Towards Expert Content Sharing in Medical Education

E. Kaldoudi, M. Papaioakeim, P.M. Bamidis, V. Vargemezis

Oral presentation and full paper publication in the proceedings of

INTED2008: International Technology, Education and Development Conference, Valencia, March 3-5, 2008

INTED2008 Abstracts Book, ISBN: 978-84-612-0192-1
INTED2008 Proceedings, ISBN: 978-84-612-0190-7

International Association of Technology, Education and Development, http://www.iated.org/

TOWARDS EXPERT CONTENT SHARING IN MEDICAL EDUCATION

Eleni Kaldoudi
School of Medicine, Democritus University of Thrace
Alexandroupolis/Greece
kaldoudi@med.duth.gr

Miltiadis Papaioakeim
School of Medicine, Democritus University of Thrace
Alexandroupolis/Greece
mpapaeoa@med.duth.gr

Panagiotis M. Bamidis
School of Medicine, Aristotle University of Thessaloniki
Thessaloniki/Greece
bamidis@med.auth.gr

Vassilis Vargemezis
School of Medicine, Democritus University of Thrace
Alexandroupolis/Greece
vargem@med.duth.gr

Abstract

The current enormous expansion in knowledge relevant to the medical practice constitutes a fundamental challenge to the educational mission of medical faculties. Medical academic institutions are increasingly required to invest in order to enrich their curricula with courses given by external experts, while experts working within an academic institution often restrict their state-of-the-art knowledge to a very limited audience. The aim of this paper is to elaborate on pedagogical, technical, and standardization issues towards an infrastructure that enables the sharing of state-of-the-art digital medical educational content among medical educators in higher academic institutions. In this context educational content is regarded as individual educational objects or collections of such with the following characteristics: (a) highly specialized, advanced and pedagogically sound; (b) developed by a recognized expert in the field; and (c) formally described with standard metadata. Medical educational content may include traditional instructional learning objects, as well as objects related to active learning approaches (such problem/case/inquiry/evidence based learning), and objects related to novel experiential teaching and studying techniques (role/game based learning). Additionally, the content may cover the whole range of types, from text files and presentations, to exam sheets, multimedia content, algorithms, teaching files, computer programs and game-based XML/HTML interactive objects. The paper discusses requirements for a flexible and adaptive metadata scheme to describe “content” in academic medical education, and presents two alternative approaches for educational content discovery and sharing via the web: (a) based on traditional isolated learning content management systems (LCMS); and (b) based on standardized architectures of federated LCMSs. Results and experiences gained from a pilot implementation are also presented.

Keywords
Medical education, e-learning, active learning, web collaboration, web2.0.

1. INTRODUCTION

Continuous advances in medicine and biological sciences lead to an ever expanding core knowledge relevant to the medical practice [1]. The most commonly cited evidence of this development is the need to acquaint medical students with the genetic basis of health and disease. In addition to understanding the structure of the human genome, aspiring physicians must master the processes that govern its expression, the ways in which those processes malfunction, and the chain of causation

that leads to disease. However, genomics is only one of several new domains of scientific knowledge that challenge the undergraduate education of physicians. The new field of proteomics covers the structure and function of proteins, particularly the ways in which proteins interact with one another in health and disease. Neuroscience is providing unparalleled new insights into the human mind and nervous system. Medicine's understanding of immunology and the inflammatory process is vastly greater than it was just a few decades ago. Epidemiology is providing understanding of the causes of disease long before underlying biochemical and genetic mechanisms are unearthed. The medical decision sciences can help physicians make more appropriate and cost-effective use of new and existing medical treatments. Last but not least, information and telecommunications technologies are currently entering the arena to play a vital role in the overall management of disease, patient and knowledge. All these areas of fundamental new knowledge are vital to understanding new diagnostic and therapeutic agents and approaches in the 21st century.

Thus, medical academic institutions are increasingly required to invest in order to enrich their curricula by developing overspecialized courses and corresponding educational content. It is evident that such an overspecialized expertise cannot be readily available in any medical academic institution, thus external experts have to be involved. More-over it cannot be easily available for professional medical doctors in their life-long continuous education. Although there is an abundance of up-to-date overspecialized medical educational content available in individual academic institutions, such content cannot at the moment be easily discovered, retrieved, re-used and thus shares across institutions and among medical teachers and students.

An increasing number of higher academic institutions are using a variety of web-based learning management tools to support their teaching. This gained experience indicates that similar web-based tools can support and enhance educational collaboration on a permanent basis among higher education and research institutions in medicine. Developers of e-learning around the world point out that access to comprehensive repositories of learning objects (LOs) and metadata is the crucial factor in the future of e-learning. Large international consortiums from research and the industry are aiming to build a common path for this vision of interoperability.

