Problem-Based Learning via Web 2.0 Technologies

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Abstract

During the last few decades, medical education is shifting is increasingly embracing active learning approaches. This shift from teaching to learning is also strongly related to an involvement of information and communication technology, and especially the Internet and the Web. The emergence of Internet 2.0 is indeed being stressed as a promising tool for advanced support of medicine and medical education. Although Web 2.0 emphasizes on participation, in its early days is still used in the majority of cases to hold and provide content (albeit created dynamically and via peer participation and collaboration) and then systematically deliver it to students. In this paper, we propose the use of wikis and blogs not just for creation and promotion of information, but as active tools to support problem based learning in medicine. In this approach, students and instructors use the web as a virtual place to collaborate and create new knowledge and new educational experiences.

1. Introduction

The current enormous expansion in knowledge relevant to the medical practice constitutes a fundamental challenge to the educational mission of medical faculties. As a result, two main issues arise in medical education: (a) the necessity for overspecialized learning material and educators; and (b) medical education is driven towards a disease-based approach, rather than the more intuitive patient centered view.

In order to address these problems, medical education is embracing tools and approaches from two different fields. On one hand, alternative educational approaches have long been introduced in medicine. These include integrative curricula delivered via active, self-directed, student-centered, experiential learning. One the other hand, information technologies are also being employed to harness information explosion and support teaching in various ways. Ultimately, these two different fields could join their contribution, with

information technology effectively supporting active learning in medicine.

Effective technology-supported learning is created when there is a successful alignment of the approach to learning with the use of technology. Having this in mind, let us concentrate on the specific characteristics and requirements of active learning. This educational approach concentrates both on knowledge achievement, as well as on the reinforcement of social skills, such as the ability to act and interact in the real world, to collaborate and solve problems. Thus in order to support active learning, it only seems natural to employ the social computing paradigm of Internet 2.0. In this paper we propose a novel use of wiki and blog technology to support medical problem-based learning on the Web. Specific aims of this work address the collaboration of remote overspecialized medical experts in order to devise, develop and deploy didactic problems, the deployment of problem-based sessions in virtual teams, where both students and instructors may be located in remote institutions, and the provision of mechanisms for continuous monitoring and evaluation, both in terms of knowledge and skills achievement.

2. Active Learning in Medical Education

Traditional medical education requires students to sit through hours of lectures on basic sciences and discussion takes place in large groups, sometimes with the whole class present. Advances in our understanding of learning processes now suggest that such techniques may be suboptimal, and that learning should evolve from learning by acquisition to learning by participation.

New approaches build on concepts of active learning, defined as the process of having students engage in some activity that makes them reflect upon ideas and how they are using these ideas. Such new educational approaches require students to regularly assess their skills and knowledge at handling real world problems. Some student centered, active learning approaches include problem-based or case-

based learning, inquiry and discovery based learning, role and game playing based learning, as well as collaborative and interactive learning of all kinds. Such approaches rely on situational learning and are active, self-directed, student-centered, and experiential [1].

Learning is perceived as a qualitative change of one's conception of phenomena and ideas and, consequently, knowledge must be actively processed by the student. A fundamental idea is that learning is organized in small student groups, i.e. tutorial groups, and not around lecture meetings. In the tutorial group students actively work with reality-based situations to formulate problems and learning needs that will guide their further studies. The teacher's role is that of facilitating learning rather than transferring knowledge. In the tutorial group, the students discuss and defend their choices and standpoints. Using library resources, text books, databases, laboratory work, field studies, lectures and other forms of faculty resources, they are urged to find answers to and perspectives on their problems and learning needs. The aim is also to develop problem-processing skills, self-directed learning skills and group competence [2]. Learning is now regarded to address to types of knowledge, explicit knowledge (conveyed by books, lectures and scientific documents) and tacit knowledge (directly related to experience and practice, as shared by interaction and collaboration) [3].

In 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 [4]. 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 origins of active learning and problem-based learning (PBL) date way back in the 1940s [5], when the idea that students may learn better by doing and by thinking through problems was first introduced [6]. After its introduction in medicine at the McMaster University Faculty of Health Sciences in 1969 [7], PBL and active learning in general has been applied in numerous curricula in health sciences, and has been the center of debate and comparative studies. Recent evidence from various disciplines suggests that active learning may work better than more passive approaches in health science education, e.g. [8], [9].

3. Information and Communication Technologies in Medical Education

The evolving shift from teaching to learning in higher medical education is also strongly related to an increasing involvement of new information and communication technology (what is often collectively referred to as "new technologies"). In recent years, advances in information and communication technology, and especially the internet, have acted as catalysts for significant developments in the sector of health care, having a strong impact in supporting medical diagnosis, enabling efficient and effective patient and healthcare management and reforming medical education [10]. There is currently an international trend to involve computers and the Internet in medical curricula as well in continuing life-long medical learning. This practice is reinforced by active support and funding from bodies such as the European Union and local governments. Specifically, the European Council in its Lisbon meeting in March 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 [11].

