In orthodontics there are cephalometric x-ray and plaster model the essential diagnostic elements needed for a proper determination of treatment, as well as for future assessment of changes caused by treatment. It is therefore important that the measurement error is the smallest and allows accurate analysis to monitor small changes during therapy [1], respectively in the case of plaster models allow precise analysis of

the placement and for simulation of movements. Slovak orthodontists' affinity to the conventional manual analysis remains very strong. The reason is not only the fact that the paper cephalometric analysis *(Fig.1a)* in the past century has been scientifically

Figure 1. A(left) manual B (right) digital

proven as clinically reliable [2, 3], but comparative clinical trials evaluating especial advantages of digitalisation of diagnostics and cephalometric analysis absented *(Fig.1b)*.

Figure 2. The manual plaster model analysis.

In regard to the sensitivity of organisms of children and adolescents, the most common orthodontic patients, is the reduction in radiation (up to 90 %) in the digital x-ray compared with conventional, really important [6]. From the aspect of scientific research is also critical, not only to maintain the competitiveness of our research in the EU, but also for maintaining a development perspective. On digital platform are based all modern treatment simulations, prediction of growth, or 3D technologies in orthodontics. From the perspective of a physician is not only an important ethical aspect of reducing the radiation level , but also speed and precision of the treatment phase, and also more efficient archiving and portability of patients records. For all this, it is important to make a step towards implementing electronic systems in the orthodontic practice.

Plaster model analysis is the groundwork for determining the treatment plan. (MJ Peluso, 2004) analysis two basic types of digital 3D models (OrthoCAD™ and Emodels™), comparing them with conventional plaster models and describes the possibilities of research. The introduction of virtual models in the orthodontic practice is in its first decade. Since their introduction, the orthodontic practice begins significantly to change. Traditional plaster replaced by virtual models, which offer the possibility of immediate exact analysis, occlusion simulation or increased three-dimensional perspective. Simulation and visualization of post-therapeutic situation is one of the key moments in of determining the treatment plan for a specific malocclusion. Italian (Franceso Garin, 2004) in Article Il set-up occlusale Virtuale: metodica e applicazione clinica presented the case study A II / 1 class in permanent dentition, which was planned as extraction therapy (14, 24, 35, 45). The resulting simulation showed new occlusal relationship with the necessary distribution of anchorage and forces to optimise management of post-extraction spaces. From original silicone prints virtual model was designed to determine the treatment plan. To achieve the ideal intercuspidation after extraction therapy is necessary to evaluate several different virtual simulations made. The disad-

Figure 3. Students of dentistry record values of manual plaster model analysis.

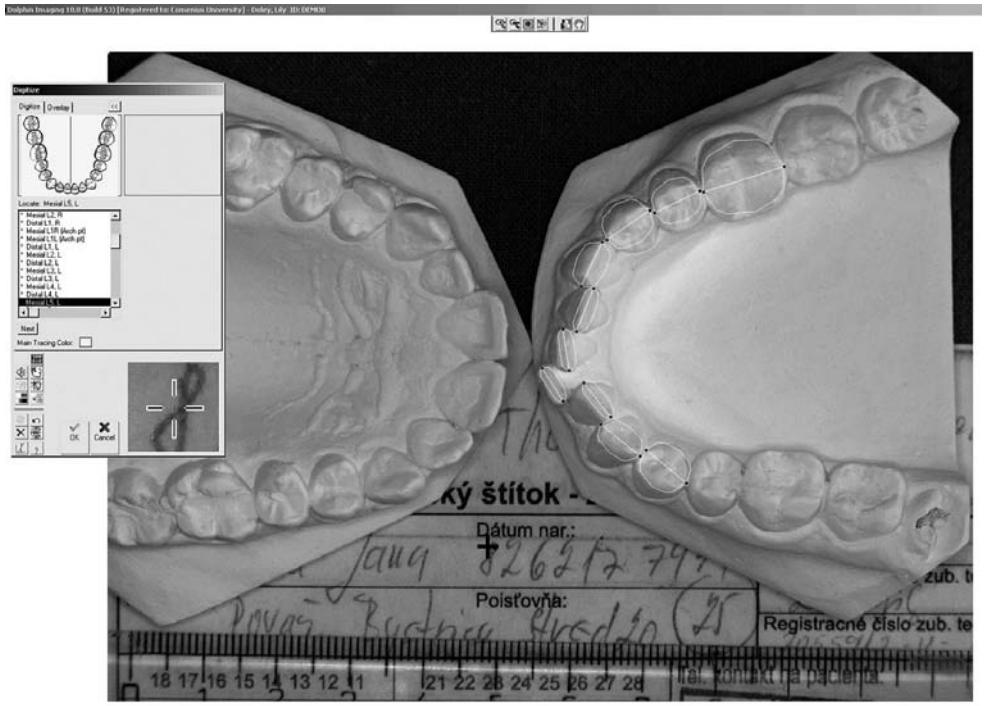

Figure 4. The software model analysis in the Dolphin Imaging 10 environment.
In the left window analysed points are visible. On mandible at right contours of already analyzed part are visible. Mouse over the number 8 on the left to enlarge and increase accuracy. Photo with a ruler made by digital camera Canon PowerShot G5 – 5 megapixels in 2592 × 1944 resolution.

vantage of this particular system is its limitation on complete permanent dentition.

Manual analysis of plaster models is made by students with digital sliding yardstick. The values are recorded and times required for digital and manual analysis are compared *(Fig. 2 and 3)*. Software analysis of models seems as insufficiently reliable. A research on this topic is made nowadays. To support the promotion of digital cephalometric analysis in the years 2007–2008, we made our own research on a set of 100 patients in which we compared reproducibility of digital to manual cephalometric analysis.

Materials and methods

In the above-mentioned study were 100 randomly selected cephalometric x-rays of patients aged 10 to 20 years analysed. Data collection took place at the Department of Orthodontics of Clinic of dentistry and Dentofacial Surgery of LF UK and OUSA from October 2006 to November 2007. Cephalograms were made on analog dental X-ray machine type: CHIRALUX2, digitized on common illuminator by digital camera Canon PowerShot G5 – 5 megapixels in resolution 2,592 × 1,944 pixels. Cephalometric parameters: angle SNA, SNB, ANB, PP / ML, interincisival angle and Wits were analysed. Statistical evaluation was performed in MS Excel in co-operation with a statistician.

When comparing the clinical measurements made by an older-established and a new-innovative method, it is often necessary to evaluate their correlation. This is important to evaluate whether the new method can replace the older one. In this study data were compared, their true values were unknown. In the case of the calibration method known values are analysed by new method and compared.

Analysis reliability was determined by Bland-Altman [7] designed methods. This statistical method allows a simple estimation of the correlation between two measurements of identical variable (reliability), and between the two methods (reproducibility).

For each studied parameter on one cephalogram is paired values difference shown in regard to their average. If both methods correlate ideally, points lie on a horizontal line (average) – zero. The deviation represents the offset of points from this line. Reliability interval represents a range, which includes 95 % normally distributed values. Charts because of their number and size are not possible to show in this study. Comparison of reliability interval range with clinically determined value of standard deviation for particular cephalometric parameter determines clinical significances of differences. If the differences between the two measurements in the range are not clinically significant, manual may be replaced by digital.
To determine the accuracy of the methods repeated measurements were carried out – 5 random cephalograms, analyzed by 3 different doctors (twice analysis for each method). In total 30 manual and 30 software analyses (6 monitored parameters). Normality distribution of the group was statistically evaluated and interval estimation of reliability for observed parameters dispersion (SNA, SNB, ANB, PP / ML, interincisival angle and Wits) – *(Fig. 2)* was computed. 6 charts (one for each parameter) were made; each one shows the difference between the two values (the first and second method) in regard to the value of their average. P-value ≤ 0.05 was considered statistically significant. Some partial results of the research were published and presented in the European Orthodontic Symposium in Lisbon [11] and Conference of postgraduate students in Medical faculty Bratislava [12]. All statistical analyses were designed and coordinated by professional statistician.

Results

In accuracy evaluation of cephalometric analysis methods the interval estimation of reliability shows the smaller accuracy of manual methods. Problematic is the linear parameter Wits (mm), which is different to the other angular parameters more sensitive to the low x-ray quality and subjective rounding of evaluator in manual method. After comparing its interval of reliability is 5.23 mm. All other parameters did not exceed clinically referred ranges. The results also confirm the accuracy of the actual digitization process is scientifically adequate.

Conclusion

Manual processing requires much time and has a higher risk ratio of errors caused by doctors (error in reading from the manual measuring devices and transcription of values). Cephalometric point's reproducibility in conventional processing on paper compared with the analysis of digital images has recently been disputed. Sayinsu made in the year 2007 a research comparing cephalometric analysis errors for the scanned (300 dpi) as well as the originals x-rays [4]. His research confirmed that the reproducibility of analytic software Dolphin Imaging and conventional methods was significantly correlated and also supported the importance of digitalization, the archiving, mobility and digital improving (increasing the contrast and sharpness) of cephalometric x-rays. Research, however, probably in cause of chosen digitalization setup (scanning, making points using pen), failed to conclusively assess the accuracy of methods. Comparable research also made Collins [5], which on 20 cephalograms confirmed that the analysis of digital photographs of cephalograms is comparable with the analysis of scans. Research has shown, however, uncertainty in the assessment of linear parameters in contrast to the angular. Both studies in part correlate with our results; they have smaller groups of patients and different digitizing procedures. The results of both studies show errors in the evaluation of linear parameters (in our Wits). The most likely cause is the high variability in the quality of images. Our results encourage to take advantage of using the originally-digital images and comparing the two methods in the analysis of plaster models.

Cephalometric analysis validity and reproducibility realised manually and digitally is in a high correlation and therefore can software analysis fully replace manual. Dispersion of repeated measurements is more prominent in manual method. So more precise is the digital one. Regarding speed, accuracy, and later the scientific and clinical usefulness can be based on our study recommend cephalometric digital analysis for routine use and as an evolutionary follower to the conventional manual method.

Validity and reproducibility of plaster models analysis is questionable and already in first stages of research is clear that it will be extremely sensitive to the digitalization setup.

Implementation of digital analysis leads to patients' virtualisation and later virtual treatment simulation on real patients' virtual models. Students who acquire skills with software analysis and experience in virtual treatment simulations will later in practice, more tend to further education in this growing dimension. Changing the education curriculum and implementing these new methods helps to change the clinical practice in few years.

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PRACTICAL USE OF TELECONFERENCE AND IMAGING TECHNIQUES FOR NEUROSURGICAL EDUCATION

13

Z. Novák [1], I. Říha [1, 2], J. Chrastina [1], D. Schwarz [3], L. Dušek [3]

[1] Dpt. of Neurosurgery MF MU St. Anne's Hospital Brno
[2] Institute of Biomedical Engineering, FEEC BUT, Brno
[3] Institute of Biostatistics and Analyses MU, Brno

Abstract
Since the foundation of Neurosurgical Clinic MF MU Faculty Hospital St.Ann's in 2004 particular attention has been paid to the process of teaching and education. The concept of telemedicine department was established in close cooperation with the management of Medical Faculty Masaryk Univerzity, Faculty Hospital St. Ann's, Institute of Computer Technique Masaryk Univerzity and Institute of Biostatistics and Analysis Masaryk Univerzity. Theentire concept is based modern communication system, making transmission of visual and acoustic signal possible together with transmission of data from navigation system, cameras scanning the surgical field, surgical microscope, neuroendoscope and C arm. The comment of the teacher together with the posssibility of direct communication with the surgical team brings maximum didactic benefit from the wide spectrum of live surgeries directly presented to pregradual students and postgraduate trainees.