Indeed, a number of research projects are already dealing with the exchange of learning objects (LOs). ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe) was among the first consortiums that significantly contributed to technology-based education and sharing of training material. In the case of COSMOS (An Advanced Scientific Repository for Science Teaching and Learning) and COLDEX (The Collaborative Learning and Distributed Experimentation) researchers aim to expand learning resources among institutions for science instruction at secondary and university education. CELEBRATE (Context eLearning with Broadband Technologies) and SLOOP (Sharing Learning Objects in an Open Perspective) also aim to create a database of learning objects for either primary and secondary schools throughout Europe or for all levels of formal and non-formal education. Other projects like SeLeNe (Self e-learning Networks) have contributed to the formation of learning communities by relying on semantic metadata describing educational material. EdReNe (Educational Repositories Network) aims to facilitate access to the existing web-based repositories of learning resources by providing recommendations and useful tools. At a national level, UCeL (Universities' Collaboration in e-Learning) in UK attempts to collaboratively produce and share resources for medicine and other health-professional disciplines. Beyond the borders of Europe, in Canada, Australia, and the U.S., several initiatives have been already launched to create a university-level formal education platform providing reusable learning objects for all disciplines, like GEODE (Global Education Online Depository and Exchange), MERLOT (Multimedia Educational Resource for Learning and Online Teaching), CLOE (Co-operative Learning Object Exchange) and others. Over and above, ARIADNE together with Education Network Australia (EdNA Online), LORNET in Canada, MERLOT in the US, and NIME (National Institute of Multimedia Education) in Japan have established the Global Learning Objects Brokered Exchange (GLOBE) and committed to work collaboratively on a shared vision of ubiquitous access to quality educational content.

In order to support the emerging integrative curricula structures and exploit the over-specialized knowledge available by different experts, information technology can be employed to develop virtual distributed pools of autonomous specialized educational modules and provide the mechanisms for searching, retrieving, evaluating and rating, adapting and revising educational content in medicine and life sciences. Along these lines, the IntraMEDnet project (IntraMEDnet: A Mediterranean Research and Higher Education Intranet in Medical and Biological Sciences", funded by the EU Community

Initiative Programme INTERREG III ARCHIMED, European Regional Development Fund, 2006-2007) in the Eastern Mediterranean explores the idea of exchanging expert educational material among medical universities. Partners from 5 universities from 3 different European countries are setting out to develop a distributed pool of specialized educational modules in state-of-the-art scientific issues related to medicine and biological sciences. Over-specialized scientists from different institutions develop individually related educational modules which are then combined dynamically on a virtual e-classroom on the web in order to form integrated educational units. This paper discusses educational content in medicine, presents the IntraMEDnet approach for sharing this content and reflects on further advancements.

2. EDUCATIONAL CONTENT IN MEDICINE

Educational content in medicine includes a broad range of learning object types that address both aspects of medical education, namely theoretical instruction and clinical apprenticeship. Apart from educational content that is produced by academics and clinical teachers based on accepted scientific knowledge, medical education is greatly based on data and material produced in the hospital and the medical practice [2].

Another important factor that adds to the complexity and variability of medical educational content is the shift from traditional classroom-based teaching towards adult education [3]. The problem of the ever expanding knowledge, core and discipline as well, questions the educational approach where knowledge is seen as a quantity that can be transferred from one individual to another. Current approaches focus on adult education and situational learning and are active, self-directed and experiential, with a readjustment from process to product. The emerging view is of learning as an active, constructive, social, and self-reflective process with the aim to develop problem-processing skills, self-directed learning skills and group competence. These basic research findings on learning suggest the need for educational environments that are learner-centered and knowledge-rich, guided by assessment, and situated in a community of learners. Thus in current medical education, educational programs increasingly include case-based or problem-based learning and other small group instructional models, collaborative organizations to support student-faculty interactions, and technology-enhanced educational tools. Furthermore, new integrative curricula structures are proliferating in the form of multidisciplinary block courses in the basic sciences, blended clerkships (combining two or more specialties into one clinical experience), and integrated clinical experiences in multidisciplinary health care settings. The USA Institute of Medicine identified “employ evidence-based practice” and “utilize informatics” among a set of 5 core competencies for all health professionals [5]. The American Boards of Internal Medicine (ABIM) and Medical Specialties, in their maintenance of certification, now place a premium on self-directed, practice-based learning.