Like many other cognitive domains, medical education can be considered in terms of three levels of increasing complexity and importance [12]: information (i.e. simple facts), knowledge (i.e. information with a purpose), and understanding (i.e. conscious knowledge, achievement of explanation and grasp of reasonableness). Technology has been employed in diverse ways to support different levels of the educational process. Supporting the dissemination of information is the easiest and most straightforward achievement of information and communication technologies. They have extensively and successfully been used to give quick, easy and cheap access to information sources, such as books, textbooks, atlases, medical and biological databases, research journals etc. Structuring and organizing information with a particular educational purpose refers to knowledge. On the other hand, understanding implies experience as well as inquiring [13]. Managing and supporting these levels of the educational process is a rather complex issue. Technology can certainly help by providing digital teaching files for the student to practice, together with tools that support continuous self-evaluation and mediate teacher-learner exchange. Of major importance is the potential of hypertext technology to provide interconnected pieces information, and link questions with explanations within the wider scope of a particular medical task.

However, in order to promote knowledge and understanding in medical education, information technology, and especially the internet, should embrace and support active learning approaches. It has been argued that computer mediated communication can be used to enhance collaboration and interaction within learner's groups. Especially, asynchronous discussion boards give the opportunity to analyze interaction and learning, measuring participation levels and interaction patterns. A comprehensive review of general research and practices in the area is presented in [14].

Initially, the Internet and the Web were a static structure with passive viewers. Currently they are changing towards a second generation of dynamic services and communication tools that emphasize on peer-to-peer collaboration, contributing, sharing, usually known under the collective term Web 2.0, coined by O'Reilly in 2005 [15]. Web 2.0 is not an upgrade, but a whole range of new technologies, tools and services that support and promotion group and community activities. 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, e.g., [16],[17], and [18].

The majority of medical wikis available today aim to create vibrant, up-to-date discussions, as well as accurate and easily accessible banks of knowledge. A list of more than 50 medical wikis are available on http://www.davidrothman.net/list-of-medical-wikis/ (accessed on 1/2/2008). However, with everybody contributing in medical wikis, there is a concern about using them for attaining critical information. Blogs in medicine are used as online journals to present and discuss clinical cases and images on a personal basis or within groups, and have also been proposed as potential tools for disease prevention and health promotion [19].

4. Supporting PBL via Web 2.0

Although Web 2.0 emphasizes on participation, in its early days it is still used in the majority of cases to hold and provide content (albeit created dynamically and via peer participation and collaboration) and then systematically deliver it to students. In this paper, we propose the use of wikis and blogs not to create, store and provide information, but as active tools to support problem based learning in medicine. In our approach, students and instructors use the web as a virtual place to collaborate and explore and create new knowledge. Specific objectives of this work include:

(a) support collaboration of remote overspecialized medical experts in order to devise, develop and deploy didactic problems for problem based learning in medicine;

(b) deploy problem-based sessions in virtual teams, where both students and instructors may be located in remote institutions;

(c) support strong instructor's presence;

(d) provide tools for student inquiry and collaboration; and

(e) provide mechanisms for continuous monitoring and evaluation, that would address direct knowledge, as well as tacit competencies targeted via PBL.

Considering the academic educational set-up, there is also the additional requirement for integration with generic environments that support teaching in higher education, i.e. open source learning management systems and related educational standards [20].

Our approach combines collaborative tools such as wikis, blogs and forums in order to provide problem based learning solely on the web. In these PBL 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. 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.