Keywords
telemedicine, data transmission, education in neurosurgery

Introduction

Immediately after the foundation of a new Department of Neurosurgery MF MU FN St.Ann's involved in the process of education the concept of theoretical and practical education of medical students was discussed. The requirements for concrete and practical education are put forward and these demands are great challenge for the teachers and other people, involved in the process of teaching, for instance OR personnels, ICU or standard ward staff. Also the spatial limitations of the operating room must be considered because they prezents as a great obstacle for practical education especially when dealing with larger group of students.

The extent of information that must be continuously and meticulously followed and processed by the operating surgeon during even routine operation is increasing. Together with the changes of the surgical field as observed by surgeons eye or as depicted by means of surgical microscope or endoscopic system the images from C arm or neuronavigations are continuosly presented intraoperatively to the surgeon. Therefore is is very difficult to fullfil the requirements for mutual bilateral communication with the students.

The remarks and needs mentioned above led directly to the concept of telemedicine department. The project was supported by the management of Faculty Hospital St. Ann's as well as Medical Faculty and especially the role of the Dean Prof. Jan Žaloudík, MD, PhD. should be underlined. Stimuli of immense value originated from the cooperation with Institute of Biostatistics and Analysis (Assoc. Prof. Ladislav Dušek, PhD. and Daniel Schwarz, PhD.)

and Institute of Computer Technique MU (Assoc. Prof. Václav Račanský, PhD.) [1].
The concept of teleconference room with students and teacher has been born in this cooperation. The room is directly connected to the operating room by means of camera system, transmitting OR interior and outputs of imaging systems to the teleconference – teaching room. Moreover the system utilises the connection to the hospital LAN as well as to theMetropolitean Network, therefore not only in- department and in-hospital teleconferences, but also university-based, municipal, intercity, international and intercontinental teleconferences are possible.

The content of the project

The project contains several parts utilising the different parts of department equipment for education process.

3D modelling of real intraoperative situations with the possibility of segmentation of different given anatomical structures

The distorted anatomical relationships of a defined intracranial structure(s) can be demonstrated with the help of the 3D model and the relationship of clinical symptoms to this structural changes can be easily prezented. Moreover the different surgical approaches can be also planned and discussed. The operating software (stereotactic planning software Praezis) makes the formation of 3D reconstructions possible together with detailed study of lesion shape and relationship to the surrounding structures.
The model of virtual endoscopy of brain ventricles facilitates greatly the process of ventricular anatomy study. The real endoscopic surgery can be modelled with virtual ventriculoscopy – inspection of intraventricular structures. Any trajectory of the virtual endoscope can be selected, for instance with the endoscope entry point in cisterna magna and passing through the fourth ventricle and Sylvian aquaeduct to the third ventricle. Anatomical terms marking the individual structures in different projections facilitates greatly the formation of the idea of surgical anatomy as perceived from different angles.
The use of teaching workstation HP XW 4400 with EIZO FlexScan and SeeReal Technologies Cn 3D brings promising outlooks for the future.The workstation facilitates greatly the perception of 3D relationship of defined anatomical object or objects forming surgical situation. Therefore 3D presurgical planning is possible with surgical simulation as a tempting prospect for the future.

The use of teleconference technique for neurosurgical education

Teleconference technique has proven its great practical value during the process of pregradual education of medical students and postgradual trainees. The timetable of 3 days courses on neurosurgery for pregrad-

Tab.1 Timetable of pregradual course on neurosurgery for medical students

Schedule	Department of Neurosurgery MF MU FH St.Ann's Brno
1st day	Intracranial hypertension Neurotraumatology Intracranial haemorrhage, subarachnoid haemorrhage Epileptosurgery, functional neurosurgery, stereotaxy, neuronavigation
2nd day	Endoscopic neurosurgery Neurooncology Degenerative spine problems
3rd day	Spine and nerve trauma Compressive syndroms

Note : 1–2 teleconferences from the OR will be included with topics depending on surgical plan.

ual medical students makes use of teleconference transmissions from the OR *(Tab.1)*.
The following devices from the operating room are connected to the hospital LAN (speed of data transmission 100 Mbps) and fiberoptic cables (speed of data transmission 1 Gbps) *(Fig.1)*.

- communication system VSX 7000 with multidirectional microphones
- system of data storage AIDA (STORZ)
- digital camera
- surgical microscope camera
- endoscopic camera

The choice of the device is controlled by the switch system.
The second part of the communication system is placed in the teleconference room with multidirectional microphone and computer workstation connected directly to the data projector and audio - output. These devices are under the control of the teacher working directly in the teleconference rooom .The already mentioned system for 3D vizualisation HP XW 4400 is another part of teleconference room equipment.
The teaching – teleconference room and operating room are mutually connected by means of two teleconference systems Polycom ViewStation VSX 7000 making visual and verbal communication between the involved persons possible.

The following fundamental data further specifying the teleconference technique should be prezented:
Videosystem can work in PAL as well as NTCS norm with the speed of data transfer ranging from 56 Kbps to 2 Mbps. Data transmission by means of LAN system is based on H.323 standard reflecting the contemporary requirements. H.263 + standard enhaces the quality of the transmitted image .For data transfer by means of lower permeability lines (for instance ISDN) standard H.320 is used. The entire system is based on patented technology for fully bidirectional sound transmission with echoes and noises supression.
Data from PACS, operating room, surgical microscope, endoscope and imaging modalities (neuronavigation and C arm) can be transmitted to the teleconference – teaching room. Mutual communication with the students facilitated by the above described equipment may also enhance the quality of education in neurosciences by means of direct connection of theoretical knowledge with the surgical possibilities.
The questions asked by the students can be answered by the teacher in the teleconference room as well as by the members of the surgical team directly from the operating room. The practical aspects of teleconference education has been perfected and it is not difficult to combine the process of edu-

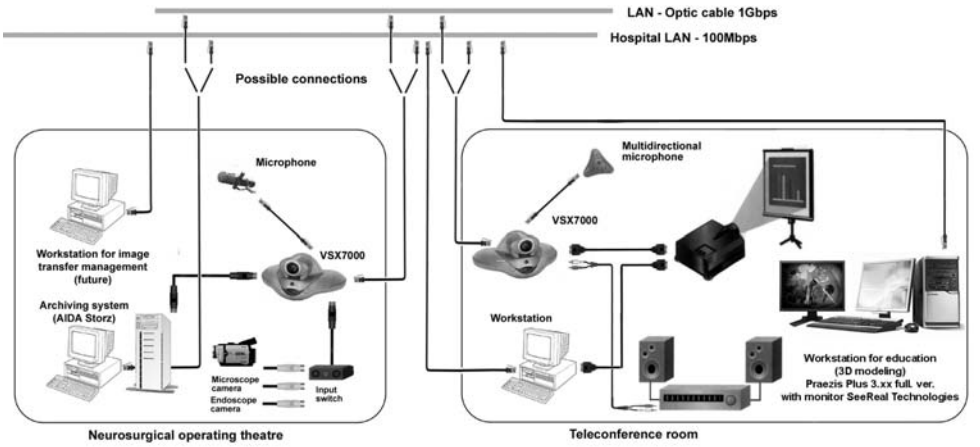

Figure1: The scheme of teleconference technique connections used for the purposes of telemedicine and education in Department of Neurosurgery MF MU FH St.Ann's, Brno

cation with direct transmissions from the operating room. The students can observe all the key surgical steps, starting from patient preparation for surgery, surgical approach and the intracranial surgery as recorded by means of neuroendoscopic system or surgical microscope. It s also possible to watch the results of intraoperative electrophysiological monitoring. Relevant neuroanatomical, pathophysiological and clinical data can be prezented by the teacher and theoretical knowledge can be immediately combined with practical clinical application. Economy benefit can not be neglected.

Data archiving – Mini Pacs

Not only hospital PACS, but also local PACS server storing the data for publication and teaching activity of neurosurgical department are connected to the hospital backbone network by means of Switch (1 Gbit/s–100 Mbit/s). The datasets of imaging techniques (presurgical planning and follow-up studies) as well as videorecord of key surgical steps are stored. Archivation systems Aida Storz, navigation computer workstation and C arm are attached to the backbone network by means of switch.

Teaching CD

Teaching CD containing videorecords of neuroendoscopic surgeries with the necessary theoretical backround are currently prepared.

Conclusions

Pregradual education and postgradual training are integral parts of teaching department profile. The foundation of telemedicine department was the result of interdisciplinary cooperation and its imlplementation into daily practical work was greatly facilitated by the management of Medical Faculty MU, Faculty Hospital St.Ann's, Institute of Computer Technique MU and Institute of Biostatistics and Analyses. Together with telemedicine conferences from the operating room theatre facilitates greatly the process of techaing and education in neurosurgery and 3D reconstruction of objects by means of dedicated software is another topic of work made possible by the computer equipment. Education CD presenting theoretical knowledge related to the defined field of neurosurgery together with important surgical steps are being prepared. The use of telemedicine in the proc-

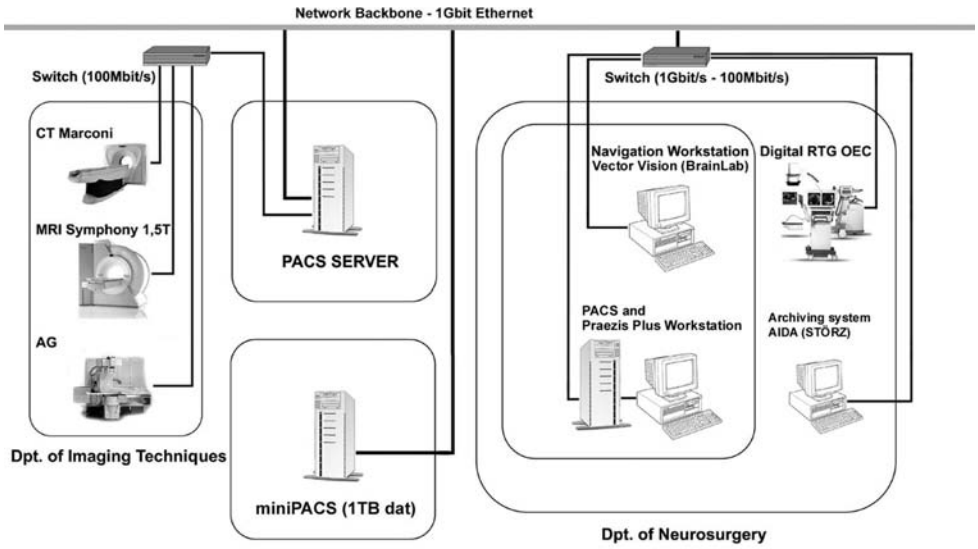

Figure 2. Data transmission from imaging modalities to hospital PACS archiving server

ess of education was presented on national meetings and became also a topic of a scientific poster, presented on Computer Aided Radiology and Surgery 2006 in Osaka [2].

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14 THE NEWS IN OPHTHALMOLOGY AND REFRACTIVE SURGERY, LECTURES FOR STUDENTS OF MEDICAL FACULTY

S. Synek, M. Synková

Department of Ophthalmology and Optometry, Faculty of Medicine, St. Anne's University hospital Brno

Abstract
Practical courses of Ophthalmology and Optometry depend on digital output projection of ophthalmic apparatuses. Digital signals enable creation of audiovisual lectures and integration of more students in active lectures.