Under the above considerations, educational content in medicine corresponds to a wide variety of objects, including traditional instructional learning objects, as well as objects related to active learning approaches (such problem/case/inquiry/evidence based learning), and objects related to novel experiential teaching and studying techniques (role/game based learning). Additionally, medical educational content may span the whole range of types, from text files and presentations, to exam sheets, multimedia content, algorithms, teaching files, computer programs and game-based XML/HTML interactive objects. Finally, medical expert instruction should also be considered as a learning object itself.

In order to support the emerging integrative curricula structures and accommodate the over-specialized knowledge available by different experts, such medical educational objects should exhibit the following basic characteristics:

- they should be self contained educational units;
- they should have well specified educational objectives;
- they should be thematically targeted and overspecialized;
- they should be developed by overspecialized experts in the specific thematic area.

Additionally, reusability of such objects among different organizations requires that they are formally described with standard metadata. Learning objects, as independent units of educational material targeting to specific training needs, constitute one of the main research topics in the e-learning community. Many research initiatives in the field address the issue of LOs' reusability, via designing standards (official or de facto), specifications and reference architectures. Types of e-learning standards and specifications include among else the following [4]:

(a) metadata standards, addressing attributes used to describe LOs, such as LOM, HealthcareLOM (extension of LOM to healthcare), Ariadne Metadata Specification (which provided input to LOM), Dublin Core, etc.; and

(b) packaging standards, regulating assembly of LOs and complex units of learning, such as IMS Content Packaging/Learning Design, SCORM (which is a combination of other standards), and HealthcareSCORM (extension of SCORM to healthcare).

Finally, seamless global sharing of educational content in medicine requires a flexible and adaptive metadata scheme for medical educational content description based on existing standards (such as LOM, and HealthcareLOM) for medical learning object description. Special consideration should be given to issues such as: (a) metadata multiliguality; (b) metadata to address competency/outcomes profile matching; (c) different presentations of the same content, e.g. for users with special needs, for various display devices, etc; (d) contextual learning objects, i.e. originally designed to have a specific meaning and purpose for an intended audience; and (e) mutated learning objects, i.e. re-purposed and/or re-engineered from their original design for a different purpose and/or audience, while attaining an acceptable level of validity.

3. SHARING EDUCATIONAL CONTENT IN MEDICINE

There is currently an international trend to involve information and communication technologies in medical curricula, as well as, in continuing life-long medical learning. As in many cases of technological advancement, initially, these new technologies have been introduced as solutions to medical education problems of the past. However, after a certain point the integration of the technology into the frame of mind leads to what is known as a paradigm shift: a fundamental change in the perceptions of the environment brought about by new technology. It is in such a juncture that medical learning is currently at. The introduction of new information technologies applicable to the learning experience covered by the blanket term "e-learning technologies" had the same effect. Initially the use of these new technologies consisted of almost copying existing courses and transferring them from the classroom to the Web. Information technology tools and environments have successfully been employed in supporting specific isolated aspects of medical education. However, their full potential remains to be exploited through technological solutions that will by large confront the problem of ever-expanding knowledge in medical education. In order to support the emerging integrative curricula structures and accommodate the over-specialized knowledge available by different experts, information technology can be employed to develop virtual distributed pools of autonomous specialized educational modules and provide the mechanisms to combine dynamically individual educational modules and create educational units and the corresponding learning episodes.

Currently, an increasing number of academic institutions are successfully using a variety of web-based Learning (Content) Management Systems (LCMS) to support the educational process. The next step is to implement efficient brokerage mechanisms for educational content sharing (including discovery, retrieval and seamless use) in higher medical education institutions across borders. A recent development in the field is the CORDRA specification and reference model (http://cordra.net/, as proposed by ADL: Advanced Distributed Learning Initiative, http://www.adlnet.gov/), which is based on a number of the above mentioned standards, and aims to combine appropriate technologies and existing interoperability standards into a reference model that will enable learning content to be discovered, retrieved and re-used through the establishment of interoperable federations of learning content repositories.

Considering current state of the art as well as common practice in related technology, the IntraMEDnet consortium has developed a first approach towards sharing medical educational content. It is based on the common practice of isolated content repositories as maintained by the individual institutions'

Learning Content Management Systems (LCMSs) on the web. In this network, educational content is described using the a minimal metadata description scheme and provided in a standard way (using SCORM and HealthcareSCORM for content structure modelling) on a number of individual partners' LCMSs. Basic metadata information that describes each learning module includes: author details, copyright, language(s) of instruction, educational context, educational goal, educational objectives, learning outcomes, teaching methods/strategies, content outline, keywords, instructions for use, object type and format, instructions hours and workload and object lifecycle and scheduled updates.

