ENHANCING MEDICAL CURRICULA VIA ONLINE PROBLEM BASED LEARNING – EXPERIENCE USING WEB 2.0 TECHNOLOGIES

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Abstract

During the last few decades, medical education 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 Web 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, it is used, in the majority of cases, as for content provision (albeit the dynamic creation of content via user/peer participation and collaboration) and subsequent delivery to students. In this paper, we shift the aforementioned emphasis of the use of wikis and blogs towards active support for problem based learning in medicine. The approach is based on a blended learning scheme, where e-learning is actually complimentary to traditional classes (lectures, demos and labs), and it utilises the Moodle open source learning environment. Work is illustrated along three main objective lines: (a) deployment of problem-based sessions in virtual teams, where both students and instructors may be located in remote institutions; (b) provision of tools for student inquiry and collaboration; and (c) provision of mechanisms for continuous monitoring/assessment and evaluation, thereby, addressing direct knowledge, as well as, any tacit competencies targeted via PBL. Our approach combines collaborative tools such as wikis, blogs and forums in order to provide problem based learning solely on the web. 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. Evaluation results indicate that Web 2.0 technologies have a major role to play within the educational arena.

Keywords

Web 2.0 technology, blogs wikis, discussion forums, active learning, standards, medical education, open source, problem based learning, web collaboration

1. INTRODUCTION

The current enormous expansion in knowledge relevant to 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) the need to shift emphasis from a disease-based approach, to 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/Web 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.

So, the remaining of this paper is structured as follows. In section 2, background information on active learning and its role in medical education is provided, followed by an analytic account of how technology may be engaged to support this in the third section. In the last two sections of the paper, we provide practical examples and discuss the importance of how the aforementioned goals have been achieved in specific learning settings.

2. ACTIVE LEARNING IN MEDICAL EDUCATION

Training and education demands rise with the growing importance of a “knowledge society”, that is a society based on knowledge as a value, not only cultural but also economic. Nowadays, the competitive advantage of a nation is shown by the expertise and the behavior of its human resources. Current innovations in information systems and communication services mark the switch from the “information society”, characterized by a mass information seeking and based on the distribution of pre-defined and standardized data, towards a “knowledge society”, which emphasizes the cognitive advancement and, consecutively, involvement of each individual. The growing use of internet not only modifies quickly and habitually the way people work but it also leads the race in this educational revolution.

New educational approaches build on concepts of adult education. They 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],[3]. Learning is now regarded to address two 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) [4].

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], [10] and [11].

In response, professional organizations worldwide have called for increased emphasis on training in life-long self-directed learning. The emerging view is of learning as an active, constructive, social, and self-reflective process. 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. In higher 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 [12], [13], [14], [15].
3. ENHANCING MEDICAL EDUCATION VIA INTERNET TECHNOLOGIES

When new technologies were deployed in education about two decades ago (although experimental attempts date back to 1970s), there was a considerable hype about the emerging electronic teacher, which fortunately soon enough subsided to reveal serious limitations of the computer-to-student educational model [16]. The traditional two-fold model of medical education, theoretical instruction based on textbooks and clinical practice with one-to-one interaction, need not be reformed [17]. Employing new technologies should just aim to support and enhance (not replace) already proven educational techniques and processes, mainly by extending the amount and availability of knowledge and instruction as well as the place and duration of the educational process. 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 [18].

In retrospect, it is possible to identify three generations of information technology supported learning, which usually come under the collective term of “e-learning” (literally translated as “electronic learning”). The first generation is based on multimedia technology support, such as videos, CD-ROMs or other stand-alone educational software. The second generation employs telematic technologies and it is basically set up as teaching via the web, where conventional educational material, as well as entire educational courses, are delivered via the network to remote students. The last, emerging generation, is about web based learning, where the network is used as a means to create active, context based, personalized learning experiences. This last generation of e-learning shifts the emphasis from ‘teaching’ to ‘learning’ and from the notion of technology as a didactic mediator to the notion of sociable, peer-supported, involved learner.

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. Initially, the term was coined by O’Reilly in 2005 [19] as an attempt to emphasize the fact that despite the late 90s shortcomings of the ‘.com’ model, the web still appeared strong and promising new features such as ‘social software technologies’ were emerging. Web 2.0 is not a program or an upgrade or a single concrete piece of technology, it is rather a more fully implemented Web. It is based on the same infrastructure and standard protocols, and on well-proven technologies and tools of the Internet and the Web. However, the term Web 2.0 encompasses a whole new meaning and a collective emergent behavior of the use of these technologies, tools and applications that create networks and communities of users (both humans and programs) that enhance and promote participation, collaboration, sharing, openness, reuse, agility, personalization, apomediation (a term coined by Eysenbach [20] to characterize an alternative way for users to identify trustworthy and useful information by seeking information with peer guidance, as opposed to using some sort of mediation, or bypassing it altogether - commonly referred to as disintermediation).

All this emergent behavior that characterizes Web 2.0 is enabled one way or the other by a variety of applications and tools that form the core of Web 2.0, and by their turn are empowered by an ensemble of technology, embracing both familiar technology from the early days of the Web as well as innovations. Among common Web 2.0 tools that are being explored for their possible use in education are wikis, blogs, podcasts, social networking tools and virtual worlds [21],[22].