Keywords
practical course, ophthalmology, optometry, digital signal of output, audiovisual lecture

Lectures of Ophthalmology and Optometry are very specific. The eyes and surrounding tissues are very small and there are necessary to used specialize ophthalmic apparatuses. The last years we can see quick advancement, very many new diagnostic devices discovered every year, which can offer precise diagnosis and new modality of treatment. The news in ophthalmology and optometry we can rank into new devices and new therapeutic approaches, but also in news in anterior and posterior eye surgeries. Nowadays we use new devices e.g. OCT (ocular computer tomography), GDx (glaucoma diagnostic), HRT II-III (Heidelberg retinal tomography), Wavefront analyser (aberometry), corneal pachymetry, 3D ultrasonography. All devices use monochromatic laser arrays. Output is digital signals of pictures and mathematic formulas, which we can utilize in diagnostic procedures, follow up of treatment and lectures. *On fig. 1* there is diagnostic of glaucoma by HRT II. By means of laser scanning ophthalmoscope we examine optic nerve, HRT glaucoma program compute configuration of optic nerve head, thickness of nerve fibers and probability of disease. Chosen example is physiologic optic nerve. The digitalization of output has great acceptance. The eye examination is an individual procedure.

Figure 1:Retinal camera and slit lamp enable active participation of whole student's group in lecture. Output picture demonstrates correct approach to examination, pathologic condition and checking of students. We can create atlas of physiologic and pathologic eye conditions.

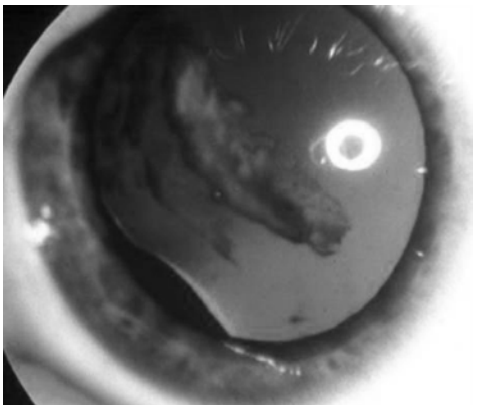

Figure 2: On the picture there is a coloboma of lens. Internet presentation offer learner controlled instruction, multimedia lectures and tests. Video output from operating microscope makes possible archive and demonstrate basic surgical procedures.

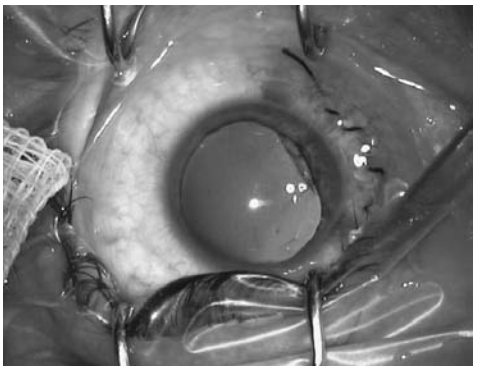

Figure 3: Picture is showing status after surgery of penetrating eye injury.

Refractive eye surgeries include large diagnostic and therapeutic procedures, e.g. optimal optic aids, contact lenses, intraocular lens implants to sophisticated laser intervention. Integrating parts of learning material there are making the acquaintance of concurrent access and choice of advisable approach.

Summary

Presentation of trends in ophthalmology and refractive eye errors needs new methods. E-learning makes the best account of multimedia and modern examination devices in procedures in education.

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15 E-LEARNING SUPPORT FOR PATHOLOGICAL PHYSIOLOGY COURSES AT THE MEDICAL FACULTY, PALACKÝ UNIVERSITY IN OLOMOUC

J. Veselý, B. Řeháková

Palacky University, Olomouc

Abstract

The present poster contribution to the Conference refers to the project "E-Learning Support for Pathological Physiology Courses at the Medical Faculty, Palacký University in Olomouc". This project was financially supported by the European Social Funds and the State Budget of the Czech Republic (Ministry for Education, Youth, and Sports, Czech Republic). The project lasted for 18 months and was realized under the Action Measures for the Development of Human Resources, No. 3.2, during the years 2007–2008. It aimed at creating a new e-learning web background to support education of pathological physiology in both medicinal and non-medicinal study programs that are taught at the Medical Faculty as well as the newly established Faculty of Health Sciences, Palacký University, Olomouc. The project outcome is a web portal http://pfyziol.upol.cz. This portal is freely accessible to the public. In the basis of the portal there are video-recordings of lectures, delivered by teachers, along with their entirely synchronized oral and PowerPoint presentations. These virtual lectures (webcasts) are equipped with robust search and navigation systems and supplemented with auto-educational test sets.

Keywords

webcasting, pathological physiology, European Social Funds, e-learning, medicine

Project content

The processes of diagnosis and therapy in clinical medicine are complex and demanding deep understanding etiology, pathogenesis, and development of diseases. An incompetent doctor neglecting important symptoms and overstating some other partial ones erroneously may seriously invade a patient. Hence, teachers should intent on expanding students' the abilities to apply multiple rational operations in the decision-making process of diagnosis and treatment. This substantiates utilization of highly integrative educational methods. Relevantly, the Medical and/or Pathological physiology is traditionally thought to be the key pre-clinical integrative subject in medical curricula. Transition from the pre-clinical to clinical part of the curriculum represents to the students one of the predominant, uneasy if not critical educational periods. Before advancing to clinical studies, medical students are expected to reach a considerable level of knowledge as well as developed aptitude to incorporate them in due logical operational schemes that are required for grasping the complex world of modern diagnostic and therapeutic approaches.

The present poster presentation gives information about the project "E-Learning Support for Pathological Physiology Courses at the Medical Faculty, Palacký University in Olomouc". The project was financially supported by the European Social Funds and the State Budget of the Czech Republic (Ministry for Education, Youth, and Sports, Czech Republic). It lasted for 18 months and was realized under the Action Measures for the Development of Human Resources,

No. 3.2, during the years 2007–2008. The project aimed at creating a new e-learning web background to support education of the study subject Pathological physiology in both medicinal and non-medicinal study programs that are taught at the Medical Faculty as well as the newly established Faculty of Health Sciences, Palacký University, Olomouc. The project outcome is a web portal http://pfyziol.upol.cz. The following eleven educational sections are presented to the students in the portal, which organized in a modular way: 01, Nervous system; 02, Endocrinology; 03, Hemostasis; 04, Inflammation; 05, Cardiovascular system; 06, Kidney; 07, Respiratory system; 08, Gastrointestinal system; 09, Energetic balance; 10, Water and salt balance; 11, Acid-base balance. In the basis of the portal http://pfyziol.upol.cz there are video-recordings of lectures, delivered by teachers, along with the teacher's oral and PowerPoint presentations which are all completely synchronized (webcasts). The portal utilizes the advanced stream-technology and, thus, it is freely accessible to the public, even if the lectures amount to more than 60 hours and 2,000 PowerPoint frames, in total. In addition, the lectures are completed with robust search and navigation systems organized according to key words that enable students to randomly find any required part of an educational material. Moreover, the lectures are supplemented with auto-educational test sets. Both the PowerPoint presentations and their oral accompaniments are freely downloadable by the students and utilizable off-line.

Conclusion

The educational project presented in the conference poster resides on the basis that the role of a teacher in the educational process remains hardly expendable. Nevertheless, the role admits substantial changes in the scope of novel precipitous e-learning opportunities. The e-learning portal http://pfyziol.upol.cz created in the project "E-Learning Support for Pathological Physiology Courses at the Medical Faculty, Palacký University in Olomouc" as its major outcome clearly represents a useful complementary educational support. Teachers can easily employ it during their tutorials and students during their home studies; implicitly, the students can use the educational supplies contained in it any time and anywhere.

Acknowledgements

The project "E-Learning Support for Pathological Physiology Courses at the Medical Faculty, Palacký University in Olomouc" was realized under the Action Measures for the Development of Human Resources, No. 3.2, during the years 2007–2008. It was financially supported by the European Social Funds and the State Budget of the Czech Republic (Ministry for Education, Youth, and Sports, Czech Republic).

16

MICROSCOPIC ANATOMY, E-LEARNING FOR MEDICAL STUDENTS

M. Pomfy [1], Š. Tóth [1], J. Majerník [2]

[1] Department of Histology and Embryology, Medical Faculty of P. J. Šafárik University, Košice, Slovakia
[2] Department of Medical Informatics, Medical Faculty of P. J. Šafárik University, Košice, Slovakia

Abstract
Nowadays, there is a growing trend in needs to modernize the teaching methods of morphological subjects at the medical faculties. For that reason we prepared an electronic version of education presentations for students using modern information and multimedia techniques, new literature data and histological bioptic materials. These electronic presentations include chapters from microscopic anatomy and basics of embryology. Finally, presented education materials will be composed as electronic textbook and distributed over the internet to the students of medicine. The aim of our effort is to increase the efficiency of the histology study, as well as to provide the most important information for medical students in digital forms that they can easily use within their further education.

Keywords
microscopic anatomy, histology, embryology, e-learning, education

Introduction

Because of the negative development in our society during the past decade, the education, health care services and further areas of human life were displaced out of the world trends. Especially, in the education process, it concerns the draft and composition of study and, of course, the electronization. The current shortage of modern electronic books assigned for study is evident not only at the nontechnical universities. The study books of histology and embryology by authors Janošík, Srdínko, Frankerbenger, Wolf, Klika, Vacek, Kapeller and Maršala were published many years ago (Wolf, 1956). Some of these publications are simply the translation of foreign original texts (Konrádová et al. 2000, Junqueira et al. 1995). Recently, the writing of qualitative and appropriate modern medical books is very difficult, because the information stated in are often outdated at the time of printing.

Electronic book for students

The lack of modern text books at the University of Pavol Jozef Šafárik, Faculty of Medicine motivated us to prepare the electronic version of lectures from cytology, general histology, microscopic anatomy and embryology. To create it, we used current world literature and knowledge's from cytology, histology, histopathology, histochemistry, immunohistochemistry and embryology. At the same time we expect that these electronic data and information included in will be progressively actualized. The only electronic version of education materials allows us to do it easily, quickly and as many times as needed.
At the present time, we have completed a complex education data from microscopic anatomy, which will be presented for the students of medicine in electronic version as the first part of multimedia presentations set. Whole electronic publication of microscopic anatomy is composed from three

Table 1: List of chapters prepared for Microscopic anatomy e-book.

Chapter	Authors
Cardiovascular system	Jonecová Zuzana
Lymphoid system	Mechírová Eva
Respiratory system	Pomfy Mikuláš
Alimentary system I.part	Pomfy Mikuláš
Alimentary system II.part	Pomfy Mikuláš
Alimentary system III.part	Tóth Štefan
Urinary system	Mechírová Eva
Female genital system	Veselá Jarmila
Male genital system	Mechírová Eva
Endocrine system	Domoráková Iveta
Nervous system	Danková Marianna
The integument	Domoráková Iveta
Sense organs and Sensory receptors	Tóth Štefan

main parts. The first one includes description of chapters and materials as are summarized in the following table.