At a first stage more than thirty such specialized modules have been disclosed in individual partners' LCMSs on the web in a variety of thematic areas that include medical informatics, health and safety, haemodialysis, gynaecology, advanced techniques in therapy, diagnostic imaging, and scientific knowledge management. These specialized learning modules are currently being shared, used and incorporated into courses, curricula and continuing education offered by the various partners of the consortium in order to support and enhance traditional instructional teaching in remote institutions.

A major question raised during this course of educational material exchange involved the potential of using the same pools of educational modules to support active learning episodes (such as problem/case/inquiry based learning) on the web. The requirement here is to be able to combine overspecialized modules developed by different experts in remote institutions, while ensuring their virtual presence as instructors to guide students through the active learning experience. Such an endeavour places certain additional requirements:

- mechanisms for personal inquiry;
- support of active collaboration;
- strong instructor's presence;
- mechanisms for continuous monitoring and evaluation.

All these are central notions within the emerging Web 2.0 paradigm. This refers to the evolution of web towards a platform of programming services and a knowledge-oriented environment with the aim to enhance and facilitate collective users' creativity, collaboration and sharing. In web 2.0 the user is seen as a contributor, rather than a recipient. Content is created by participation and collaboration as an emergent product of human interactions. Most commonly used representative web 2.0 applications include wikis and blogs. Wikis are websites that can be edited by anyone who has access to them, while blogs are online multimedia personal logs that can be commented on by other users. This second generation web application paradigm is currently being highly adopted for health-related professional and educational services online [6].

In our approach we combined collaborative tools such as wikis, blogs and forums in order to provide problem based learning solely on the web [7]. In these sessions, instruction is performed by an interdisciplinary team of experts from remote institutions, while the group of learners can be students from the same or different institutions within the consortium. Instructors collaboratively develop a problem in a wiki. Discussion is initiated via a problem's blog or forum, where students and instructors collaborate to analyse the problem, identify conquered knowledge and plan actions for problem solving. Then students search (via the web and not only) and collaborate to solve the case via the wiki. Apart from general literature inquiry, this procedure is also based on the on-demand compilation of various individual educational objects provided on the independent LCMSs in order to support and realize a specific medical didactic problem. Student activities, progress and more importantly gained experience and competences are recorded, shared and commended on via their personal blogs. The entire learning episode and all its steps (with the final problem/answer deployment) are recorded, commended on and monitored via the wiki (final and intermediate versions) and the participants' blogs.

The case of teaching telemedicine within a Medical Informatics course is currently being addressed via a series of didactic problems. Specifically, a taxonomy for teaching telemedicine has been defined [8] to support the organization and management of individual learning modules, while a case authoring tool has been developed to facilitate didactic case compilation for inclusion in generic learning management systems [9].

All educational activities presented in this paper are deployed via open source generic learning management systems already used by the partner universities. Central to this activity is the employment of the emerging e-learning standard Shareable Content Object Reference Model, SCORM [10]. SCORM has been designed by the U.S. Government's initiative in Advanced Distributed Learning (ADL, http://www.adlnet.org) as a set of eXtensive Markup Language (XML) based specifications to define, manage, access and deliver modular educational objects so that they can be easily shared among different learning management systems.

4. REFLECTIONS AND FUTURE WORK

The European Council in its Lisbon meeting (2000) set forth the European policy for an information and knowledge-based society, stressing the need to encompass the emerging technological revolution and change in the exchange of knowledge affecting all institutions and various aspects of the society. The new opportunities offered by the Internet and the expansion of information and communication technologies have enabled the explosion of web-based educational initiatives, like online education and e-learning.

Collaboration and content sharing (i.e. virtual expert educator sharing) in medical education will inevitably alter the overall process of developing and preparing course materials. Participants in a content sharing network share responsibility for ensuring that the collaborative process is successful. The formation of task forces (or consortia) of participants is one approach to ensure that full responsibility is not vested in just one of the institutions involved. With this in mind, the notion of collaboration goes beyond merely sharing tasks and content across different educators. Shared resources should be used along with educational standards for the interoperable use of medical educational material across Europe in order to maximise content uptake by medical educators in attempting to underpin and extend current teaching and learning, minimise inefficient practice, reduce costs, and eventually improve the consistency and quality of health care and wellbeing of patients throughout the EU.

Along these lines, the IntraMEDnet project (2006-2007) employs information technology in order to develop virtual distributed pools of autonomous specialized educational modules, thus supporting emerging integrative curricula structures and promoting the over-specialized knowledge available by remote experts.