One current implementation is based on the wiki, blog and forum modules as available in the Moodle 1.8.4 open source learning and course management environment (http://www.moodle.org/). Moodle emphasizes on social constructionist approach to education, and on mechanisms for rich interaction within online courses. It is multilingual, exhibits several thousands of registered sites, and embraces among else a variety of Web 2.0 technologies.
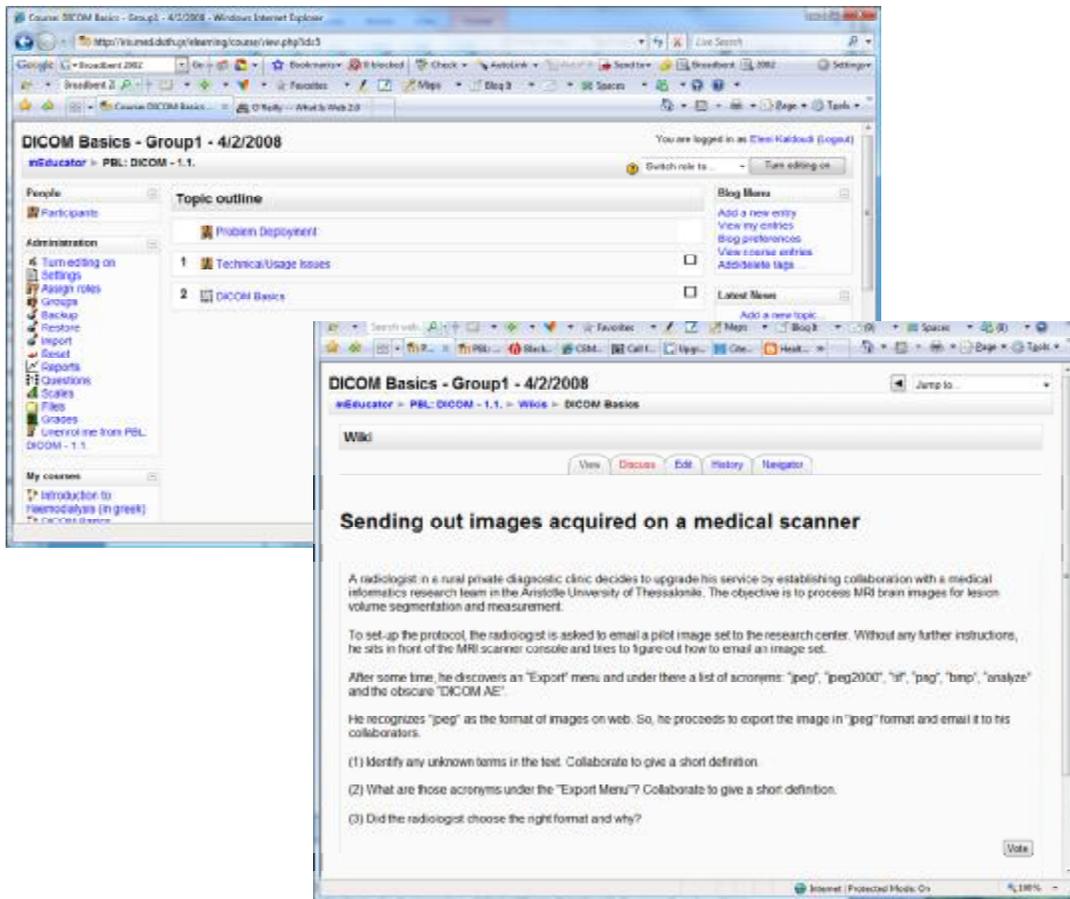
Figure 1: The front page of the PBL course in DICOM Basics and a wiki page stating the first step of the didactic problem.

A specific example of PBL deployment currently being taught is a multi-stage PBL session on "DICOM basics" (http://iris.med.duth.gr/elearning/). The session is currently being taught to students of the MSc in Medical Informatics at the School of Medicine, Aristotle University of Thessaloniki. However, the problem is being developed dynamically and remotely by experts from various institutions.

The PBL session is presented as an individual course in the Moodle LMS, consisting primarily of discussion forums and a wiki. The didactic problem in this case is deployed in a number of consecutive steps. The students are expected to read through the first step, and discuss it via the problem's forum. Then, they should set out to find the answers to the questions asked, as well as answer all other questions that have been raised during the forum discussion. They have to record important steps of their search in their personal blogs, as provided within the environment. Finally, they have to provide answers collaboratively in the

wiki. They are also urged to discuss each wiki entry via the special entry discussion page within the wiki.

During this process, three different instructors participate in the forum and wiki discussions. Instructors initially collaborate via the wiki in order to develop the didactic problem. An example of the first step of such a problem currently being deployed is shown in Figure 1.

Once the session is initialized, the students are encouraged to spend some time to get accustomed with the environment and the procedure. This familiarization phase always spawns interesting side discussions on technical issues around web 2.0 technologies as well as on educational notions and approaches, which are conducted via a second forum devoted to technical and procedural issues. Then, the first step of the problem is deployed and initial discussion is conducted via the forum. The students are encouraged to list unknown words and notions in the wiki (under a "Problem Deployment" area) and

perform personal or collaborative inquiries in order to resolve them. Final conclusion for each wiki entry is reached via a discussion for the specific wiki entry. Instructors participate in all discussions with comments and cues.

An important feature of this approach is that it enables various expert instructors (remotely located) to comment on and participate in the discussions providing highly specialized knowledge in their individual field of expertise.

Another interesting issue is that tacit knowledge can be recorded, archived and mined, via the blog entries of the participants. Using the provided blog, instructors can record interesting and important steps in addressing questions, thus implicitly recording their expertise in scientific problem solving. On the other hand, students can record their own process of tackling the problem, searching literature, resolving ambiguities etc. These blog entries can then be viewed collectively as PBL session entries to reveal the progression of problem solving procedure or as individual participant blog entries that may help evaluate personal progress and especially reveal skills mastered by each participant and the process of evolution in skill mastering.

5. Discussion

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 in medicine. However, the success of online education depends more on the mechanisms that make educational content available to learners and techniques to support the learning process, rather than on the educational content itself. Moreover, effective online learning experiences require a successful alignment of the learning approach with the technology used.

Such an inherent alignment exists between the notion of active learning and the paradigm of Web 2.0 technologies, as they both rely on and emphasize on social skills (such as collaboration, interaction and peer activity) as opposed to mere content. In our approach we take advantage of this inherent alignment, and use the wiki and blog Web 2.0 technologies to create online distributed problem-based learning sessions in medicine.

Work in progress elaborates on mechanisms to process and analyze the learning process as recorded in personal blogs of our approach so as to extract meaningful information about capturing expert's

practical skills and monitoring learner's progress in learning.

6. Acknowledgement

7. References

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