The second and pivotal part of the book consists of eleven chapters covering description of systems of all human body organs. Each chapter from presented microscopic anatomy book has uniform structure. The first section of this structure defines basics of embryology and contains general information about development of organs (origin and time of formation). The next section includes the histological structure of particular organ and its systems (histological features under light microscope, ultrastructure under electron microscope, basic functional histophysiological information, as well as the major differential diagnostic histological features). All chapters contain many representative and clear figures stained by basic histological and special histological, histochemical and immunohistochemical methods. The third and the last section of defined and here presented electronic structure of chapters is composed of alphabetically arranged references to relevant sources of information. There are included textbook, monographs, and also websites of prestigious experts and teams of specialists.

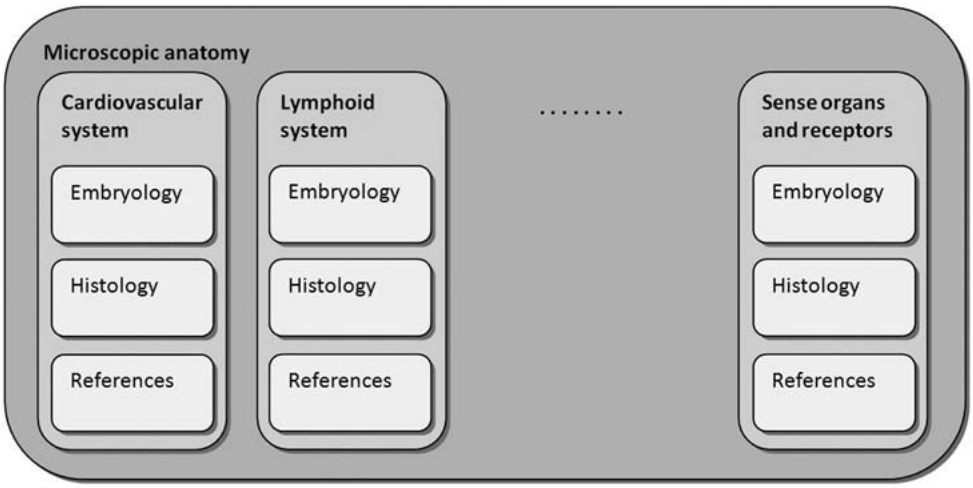

Figure 1: Structure of Microscopic anatomy e-book.

The block diagram of presented chapters' structure is shown on *fig. 1*.
The second part of the electronic presentations in the e-book will be composed of individual histological slides from all organ systems in the form of virtual histological atlas. This on-line virtual histological atlas is also determined as good tool for final examination from histological slides.
The important questions to test knowledge of students are included in third part of the publication. Using these questions, the students of medicine will be able to verify their knowledge before they attend the final examination from Histology and embryology.

Forms of publication

The book presenting compact authors' craft will be published only in electronic form to ensure the highest quality of used multimedia information. There were two possibilities of publishing this education multimedia book.
The first one was offered by the publisher Equilibrium. In that case, the publication can be distributed in on-line version as a special locked PDF format accessed at the publishers' website. Such locked education material will include also one half of key, needed to open the document or its parts. The second half of the key will be distributed by publisher together with purchase of product. This part of the key will be unique for person and for his/her computer. In that case the book will be opened only on one, so called "licensed", reader's computer. Due to the complicity of this publication way, necessity of additional fees and technical problems on the side of publisher and thanks to the newly established project MEFANET and its activities we decided to publish the book using the second way.
Microscopic anatomy will be published on the multimedia support in education portal of the Pavol Jozef Šafárik University in Košice, Faculty of medicine. We prepare both the off-line and on-line versions. On-line version will be available as multimedia CD and/or DVD. On-line version will be periodically updated and the readers, in our case our students, will be allowed to comment and discus about it. We suppose this will help us to improve the communication between authors and students.

Conclusion

The first version of Microscopic anatomy e-book was realized at our faculty. We will share it for our students using the faculty portal of multimedia support in education of clinical and health care disciplines. Such modern publishing forms convinced us that the information and communication technologies offer even more and more possibilities to reach the most effective and the most demonstrative education. Using of new multimedia technologies in education also leads to the highest demands on reassessment of teachers' qualification and capabilities. However, the highest benefit from this and similar publications is expected for the consumers of the content.

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17 MULTIMEDIA APPLICATIONS AT THE FACULTY OF MEDICINE IN PILSEN, CHARLES UNIVERSITY; THE UTILISATION OF ADOBE PRESENTER

M. Dvořák, L. Bolek, T. Junek, P. Mika, M. Navrátil

Institute of Biophysics of the Faculty of Medicine in Pilsen
Education and IT Application Department

Abstract
Simple text is simply not enough any more! Multimedia teaching support and applications are important complement in education. They cater for students' acquisition of present information using all senses, encouraging thus deeper understanding, analysis and categorising and, consequently, interpreting the given issues.

Keywords
multimedia, adobe, flash, captivate, presenter

Multimedia Applications used at the Faculty of Medicine in Pilsen (hereinafter FMP)

Since 2004, the Education and IT Application Department (hereinafter EITAD) has been involved in the process of development of electronic forms of tuition at FMP. At the same time it caters for technical support and consulting the development of electronic educational materials provided to the FMP's theoretical institutes and clinical stations. At the beginning this involved mainly study texts supplemented with some charts and simple graphics. Later on, as information technologies developed and new trends in education emerged, more efficient hardware and software was purchased for individual stations. All this urged for the development of more sophisticated multimedia applications.

At present, majority of the stations are well equipped with hardware for digital photography, video- or audio recordings. However, the individual stations are often not capable of processing the gathered material and developing comprehensive multimedia applications based upon the material, as this usually requires using quite sophisticated software such as Adobe Flash or Adobe Captivate. Most of the multimedia educational applications thus have been developed either by the EITAD staff or in cooperation with them.

Examples of the Multimedia Applications

Let us list here briefly the so-far developed multimedia educational applications. Included are also those being in the process of developing at present, possibly to be made available for Mefanet.

The most diligent in this respect is the FMP's Institute of Anatomy, whose staff have already developed two comprehensive multimedia educational applications that have been made accessible to students within the electronic courses, and another one is currently being processed. First of the two mentioned applications is a topographic anatomy of the trunk *(see Fig. 1)*. It consists of several schemes of serial horizontal sections of the neck, thorax, abdomen, and pelvis, in different skeletotopical levels. The other multimedia educational application

deals with the visualisation of the inguinal channel *(see Fig. 2)*, catering thus for better demonstration of different layers of the channel. As already mentioned, third application is now being developed dealing with the anatomy of the cranial base.

Within the course of clinical biochemistry, there are two multimedia applications aimed at graduants as well as different specialists and medical students. First of these deals with comparison of two methods *(see Fig. 3)*, showing the changes in relation of two compared methods resulting from altered input parameters. The other application *(see Fig. 4)* demonstrates critical difference in selected parameters.

Although the following case is not a multimedia application in the orthodox sense of the word, we would like to present the Pictorial Atlas of Dental Tools *(see Fig. 5)*, an EITAD's development for a dental clinic. This pictorial atlas depicts over 70 different tools, accompanying the illustrations with elementary text information.

Most of the presented applications were and are developed using the Adobe software, namely Adobe Flash and Adobe Captivate. Both these programs are far too difficult to operate by ordinary clinic or academic members of FMP; therefore, their mass implementation is rather unlikely.

Unfortunately, EITAD's capacity is limited and does not match the demand from different academic and clinic stations for the development of multimedia applications. This has urged us to search for some sort of tool that would be accessible for a standard PC user without the need of lengthy training.

Utilisation of Adobe Presenter

Adobe Presenter is not an independent application; instead, it is installed as a complement to MS PowerPoint, versions 2003–2007. We see an advantage of this software mainly in the fact that most of the academic or clinic members are quite familiar with MS PowerPoint and have operational experience with this software. Using Adobe Presenter enables its users to insert spoken commentary and multimedia content directly in their presentations created in the PowerPoint environment.

Another useful propriety of this software is the possibility to create simple tests. Adobe Presenter offers several types of test questions from the classical multiple choice to e.g. matching tasks. The curriculum presented in the electronic form may thus be enhanced with feedback or progress tests that would show whether or not the students acquired what they were supposed to. LMS operators are likely to appreciate the compatibility of the tests with the SCORM and AICC standards, so that the test results may be used in different systems under those standards or incorporated in the final students' evaluation. For example, at FMP, we often transfer the test results to the electronic courses the students “attend” within the Moodle LMS.

As the output of such MMD presentation, you may get standard HTML pages enhanced with SWF files, regardless to the platform used; or, you may develop a PDF presentation executable in Acrobat Reader 9.0 or higher. If linked to the LMS, the output of this is a complex SCORM package.

Adobe Presenter is downloadable as a 30-day free trial version (full functionality) from www.adobe.com to be purchased after thorough evaluation.

18 ON-LINE MULTIMEDIA SUPPORT OF EDUCATION AT THE FACULTY OF MEDICINE

J. Majerník, Ľ. Podracká, Ž. Majerníková, M. Pomfy

Faculty of Medicine, Pavol Jozef Šafárik University in Košice, Slovakia

Abstract

Trends of multimedia education tools utilization at Pavol Jozef Šafárik University in Košice, Faculty of Medicine are described in this paper. Authors summarize implementation of multimedia support in education portal, their own experiences, and recent skills with its management at the faculty as well as users responses. They indicate possibilities of portal future development, point out solved and unsolved problems and emphasize advantages of presented publication platform concept, which allows teachers to publish their electronic works and students to search for education materials they need for study. Furthermore, the fact, that the modern information and communication technologies offer great possibilities to built qualitative electronic education works is also emphasised. Therefore, the teachers should be directed to use them very actively to make education process more attractive and they also should motivate students to find more effective forms of obtaining and improving their theoretical and practical knowledge. Authors suggest to use today's modern technologies to improve traditional education forms and to modify conservative approaches of communication between teachers and their students.

Keywords

multimedia tools, electronic education, information and communication technologies

Technologies and education

Exploitation of modern information and communication technologies in pedagogical activities has a great number of considerable advances. They markedly improve quality and efficiency of education in pre and post gradual study. Education based on multimedia tools is no longer only a matter of technical branches, but it was significantly applied also to the fields of study as are clinical and health care disciplines. On the other hand, it is characterized by specific requirements that necessitate using of sophisticated solutions. These result from processing of sensitive data of patients' health status, need for detailed control of clinical diagnoses and outputs designated for usage in pedagogical processes, from elementary protection of personal data etc. Significant requests on effective education forms are recognized in fields related to diagnostic methods and laboratory examination techniques.

The most frequent barriers in expansion of multimedia based education are conservative approach to pedagogical process, apprehension resulting from potential complications of new technologies to be used, insufficient technical skills of authors and/or users and poor methodical support. Nowadays, traditional education forms do not offer satisfactory space to handle specialized education problems. Therefore, there is a need to search for effective education supporting tools. Solving of methodical problems and achievement of effective production of new types of electronic education materials that uses modern information and communication technologies can be obtained within well cooperated teamwork of professionals and specialists. Cooperation of faculties and/or universities creates good assumptions and warranties for effec-

tive utilization of both human and financial sources needed to solve most of above mentioned problems.