Learning objects in medical education have been identified and described in this approach for the specific needs of the partners and the educational needs as identified within the project. For further development and sustainability of the approach of module exchanging in medicine, educational modules should be described in a broader sense, considering all different pedagogical approaches employed in medical education (from instructional teaching to case/problem/inquiry/evidence based learning etc), including a variety of tools and technologies used in medical education. Further research should also elaborate on a flexible and adaptive metadata scheme for medical educational content description so as to cope with different cultural, language, social and legal requirements of the different countries and to ensure semantic interoperability of educational content. Such efforts should be in accordance with relevant standardization work, geared for example MedBiquitous - a non-profit, international group of professional medical and healthcare associations, universities, commercial, and governmental organizations dedicated to advancing healthcare education through technology standards that promote professional competence, collaboration, and better patient care (http://www.medbiq.org/).

For further development and sustainability of the approach of module exchanging, educational modules should be described in a broader sense, considering all different pedagogical approaches employed in medical education (from instructional teaching to case/problem/inquiry/evidence based learning etc), including a variety of tools and technologies used in medical education. Further research should elaborate on a flexible and adaptive metadata scheme for medical educational content description so as to cope with different cultural, language, social and legal requirements of the different EU countries and to ensure semantic interoperability of educational content.

Current work presented in this paper involves distributed pools of educational modules as maintained by independent distributed LCMSs on the web. In this approach, educational content is provided in a standard way (using SCORM for content structure modelling) on a number of individual partners' LCMSs. Content discovery and retrieval is performed individually within each LCMS. Further research should elaborate on novel notions of federated educational content repositories, as described for example by recent activities of the ADL (Advanced Distributed Learning initative, http://www.adlnet.gov/) and the corresponding CORDRA standard model architecture for establishing interoperable federations of learning content repositories.

Acknowledgement

This work was supported in part under the grants: (1) "Reforming Undergraduate Education in the School of Medicine, Democritus University of Thrace", which is funded by the Managing Authority of the Operational Programme for Education and Initial Vocational Training, a joined funding programme of the Greek Ministry of National Education and Religious Affairs and the European Community (European Social Fund and European Regional Development Fund); and (2) "IntraMEDnet: A Mediterranean Research and Higher Education Intranet in Medical and Biological Sciences", 2006-2007, no.027867, which is co-funded by the EU Community Initiative Programme INTERREG III ARCHIMED, European Regional Development Fund.

References

[1] Papaioakeim M., Kaldoudi E., Vargemezis V., Simopoulos K. (2006). Confronting the problem of ever expanding core knowledge and the necessity of handling over-specialized disciplines in medical education. Proceedings of ITAB 2006, Ioannina, Greece, October 25-27, 2006.

[2] Kaldoudi E., Vargemezis V., Simopoulos K., "Information and communication technologies in medical undergraduate education", Journal for Quality of Life Research, vol. 2(1), pp. 33-37, 2004.

[3] Jones R., Higgs R., de Angelis C., Prideaux D., "Changing face of medical curricula". Lancet, vol. 357(9257), pp. 699-703, 2001.

[4] Devedzic V., Jovanovic J., Gasevic D., "The pragmatics of current e-learning standards", IEEE Internet Computing , vol.11(3), pp.19-27, 2007.

[5] Institute of Medicine. Health Professions Education, "A Bridge to quality". Washington, DC: National Academies Press, 2003.

[6] Boulos M., N., K., Maramba, I., Wheeler, S. "Wikis, blogs and podcasts: a new generation of Web-based tools for virtual collaborative clinical practice and education", BMC Medical Education, vol. 6, pp. 41-49, 2006.

[7] E. Kaldoudi, "Problem-Based Learning via the Web: Supporting Student Collaboration & Instructor's Presence", International Workshop on Medical Education: Current Trends and Challenges, Alexandroupolis, Greece, December 14-15, 2007. http://iris.med.duth.gr/MedicalEducation2007/

[8] Bamidis P.D., Angelidis P., Kaldoudi E. (2006). Introducing telemedicine and telehealth in undergraduate medical education. ITAB 2006: IEEE International Special Topic Conference on Information Technology in Biomedicine, Ioannina, Greece, October 26-28, 2006

[9] Kaldoudi E., Karaiskakis D., Antoniou P., Xinidis D., Manavis J. (2006). Teaching files as learning modules in undergraduate medical mducation. ITAB 2006: IEEE International Special Topic Conference on Information Technology in Biomedicine, Ioannina, Greece, October 26-28, 2006

[10] Advanced Distributed Learning (ADL), "Sharable Content Object Reference Model (SCORM®) 2004", 2nd Edition), http://www.adlnet.org/ (last accessed on April 2007)