Portal of multimedia support in education

Trends of modern education forms based on latest information and communication technologies and used especially in technical study branches motivated us to built services that allow teachers to publish their works for students in an easy way and offer students to get access to specialized study materials and literature. Such sophisticated services should be adapted to the needs and computer skills of nontechnical pedagogical staff and primarily they should be easy to use for teachers and students. General problem in searching and implementation of an optimal solution is that teachers/authors share their works at different e-Learning portals, various web pages and also in off-line forms using CDs, DVDs and/or flash memories. Due to their working load they often do not have time to change this way and/or form of education material. We prepared building of faculty web gate to collect links of such works created by our teachers. Before we could finish its realization we acquired information about more effective concept exceeding the faculty bounds. The concept of elaborated project was introduced at the international conference MEFANET 2007 by Dr. Schwarz under the name "Multimedia support in education of medical and health care disciplines". First concept of presented portal was created as an output of project MEFANET (Medical Faculties NETwork).

Figure 1: Portal of multimedia support in education of clinical and health care disciplines at Pavol Jozef Šafárik University in Košice, Faculty of Medicine.

Pavol Jozef Šafárik University in Košice, Faculty of Medicine joined the project MEFANET with the aims to contribute to interfaculty cooperation and to support utilization of electronic education forms. Faculty staff installed the portal package, created by Institute of Biostatistics and Analyses, Faculty of Medicine, Masaryk University Brno as first of three medical faculties in Slovakia. Language support of first version was English and Czech. In order to support also Slovak users we created Slovak package and offered it to be included and updated in new portal releases. Portal was successfully on-line accessed for the community of internet users after verification of its functionality and adaptation of its layout and sections to the faculty requirements respecting all roles of MEFANET agreements in March 2008. In a short time we obtained also ISSN number to raise the level of presented education materials. Portal was successfully updated to all available releases during its almost one year operation. Even if its operation is short, it is still continuously and reasonable adopted to reflect needs of authors from our faculty. This contributes to its relatively high visit rate and to positive response of its users. Portal of Pavol Jozef Šafárik University in Košice, Faculty of Medicine is now worldwide available at http://portal.lf.upjs.sk.

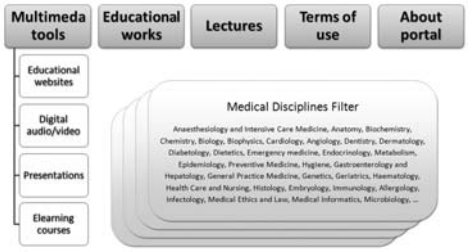
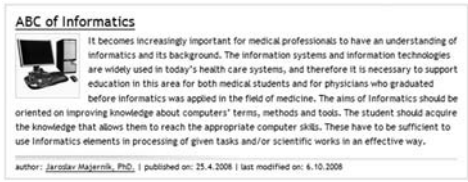


Figure 2: Classification structure of published education works.

Nowadays, portal allows publishing of electronic works created at the faculty workplaces by members of its pedagogical staff and/or by members of other faculties

included in project. Published works are categorized into medical disciplines specified by the MEFANET coordination committee. Filter of these medical disciplines is only the compulsory and unchangeable part of portal concept and allows uniform export of publications from local portals to the MEFANET central gate. To make users orientation on the portal easier we prepared a structure that classifies the most used types of education works. Designed structure is shown on *fig. 2*. Portal is divided into five sections according to this structure. The sections include "Multimedia tools", "Educational works", "Lectures", "Terms of use" and "About portal". Section "Multimedia tools" is further subdivided according to the type of multimedia education materials on "Education websites", "Digital audio/video", "Presentations" and "e-Learning courses". Publications included in the section "Education works" represent compact materials relevant to at least one subject taught at the faculty. Here published works have the form and extent equivalent to printed scripts or textbooks. Section "Lectures" allows authors to publish lecture notes, presentations and other education related works. Section "Terms of use" specifies conditions of portal usage, bibliographic quotation, copyrights protection and other usage related information. The last section "About portal" includes basic information about portal.

Published education materials are presented in uniform design to make orientation on the portal easier and more transparent. Therefore, except of compulsory attachments, the works should contain also all formal appurtenances including annotation and short descriptive article. Descriptive article informs readers about presented content and is available for all users including those unregistered that may not have access to other attached documents. On the other hand, uniform presentation and design make portal more attractive. Necessary arrangements to reach the uniform layout and to raise attractiveness are fully performed by redaction staff so the requirements on authors are minimized to the skills of common computer user.


ABC of Informatics

It becomes increasingly important for medical professionals to have an understanding of informatics and its background. The information systems and information technologies are widely used in today's health care systems, and therefore it is necessary to support education in this area for both medical students and for physicians who graduated before informatics was applied in the field of medicine. The aims of informatics should be oriented on improving knowledge about computers' terms, methods and tools. The student should acquire the knowledge that allows them to reach the appropriate computer skills. These have to be sufficient to use informatics elements in processing of given tasks and/or scientific works in an effective way.

author: Jaroslav Majerník, PhD. | published on: 25.4.2008 | last modified on: 6.10.2008

Figure 3: Example of annotation to education work published at the portal of multimedia support in education of medical and health care disciplines.

Portal implementation

Several important landmarks can be highlighted in the portal implementation process that we undergone till the portal was online accessed. Faculty of Medicine in Košice have implemented it in relatively short time and contributed to its further development by Slovak language pack, verification of individual functions, and recommendations for improvements.

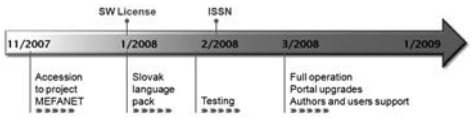


Figure 4: Implementation of multimedia support in education portal at the Faculty of Medicine in Košice.

To successfully overcome whole implementation process we have faced and solved several organizational and technical problems. These should be considered at any faculty connected to the project before the portal is installed. Generally, the system engineers meet most of them when set new publication systems into operation. Implementation process requires solving of following questions.

1. Hardware. Portal should be installed and administered at suitable technical equipment. The most important things that must be considered are safety and data protection. There was an existing server used to run the portal and we preferred to operate virtual server. So our recommendation was do not search investment for buying new equipment but to search capabilities to install the

portal as sun as possible. Later, when the number of users, authors and published works grows, the purchase of new technology equipment can be considered. We also did it in this way because we realized potential time lose during money searching procedure.

2. Portal administration. At least one system engineer is required to take control over the portal implementation and to support its further development. The easiest way is to use internal employee if possible. Five employees were instructed to manage portal's backoffice at our faculty. Permanent portal control and communication with development team in Brno and also with other faculties' administrators result in portal improvements that guarantee success and life of whole project.
3. Language. Slovak language pack missed in first portal installation package. One of the first tasks we solved was its creation. Now the portal can be accessed in three languages, namely Czech, English and Slovak.
4. Design. Color scheme of portal was adapted to the color scheme of our faculty website. Individual portals should have the colors of particular faculty. Observing of this recommendation at all portal instances will ensure better portal's identification for students that search for education materials especially if individual portals will have different color combinations.
5. Layout. Even if the faculties have no limitation in management of publication activities and methods, it is recommended to use as similar portal layouts as possible to make users' orientation easier when reading publications from several portals. The above mentioned sections *(see Fig. 2)* were defined at the portal of our faculty.
6. Quotations of published works. Standards of published contributions are guaranteed by editors, referees and/or by opponents. ISSN points out the high level of whole publication platform. Therefore, the faculties should do everything to get it. The easiest way is to fulfill all necessary requirements and ask university libraries for help.
7. Editors. Scientific committee at any included faculty should be constituted to verify quality of individual education works. We preferred to nominate the same committees that already exist on faculties. Usually the works covering topics of at least one teaching term are reviewed and officially recognized using the same conditions as printed publications. The smaller works, usually not exceeding topic of one lecture or exercise, are reviewed by referees of appropriate study field so the quality is ensured in both cases.
8. Authors. All members of pedagogical staff at the faculty are recognized as potential authors. We decided to not restrict range of them as everyone participates in education process and everyone may also use some form of multimedia to improve it. There are 291 authors registered in the author list.
9. Users. There is no limitation on range of published content consumers as well. Portal is worldwide available and the only limitations are specified by the authors. They decide which group of users will have access to the full version of published work.
10. Technical support. Support for authors and users should be offered at home faculties. To support them the series of manuals was prepared. Processing of movies, audio and other multimedia content is offered to every author by the personnel of Institute of Medical informatics.

Administration and utilization

Administration of education portal requires regular monitoring and updating of all relevant information offered to pedagogical

staff. Although it is severe and time consuming task, it should be done as best as possible to ensure quality of support, information and satisfaction of users. Authors from non technical branches are often not well computer skilled or their knowledge is not sufficient to prepare multimedia content. Presented concept of multimedia support therefore represents an ideal solution as it doesn't require special training and/or preparation for publication. The present results show that the authors realize advantages of electronic education forms despite of initial fears from technical complications. The interest in portal continuously grows and the evidence is positive user response. Next charts summarize average visit rates and grow of portal registered users.

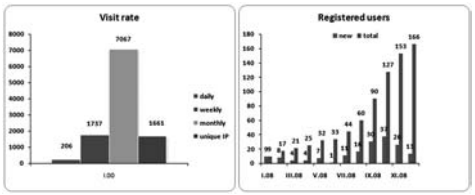


Figure 5: Average portal visit rates (left) and continuous growth of registered users during 2008 (right).

Authors usually ask for information about design that should be used to prepare their works and how such works can be published. Considering authors' working load and computer grammar, we fully support them by the Institute of Medical Informatics staff. A review of published works is shown on next charts.

Number of published works continuously grows. Higher growth is expected with the income of new teaching term as the teachers update their electronic presentations and prepare them for publication at the portal. Some of them work on completely new themes and multimedia contents. Positive message is that this on-line form motivates them to prepare not only extensive but also qualitative better materials. The authors are motivated also by growing interest of students that ask even more and more for electronic material including lectures, multimedia presentations and other works. Both groups of users can easily use services of the portal to satisfy their needs.

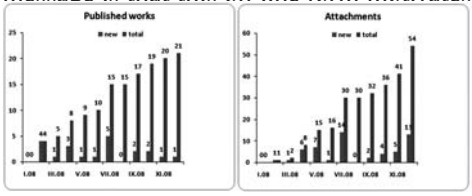


Figure 6: Number of published works (left) and number of attachments in published works (right).

Conclusion

One of the unquestionable advantages of presented portal concept to share education material is simple publication management. Any published materials can be protected and accessed to selected group of users. The problem that was not solved until now is unique authentication of users. To improve further development we recommend restricting permissions for anonymous users to send paper function. Portal of Multimedia support in education of medical and health care disciplines was successfully integrated into the information structures of Faculty in Medicine in Košice. Initial apprehensions from complexity of multimedia work preparation were minimized and authors moves from simple presentations to more advanced forms of e-learning. Doubts about advantages leading to change from traditional forms of education to those electronic were confuted and we also suggest using of modern education forms to improve relationship and communication between teachers and students.

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19 INFORMATION PORTAL FOR STUDENTS AND TEACHERS

M. Makovník [1], A. Thurzo [2], V. Hanúsková [3], Ľ. Gašpar [1], I. Očadlík [1], A. Dukát [1]

[1] Second Department of Internal medicine, Medical faculty, University Hospital Bratislava, Slovakia
[2] Clinic of dentistry and maxilofacial surgery, Medical faculty, St. Elizabeth Institute of oncology, Slovakia
[3] Medical student's association Bratislava

Abstract
Project BSM on-line was started in 2004 as a follower of the old Bratislava medical students association's web pages. It's a result of the needs of students and teachers on the Medical faculty of the Comenius University in Bratislava. It passed many stages of change and is developing constantly. Nowadays it has 2,442 registered users and is very popular between students despite the enhancements made recently on the Medical faculty's official sites.

Keywords
e-learning, information portal, stuff sharing, PHP, MySQL

Introduction

Nowadays, the most simple, effective and low-cost way of spreading information is Internet. New technologies become old quickly. It's difficult to design a well-arranged and functional system, which should be user-friendly. Tools that are not simple, dynamic and fast to operate are convicted to extinction. A good example is programming in HTML code. Student has periods when he is time-free and periods when he is overloaded. Information portal and its functions have to be flexible enough to survive phases of inactivity of its administrators. HTML code does not meet these requirements. Probably the best choice today is a combination of PHP engine and MySQL database. We had chosen it as well. Disadvantage of this selection is that we have cut out ourselves as programmers, became dependent from professionals, and our zero costs have risen.

Goals of The Project

The most important engine of development has always been demand. In the beginning it was the demand for exam questions and time-schedules. Later more specific services were wanted. The goal of the project is to digitize infrastructure of the faculty of medicine in Bratislava (LF UK), its ways of teaching that had not been significantly changed since the 19th century and to set conditions for creating a new generation of physicians with adequate computer skills. We also want to prove that moving the services to web platform helps students as well as the faculty. Processes will get faster, simpler and more effective. The standard of study and services given by faculty would get higher. The main brake is unwillingness from administrative employees in our faculty. The times in which were students used to manually copy the time-schedules from the notice board are gone forever. Who is nowadays still thinking about communicating through wall gazette as the only alterna-

tive, must be joking. The problem is, there are still some jokers abroad.

Some services offered today

Notice board – a kind of personificated bulletin board. It shows always after login to the website. Only persons with rights can add news through web interface. They can set up duration in which news will be active, set up target groups and add also a picture or enclosures. Some employees from study departement and theoretical institutes are also using this service.

Materials – exam questions, notes and guidelines ordered by categories. Lectures can be published only with author's agreement and that is probably the reason why is there so few of them. Maybe teachers are afraid that there will be a dramatic decrease of students attending their lectures after they publish their lecture presentations. Only persons with rights can add new materials.

Time-schedules – most important is the quick actualization when the study department publishes them late.

Official forms– official application forms for faculty, library etc. published either in MS Word format or printable document format (PDF).

Spasmus – on-line form of journal made by students and employees of faculty. The goal is to publish the best articles mostly with medical topics at least one time per term in paper form. Articles are published after checking by editorial stuff and can be commented by users.

Voting – the simplest way to check public opinions on LF UK. There are two types of voting in the project. In one of them we still use open source script – Advanced Poll 2.0.8. Users are not forced to login but from one computer only one vote can be made. New vote questions are given periodically. The second type of voting has traditionally questions that are not changing, concerning the best book, teacher (guru) and the worst teacher (terror). Users can vote also for Miss, Mr. and the best announcement. This module was made-to-measure and gives the actual list. The "worst teacher" uses to rapidly change at the end of exam periods. Results are reseted at the end of semester or year and archived.

Discussion forums – anonymous, non-anonymous, official and public forums in which are students and teachers communicating. If you don't know something and can't find it anywhere, ask. Somebody knows and gives you an advice. The rapid flux of comments is usually in the beginning of semesters and paradoxically during exam periods when students discuss exam questions. There is free speech on the forums and users can write nameless, if they want. The anonymity of the users is guaranteed by fact that web portal does not run physically on the servers of faculty. The BSM-Online project respects the right for liberty of speech, which is anchored in the bylaw of University. Censored by administrators are only subscriptions that are unworthy as expression of university students. Many teachers do not like this fact. In case of severe insults, the dean of the faculty can be asked to unhide the identity of the user. The right for protection of personal data must be strictly kept [2]. During past four years there was no such case.

Bourse – advertisements with the possibility of searching by keywords. They are classified to categories and automatically deleted after six months. Seller can choose the way of communication with the potentional buyer as well as delete his advertisement. There are approximately 10 adds per day. 90 % of them are materials for studying. This service „cleaned" all boards and walls on the faculty where advertisements were posted before.

Galleries – photos from social events on faculty.

Quick messages – choice for safe communication with other registered users.

Management of summer internships – module developed for the Club of foreign activities. It allows students signing for summer

internships in foreign countries, choosing country, etc. The exchange officers are managing the sign forms through this tool. Also reviews from interships, galleries, announcements etc. are published here.
Online testing for biochemistry examination – service realized in cooperation with assoc. Prof. Líška from the Institute of Medical Chemistry, Biochemistry and Clinical Biochemistry. Module gives the students opportunity to test themselves for the written part of the examination. They can choose the sources and the form is equal to that in official examination. Questions in which the user did not succeed in past are preferred by the system before random sampling.
Wifi – there are two Wifi networks in the area of faculty these days. Official university network was built a year after the students' one financed by the faculty. Both of them have 802.1x user authentification. They use EAP protocol and cover approximately half of the area. Only registered users are able to use the students' network, because radius authentification server operates with the database of users registered in the portal.
Signing for PVP and summer mandatory praxis – services are accessible but the lack of interest from the study department is preventing their usage. Students have to come personally in working hours and sign the paper. Summer mandatory praxis can be signed usually only in summer holiday. Students have to travel to Bratislava from eg. Košice (450 km) to sign the form, if they want to realize internship in their home city.
The list of absolvents of LF UK – service realized with the cooperation of the faculty. The database digitization was ordered and paid by the LFUK. Now it is possible to find all the 18,752 absolvents of LFUK since 1919. Accessible is the graduation year, study program, by women married during the school maiden name.

Methods

BSM ON-LINE introduces a system of webpages made on the basis of PHP and MySQL database. Privacy of users is covered by SSL protocol with own certificate. Because of some negative experiences we hardly-ever use open source projects. Today voting was made by open source script Advanced Poll 2.0.8. [3]. Although open source scripts are attractive for zero price and are widely used, they do not satisfy our needs and are grateful targets for spam robots. Good example was the quick chat "TagBox" [4]. It was used for a year but it had to be removed because it was flooded with advertisement spam.
System is able to run itself with the basic functions, the rest are modules. We use professional programmers for creating modules. Although the project is still in development, it is fully functional. There have never been made changes to the system control interface, which maybe stayed more intuitive traditional than logical. Changing of system control interface would frustrate the older users, which claim that the actual control has its own logic, as well as medicine.
To avoid cheaters and robots, for registering in the beginning of the project, users had to send an SMS to an administrator's private cellular phone. The administrator had to check the real existence of the user as a student of LF UK before manually allowing him to complete the registration. It was a challenge for time and money, but it was the only guarantee of keeping order in the database. Later with the cooperation of rectorate of the Comenius University in Bratislava we launched automatic identification via ISIC cards. According to the contract signed with medical student association in Bratislava (BSM) are the on-line services of BSM online available only for BSM members. All gains from the project are returned back and used for development. After the user signs a form he is staying on a waiting list. He becomes full user after his real existence is checked and the membership due to BSM is paid. Doctorands, students of the sixth class and employees do not have to pay the fee. The demand for services is on our faculty mostly from the students.

Almost every comment, material and news can be added through web interface. User does not have to know PHP, HTML or other programming languages. However, some texts can be enriched with HTML code that will be shown correctly. Unfortunately most users are passive consumers. Active and chronic contributors are only 1% of all. In our conditions it is not possible to pay an employee who would chase materials for every study group and class. In addition, the system would be dependent on one person, what never pays out. The reward for contributors is only the warm feeling from helping other people and assigned user rights, but as long as such people exist, BSM online will stick together.

Results

Today BSM ON-LINE has 2,442 registered users. Among them 1216 are members of BSM. There are 211 discussion forums with 76,873 comments. 1,552 files are shared. Approximately 29,000 pages are requested daily.

Conclusion

If the project has to be used, it must be accessible. There is always closer to the computer than to the message board. Although the number of accessible computers in our faculty is poor, there is high demand for the project. These days many students have their own computers with Internet connections at home or on the college. Computer skills of the newbies are higher year to year and after they start to study, they anticipate a functional information system.

Project BSM ON-LINE passed through many changes and improvements. It has learned to survive despite the scotomisation by a group of faculty employees. It preserved traditional academical independence and liberty of speech. Despite the pressure from students and commerce, it did not change to a chat portal or social network and stayed faithful to education, faculty and medical students. We hope the future brings more cooperation with our own faculty.

Picture 1: Introduction screen of the e-learning information portal

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20 ENHANCEMENTS OF E-LEARNING: E-PAYMENT AND ISIC/ITIC IDENTIFICATION

A. Thurzo [1], V. Hanúsková [2], M. Makovník [3], I. Očadlík [3]

[1] Department of Dentistry and Maxillofacial Surgery of Medical Faculty, Comenius University and St.Elisabeth Oncology Institute, Bratislava, Slovakia
[2] Association of medical students in Bratislava Medical Faculty, Comenius University, Bratislava, Slovakia
[3] 2nd Department of Internal Medicine, Medical Faculty, Comenius University, Bratislava, Slovakia

Abstract
The article describes two particular enhancements of academic on-line educational project of medical students – project BSM ON-LINE (www.BSM.sk). ePayment and chip identification of students and teachers are after first year in terrain. Authors describe their experience with development and implementation of these technologies as well as the flexible cooperation with central data base operators of Comenius University. They explain the motives of development of these features and also the unpredicted assets and further perspectives of both technologies. In the conclusion they present their future plans with described know-how of ePayment and contactless identification by means of the chips it the ISIC/ITIC cards. Together with previous, the authors suggest simple possibilities for taking advantage of described technologies in basic administrative and educational processes in the medical faculty.

Keywords
ePayment, ISIC, ITIC, students' identification card, chip contactless identification

Introduction

ePayment

Each complex e-learning portal which was based on limited freeware services has to face the issue of expenses linked to its maintaining and further development. Costs rise proportionally to popularity of portal, level of its safety and hardware maintenance. Whether the main sponsor of project is faculty or non-profit organization, as in our case *Association of medical students in Bratislava*, project can't ignore the financial aspects for its stable development. Most of the faculties try not to spend much money for support of e-learning. The main motive should be the higher effectiveness of provided service. Every faculty provides many support/administrative and complementary services beyond education, which are connected with expenses. Many of them are already paid. Electronic solution of administration will be desirable supplement of e-solutions in academic field.

Our project – "BSM on-line" is not financed by our faculty. We had to solve the costs for server maintenance, bills for domain and SSL certificate as well as salary for professionals in programming for further development and creation of new services. Despite achievement of the prestigious award in Slovak-wide contest ITAPA 2006, the sponsorship was not regular and easy to find. The sponsorship was not appropriate way of financing because of its irregularity and unreliability. That is why we have implemented ePayment as an imminent priority for further project existence and development. We agreed with *Association of medical students in Bratislava* on cooperation in

digitalization of membership and payments of membership fees. Every medical student can extend his/her membership in BSM through internet banking.

ON-LINE identification

Reliable on-line identification of students and teachers is one of the most important conditions for many high performing functions of e-learning systems. Either it is presence or testing on-line system, the user identification by higher authority is crucial. We create a simple interface for ISIC/ITIC chip card identification. We succeed already in the 2006 due to unique cooperation, competency and flexibility of the employees of Comenius University centre for computer services. In our case, the higher authority was the Comenius University, which was able to approve identity of our users. We create the interface between the our project and central database of university, which is enabling simple and fast verifying of students status based on the number of students ISIC/ITIC card. On this interface was built simple software, which was communicating between local PC and USB-connected reader of MIFARE chip cards. The PC was connected with verification function of project, and so indirectly with central database of persons in UK.

GOALS

Our intention during the implementation of electronic payments to our e-learning project was to win users discouraged by necessity of personal visit of BSM headquarters for extending the membership. E-payment was greatly appreciated especially during exam periods and by students from distant places. Electronic payment system also makes system and management more transparent and significantly increases the availability of services.

We wanted to give users an option to pay by their credit cards. Unfortunately it showed that the "CardPay" service is offered only by the Tatrabanka bank that required the solution including the bank account in this bank.

Another goal was to create a fully functional prototype of universal academic identification and take advantage of the fact that each student and teacher of the university is the holder of ISIC/ITIC card. These cards are standard cards with MIFARE chip. Creating the solution of the academic identification by the means of the software and hardware prototype that allows realisation of further cascade of other e-learning

Proceeding and technical background

ePAYMENT

At first there was public inquiry concerned about the most frequent used bank among users. The most frequently preferred bank was Slovenská sporiteľňa. Therefore all e-payments in BSM-Online project are based on Sporopay system offered by Slovenská sporiteľňa. Payment itself is made in the bank's website and is user-friendly. The payment is realized with the GRID card after redirection to website. When the payment is realized user is automatically redirected back to the BSM-Online website. Accuracy of signature is then checked. Registered user is able to extend his membership after its expiration with the possibility for selection of period. If user has the mail-banking service activated result of successful payment is sent to him. We are informed about every payment by email sent from bank. Data about client are then stored in MySQL database.

As the preferences of the students showed, the Sporopay system was the most widespread and due to this we implemented this particular scheme. We programmed a simple Graphic User Interface for payment of membership. The operation of "payment" is actually realized on the web site of the bank. This is why the questions of security are partially answered by this fact. Payment realized in the web browser window of the bank e-payment portal is typical for all internet

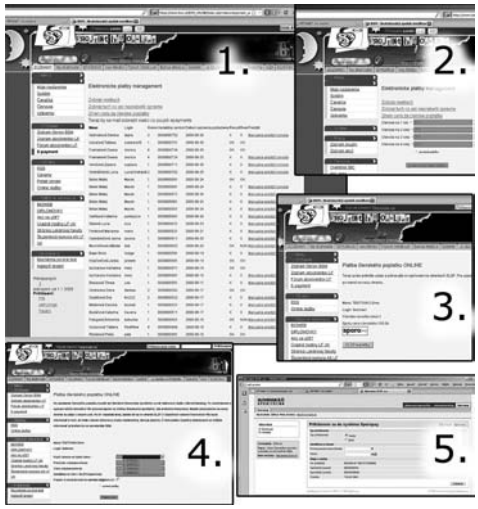

Fig. 1: enhancement of e-payment in e-learning project BSM ON-LINE.

1) ADMIN list of payments – successful, rejected of unfinished
2) ADMIN user-friendly settings for payment adjustment
3) View form student interface – options of payment through SPOROPAY
4) View form student – options of membership payment
5) Browser window of the bank where the payment is done

payments through Sporopay. This interface we programmed allows the member of the BSM to prolong his/her membership when expired. He/she could choose for how many years to prolong. After payment the information email is automatically sent. The data are send on-line in form with a special security signature that consist from specific key, variable and specific symbol, bank identification and client identification. Signature is encrypted by library mcrypt 3DES in CBC mode using sha1 algorithm. This particular software part has been programmed by 4th grade medical student – Veronika Hanúsková. Client after redirecting on the bank-web confirms the operation by the GRID card. Afterward he is redirected back to our e-learning portal.

As mentioned in introduction our identification with chip cards is based on electronic interface for verification between our e-learning project and Central database of persons of the university. This interface allows on-line verification of the student status on the basics of student's ISIC/ITIC card. The software is a superstructure to this interface. The software is installed on local PC connected to the internet. To this PC is card reader connected by USB port. By using of described verification function the number of the card is verified. The key moment is the communication between project BSM ON-LINE and central database of university persons.

Table 1: Possible situations that could occur after correct confirmation of the transaction by the user (student, employee, parent of the student etc).

	Result	Real	Status of transaction	Situation description
1.	NOK	NOK	Not accepted by bank, **not realized**	***Client certified rejection of the payment.***
2.	OK	NOK	Accepted by bank, **not realized**	***Client certified rejection of the payment. but:*** *A. due to the reason of insufficient funds in the account the transaction has been aborted,* *B. due to the bank information system that is not capable to supply the information in 3s limit (technical problem in connectivity with transactional core system).****
3.	OK	OK	Accepted by bank, **realized**	***Transaction has been accomplished.***

**** E-learning portal has to be in this case wait for confirmative email..*

In all cases above is the e-learning portal informed about the result of transaction by email.

ON-LINE interface (cooperation with the Comenius University – data flow). There is a simple explanation of the interaction between integrated systems.

Fig. 2: Identification of the incoming student (left), ISIC card (right).

Hardware interface – reader (developed software as system upgrade of described online interface and USB card reader)
We labelled the software as "BSM ISIC". Program has its own installer and was tested in Windows 98, Windows 2000 and Windows XP environment. It is possible to set its automatic start-up with computer turning on. We have no experience in testing under Vista and Windows 7 yet.

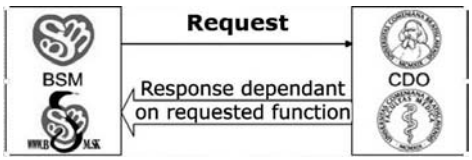

Fig. 3. Simplified scheme of cooperation with Comenius university

Curiosity

Many students get used to identify automatically without asking during contactless identification, for which we have borrowed two USB readers. Reader is tested as an identification of membership of students entering the area BSM. In relationship to this we noticed decrease of theft. And also interactive listing of last identifications on webpage was very popular. Everybody can see who is present in BSM.
Habit of students to place ISIC in wallet revealed that chip MIFARE contains many other cards – for example the public transportation. It reads its serial numbers instead of ISIC. The alternative form of identification can be based on this.

Conclusion

Current importance and perspective of both complements is evident. Slightly questionable remains the perspective of chip cards as identifiers, especially regarding new technologies working with biometric data. It is possible that era of current chip cards for identification that is in our academic just starting, will end sooner, than universities implement electronic identification with ISIC/ITIC cards to real academic life. Important factor for chip identification can be barriers between academic, state and private information databases, which will be hard to link and share information about clients/citizens/students legally and safely. So it will remain demand of one carrier – for example chip card.
This will cause a demand for universal portable data carrier – chip/SSD card/USB dongle, where can be placed several information from several institutions. We can expect a small reduction in number of cards in next year's. On ISIC card can be now recorded besides personal data also academic status and data record of Transportation Company.
If we assess ISIC/ITIC cards not from view of identifier, but from the view of data carrier, the perspective would not be ideal also. ISIC in role of eIndex is absolutely not ideal. Card can be lost or damaged. University has to have backup, safely stored information. There is no reason to provide information in this form, especially when it is not possible to guarantee safety. University can provide data through web page. Students' records are stored and provided differently, more safely. Chip card is important as data carrier in institutions where there are not central information databases, or the cooperation of systems failed.
Electronic payments will notice significant boom in next decade and from our point of view it will be necessary to follow them.

They can significantly improve comfort for both sides, increase transparency and reduce bureaucracy. If these are aims of academic representatives, implementation of electronic payments to infrastructure is only a question of time.
Our system of electronic payments is ready to use also in different areas, for example already mentioned payments for foreign clerkships. We will consider integration of PayPal and CardPay services in future, which will spread opportunities of electronic payments among more students.

Plans to future a perspectives of utilization

Innovations and bureaucracy does not go together. It is important to implement students' feedback when planning e-solutions in the university. It is often the impulse of the students that launch an innovation of traditional processes. Some academic honorabiles should abandon the concept where they expect the faculty administrative stuff to come-up with e-innovation and transformation. In most of the world the traditional bureaucracy is understood as the most frequent brake of innovation of administrative. Innovation of educational concepts is not that difficult mostly because of openness and flexibility of both – the students and teachers.
When the academic decision makers will fully understand the perspective of eLearning, define goals and establish motivational rules for creating digital content the huge self-starter will launch. The key technologies are here all around; the proper conditions for electronic publication should be enforced.
Many faculties that used to be the Mecca of development are now more frequently emphasizing their age and traditions as the attributes of quality. Many stone universities remain based on the technologies of previous millennium with no remorse. Sometime the annually increasing hunger for IT technology advancement from the students they understand in a wrong way. Students will always request the innovations and without dialogue with them no optimal IT innovation could be implemented. A faculty that listens to its students and has even the leaders aware of the mentioned will experience a rapid growth in the next decades. A faculty not capable of innovation of its administrative should reconsider its ambitions in eLearning implementation, which is task considerably more difficult.
Change of paradigm of education? As mentioned by Dr. Danuše Bauerová, Ph.D [1], it is necessary to keep-up with current trends in education and not to lag behind modern information technologies. How would look like the medical treatment today if we would not abandon the medieval paradigm, that illness origin from blood? Until today we would be searching for more advanced bloodletting. Similar is in education. Consider by yourselves how much the principles of education differ from the medieval ones?

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E-LEARNING IN LANGUAGE TEACHING AT MEDICAL FACULTIES

21

P. Nečas[1], K. Hušková[1], Ž. Šlemarová[1], J. Zahornadský[2]

[1] Department of Languages, Faculty of Medicine in Hradec Králové, Charles University in Prague
[2] Institute of Formal and Applied Linguistics, Faculty of Mathematics and Physics, Charles University in Prague

Abstract
The authors introduce a new teaching material for medical students. It is a MyQSL database for the practice of Latin terminology, medical English, Czech for foreigners and other subjects. The database was realized in cooperation with the Faculty of Mathematics and Physics (Charles University in Prague).

Keywords
e-learning, database, vocabulary, medical Latin terminology, medical English (English for Special Purposes), Czech for foreigners

Introduction

Electronic and web materials have already been used for several years at the Charles University Faculty of Medicine in Hradec Kralove. New, however, is the interactive website database called *Examen* aimed at practicing vocabulary . The first impulses and ideas to create such a database came from general medicine students, for whom it was necessary to master a large amount of Latin terminology from scientific fields such as anatomy, clinical subjects and pathology. The database application itself had to be made at the Faculty of Mathematics and Physics, Charles University in Prague .

From a technical point of view, the database was set up on the basis of SQL (precisely MySQL) to which a web application in PHP language is connected. The whole content is presented as a website accessible on-line from anywhere. Internet speed demand is minimal and the users can access the website by using just a mobile phone, thus making it possible to study vocabulary even on a train, for example. The database includes all data needed for practicing and examining vocabulary acquisition and could be expanded or corrected any time from anywhere by administrators using a specially designed interface. Due to the user-friendly nature of the program, teachers and even certain chosen students can become administrators. It is not only very easy to correct any mistakes or to upload new data, but all users can immediately see the latest changes and there is no need to download any updates. For examining and practicing itself it is enough to have an internet browser which recognizes and interprets valid web pages in XHTML data format using basic CSS and JavaScript. All modern browsers, such as Firefox, Opera, Safari, Chrome, Konqueror etc., should be suitable [1].

One of the goals of Latin instruction, besides memorizing basic medical terms, is to develop and improve the students' logical thinking skills, to combine words to make phrases, and to formulate possible diagnoses. In creating this database we also wanted to set up, besides basic sections (such as *Latin/Greek Expression* and *Czech Definition*), specific linguistic sections entitled *Grammar Info 1* and *Grammar Info 2*. The former section contains genitives (of nouns and one termination third declension

adjectives) or nominative forms of all genders (including all remaining types of adjectives). The latter section provides details about the genders of nouns and adjective types. The next section is *Remarks*. Here users can find various details and warnings about declension irregularities, common mistakes and irregular gender classifications. For better understanding of the meaning we added typical phrases to stress the word's usage within specific contexts. We also include possible synonyms and, if necessary, illustrations concerning developmental tendencies within synonymous pairs (e.g. *cavum* vs. *cavitas*). Students are also warned about negative linguistic transfer, about not assuming a one-to-one correspondence between Czech and Latin lexical items. Latin morphophonological shifts are also emphasized here because students need to be familiar with diachronic changes in anatomical terminology (e.g. the older form *chorioideus* opposed to the newer *choroideus*).

The amount of Latin medical terminology is almost unlimited and therefore we have chosen one of the most widely used textbooks, *Lékařská terminologie* [4], as the main source of material. Because this textbook is relatively old, we are aware of the fact that some Czech and Latin terms do not reflect current medical usage. Some words which are no longer used are, e.g., Czech *vidlák*, *kostižer* or Latin *substantia adamantina*, *substantia eburnea*, *foramen occipitale magnum*, etc. Bearing this in mind it is absolutely essential to cooperate with doctors on this matter.

The overall Latin database is divided into 25 chapters based on the structure of the above mentioned textbook and our own internal teaching materials. The question arises as to how we can help students learn such a large number of medical terms efficiently. One of the suggested solutions could be to add pictures which would aid in memory association, and in the case of various diseases the pictures would also reinforce better overall understanding (e.g. *emphysema pulmonum*, *pemphigus*, *panaritium*) [5]. A picture database is however still under discussion due to copyright considerations.

Similar to the Latin sections, the medical English section works based on the textbook *Professional English in Use – Medicine* [6]. There are 50 database chapters. English teaching focuses mainly on communication between doctors and patients and therefore the database content is different to that of Latin. There is not such an emphasis on explaining professional medical terms (this knowledge is supposed to be gained from Latin lessons) but rather on learning and practicing lay vocabulary necessary during doctor-patient dialogues. The majority of patients lack the knowledge of professional terms and doctors need to be familiar with lay speech.

In contrast to Latin, English is supposed to be acquired during secondary school education. Due to the analytical nature of English, it is not necessary to analyze grammar categories as in Latin. Thus we created only these sections in the database: *English Defi-*

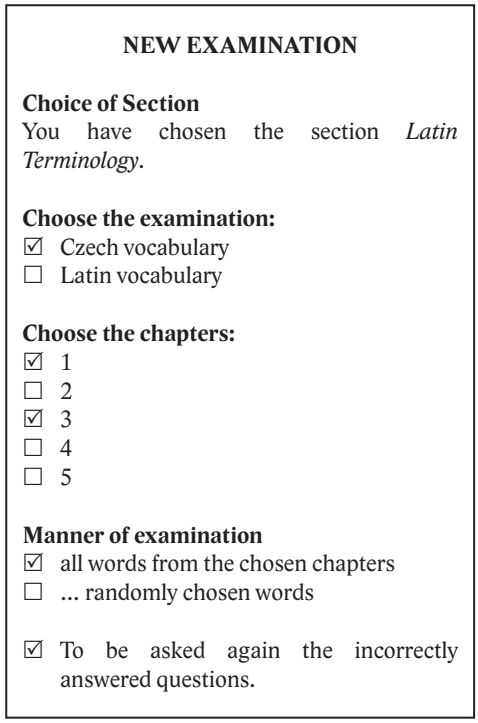

Figure 1: Illustration of the Examen database page – New examination (student's choice of chapters and manner of examination)

vomitus		
Czech Definition	**Grammar Info 1**	**Grammar Info 2**
☑ zvracení ☐ protětí žíly, otevření žíly ☐ řídký, vzácný ☐ podprůměrný vzrůst ☐ kost klíční ☐ nadměrné močení ☐ bodcovitý ☐ uzdravený, vyléčený ☐ úplavice močová	☐ -ātis ☐ -ium ☑ -ūs ☐ -ae ☐ -rtis ☐ -acis	☐ adj1 + 2 ☑ m. ☐ numeral ☐ n. ☐ konj1 ☐ f.

Figure 2: Illustration of the Examen database page – Examination (choosing correct answers in each category)[4]

nition, *Czech Definition* and *Remarks*. The *Remarks* section includes information similar to modern British dictionaries, where information such as parts of speech, relevant phrases or entire sentences are provided as examples. Besides memorizing individual lexical items, database users also have the opportunity to learn words within the context of medicine. When translating English words into Czech, we had to limit the definitions to only those related to medicine.

In the example of the Latin version, we will demonstrate how students work with the database. First, students choose a section of vocabulary on which they want to be tested (one or more chapters). Students also decide on whether they want to practice passive or active vocabulary, on the amount of chosen vocabulary and on whether they want to be asked again the questions they got wrong *(see Figure 1)*. Afterwards, the system displays a vocabulary item and offers several translation options *(see Figure 2)*.

Students mark their choices and the system confirms it or corrects it in the case of a mistake. A running score is shown in the table *(see Figure 3)*.

The main advantage of the database is its versatility. We are preparing versions of medical English and Latin terminology for students of other study programs, Czech-English/English-Czech synonyms and antonyms and also Czech for foreigners (general and medical vocabulary). The database can be used also in specific medical subjects in which terminology doublets must be mastered, e.g. in clinical immunology (CD classifications). Great opportunities are offered in learning eponymic terms which cause troubles for students but which are essential in clinical subjects, for example the term *Graves' disease* denotes *a common form of hyperthyroidism*.

We are considering adding iconic documents and recorded files, files which would include the pronunciation of English terms for Czech students and pronunciation of Czech medical terms and phrases for foreign students.

The e-learning program is supposed to help students master medical terms and vocabulary, including linguistic categories which can enhance language learning skills. One important pedagogical aspect of the project lies in student-teacher cooperation in developing the database.

Number incorrect	2
Number correct	6
Total number of questions to be answered	426
Running score	75.00 %
You are on question number:	9

Figure 3: Illustration of the Examen database page – Examination (scoring)

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1 Database *Examen* was supported by *Innovation and Modernization of Language Teaching at Medical Faculties* grant No. 478/2008 within the Ministry of Education.

2 A similar program is used for example for New Testament Greek lessons at the Hussite Theological Faculty [2], Charles University in Prague. See e-learning studies in classical languages [3].

3 The Czech noun *úplavice* has to be modified by a specific adjective: *úplavice cukrová = diabetes mellitus*, *úplavice střevní = dysenteria*.

4 Czech Definition section offers correct translation *(vomiting)* and also misleading options: *venesection, rare, hyposomia, clavicle, polyuria, styloid, healed, diabetes, contraction*.

5 Vocabulary is based on internal materials: Šlemarová, *Angličtina pro zdravotní sestry*, materials developed within the project ESF (Czech Ministry of Education) *EU sestra* No. 19452.

6 Vocabulary is based on internal materials: K. Hušková, *Latinská terminologie,* materials developed within the project ESF (Czech Ministry of Education) *EU sestra* No. 19452.

INTERACTIVE MUSCLE TABLES

22

Z. Dvorakova, L. Klimpera, L. Klucinova, J. Otahal

Faculty of Physical Education and Sport, Charles University in Prague

Abstract
This article gives information about an e-learning application created by students of physiotherapy at Charles University, Faculty of Physical Education and Sport, which is used for interactive learning of anatomy.

Keywords
muscle, interactive, e-learning, software, teaching, searching

The interactive muscle tables represent a web-based "e-learning" application which is used for the learning of human anatomy. It offers an interactive tabular overview, searching and sorting according to different factors, and also checking of knowledge of muscle anatomy using different types of test. The application si free on the web address http://www.physiotherapy.cz/im/
In the application the following information about each muscle can be found: Latin nomenclature, Czech nomenclature, beginning, insertion, inervation, function, and support function. The application is open, so it is possible to add further information about each muscle. The first time This possibility was used for the first time to put in information about muscle strengthening using the PNF (proprioceptive neuromuscular facilitation) physiotherapeutical method.
Every information about muscles (nomenclature, beginning, insertion, inervation, function, etc.) is put into a hierarchic tree structure. This hierarchic structure exactly determines the location of each information in the whole organism. This location is displayed every time you go across the information by the mouse pointer (for example after going across "spina scapulae", "skeleton appendiculare › ossa membri superioris › cingulum membri superioris › scapula › spina scapulae" is displayed).

Part of the application

The application is composed of several parts (screens):

Opening screen

On the opening screen there you can find a list of updated information about development of the application and also a contact form for sending a message.

Searching

You can use full-text searching (fulltextové vyhledávání) in the database according to all information (nomenclature, beginning, insertion, etc.) on the "vyhledávání"

(searching) screen. The possibility to search in all "branches" of the hierarchic tree structure is a great advantage of the application. When you are searching, it is not necessary to write only the concrete insertion of a muscle (for example "spina scapulae"), but you can write the name of any superior "branch" (for example "scapula") – and the application finds all muscles which begin or end at scapula.

So, you can let quickly display all muscles:

- which are inervated by a concrete nerve,
- of an upper limb,
- which do flexion in the shoulder joint,
- etc.

Lists

The "výpisy" (lists) screen gives you the possibility of displaying a summary tabular list of chosen information about chosen muscle groups.
For example you can let display:

- Czech nomenclature and inervation of all muscles of the upper limb,
- Latin nomenclature, beginning, insertion and function of pelvitrochanteric muscles,
- Latin nomenclature, function and inervation of all muscles which are placed in the database.

It is possible to display any combination of information.
It is also possible to display information in the form of a table which can be printed.

Testing

The "testování" (testing) screen is also based on an interactive principle.
The user can choose:

- which information he will be tested on (beginning, insertion, inervation, etc.),
- how many pieces information will be hidden,
- how many questions will be contained in the test,
- muscles group which will be tested,
- type of test – you can choose from 3 different types of tests:
  1. "secret array" – the application hides some information about a muscle and the user fills in the missing information,
  2. "variants" – the user can choose from 3 different variants where only one is right,
  3. "yes/no" – the application offers to the user an answer and the user has to decide if the answer was right or wrong.

Future plans to develop the application

We would like to add photos of muscles and bones to the application. We would like to have interactive photos in the application, in order to make it possible to see more

information about the structure of muscles or bones, when going across the photo by the mouse pointer.
We would also like to add to the application more information from physiotherapy.

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Authoring and implementing team

Supervison: MUDr. Jakub Otahal, Ph.D.
Idea & Software: Bc. Lukáš Klimpera
Database of muscles: Mgr. Katerina Cernikova, Mgr. Zuzana Dvorakova, Bc. Hana Kalivodova, Bc. Lenka Klucinova, Dana Kumpostova, Bc. Lucie Simkova, Bc. Anna Sulcova

NAME INDEX

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Editors:
Daniel Schwarz
Ladislav Dušek
Stanislav Štípek
Vladimír Mihál
Chris Paton

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Radim Šustr

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