Web 2.0 tools and applications make use of a range of technologies, mainly based on common internet and web technologies, that is the HTTP protocol and the suite of web development technologies, such as all variations of HTML and XHTML and CSS, XML and XSLT, Javascript, etc. However, it can be argued that the real predecessor of Web 2.0 notions and technology is the programming paradigm of web services and service oriented architectures. Web services are a middleware technology for developing service-oriented architectures (SOAs). This core technology that supports Web 2.0 is continuously evolving and growing, as new specialized formats, standards, and protocols emerge. Examples include the RSS data/metadata XML format, the FOAF (Friend of a Friend) and XFN (XHTML Friends Network) protocols involved in social networking applications.

This second generation web application paradigm is currently being highly adopted for health-related professional and educational services online, e.g., [22], [23], and [24]. 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 [25].

4. ONLINE PROBLEM BASED LEARNING

To exploit the actual power of Web 2.0 with respect to participation one needs to focus not on content provision, but on the mechanisms for this dynamic content creation, via peer participation and collaboration, in order to systematically allow for the creation and fertilisation of new knowledge. 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 medical education. In this approach, the web is utilised as a virtual place for collaboration, exploration and new knowledge creation by both students and instructors (Fig. 1). To achieve this, one must support collaboration of remote overspecialized medical experts in order to devise, develop and deploy didactic problems for problem based learning in medicine. In addition, problem-based sessions may be deployed in virtual teams, where both students and instructors may be located in remote institutions. Needless to say that, mechanisms should be provided to make the instructor’s presence strong enough. Moreover, students should be equipped with tools for inquiry and collaboration. Last but not least, mechanisms for continuous monitoring, assessment and evaluation need to be provided, so as to address the acquisition of direct knowledge, as well as, any tacit competencies targeted via PBL, and obtain as a clear picture as possible for the actual usefulness of whole approach and its wider acceptance by the students.

Fig. 1. A schematic representation of web2.0 as a virtual place for bi-directional collaboration, new knowledge and new educational experience creation by both students and instructors.

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 [26].
The approach of this paper combines collaborative tools such as wikis, blogs and forums in order to facilitate web PBL session. In the latter, 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 dedicated discussion forum (in some cases it can also be a problem specific blog), where students and instructors collaborate to analyse the problem, identify conquered knowledge and plan actions for problem solving. Once the PBL session kicked off and the above instruments were set, students had to search for relevant information (be it via the web or not) and collaborate in order to start solving the case/problem via the wiki. All student activities, progress and more importantly collected experience and acquired competences were recorded, shared and commended on via their personal blogs. The whole learning procedure 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.

Fig. 2 illustrates how a discussion forum was used in one of the modules where this approach was tested, namely, a module on Electronic Health Records (EHR) within the Postgraduate (MSc) Medical Informatics course at the School of Medicine, Aristotle University of Thessaloniki (AUTH). Note that a combination of a wiki and several (topic/tag marked) personal blogs were utilised within the specific EHR PBL as Fig. 3 illustrates.
Fig. 3. An illustration of the dedicated PBL discussion forum (left) and the personal blogs (right) used by each student for drafting their own approaches/answers to each problem/case question.

Current implementation is based on the variety of Web 2.0 technologies (wiki, blog and forum modules) available in the Moodle (v. 1.8.4) open source learning and course management environment (http://www.moodle.org/) which globally aims at the social constructionist approach to education, as well as, the mechanisms for rich interaction within online courses. An interesting issue of the approach followed in this paper is that instructors can record important steps in addressing questions, thereby implicitly recording their expertise in scientific problem solving. Moreover, students can record their own process of tackling the problem, searching literature, resolving ambiguities etc. In this way, the collection of blog entries can then be viewed as PBL session entries to reveal the progress of the problem solving procedure or as individual participant blog entries that may help in assessing personal progress and skill acquisition. Instructors may assess individual parts of the process as well as the whole process results in both qualitative and quantitative terms depending on the prescribed learning outcomes of the specific course module.

Students’ evaluation was obtained via an anonymous questionnaire emphasising on the use of Web 2.0 tools. The Moodle system lead the logged-in students to an external web site powered by another open source survey tool, namely, “PhP Surveyor” [27], so as to maintain anonymity. Evaluation of the results indicates student satisfaction by the whole approach, its friendliness (Fig 4) and especially the collaboration opportunities offered. For example Fig. 5 demonstrates the willingness of the students to experience this process in future course deployments. The essence of collaboration is also reflected on the student replies to a specific question querying “whether they were tempted to read what others have contributed in their own personal blogs” (Fig 6). Finally, students felt that the collaboration opportunities to which they were exposed were quite useful and overall enhancing their learning process (Fig. 7).
Fig. 4. Evaluation of the user friendliness of each Web 2.0 instrument used.

Fig. 5. Students indicated a positive attitude towards future experimentations with such approaches.

Fig. 6. An indicated of the underlying student-student collaboration. Most students admitted that they often consulted their fellow students’ blogs before starting their own entries.
Fig. 7. Evaluation indicates that the overall educational process was enhanced by the approach followed.

5. DISCUSSION

In this paper we described a PBL approach for Medical Education in which active and collaborative learning is envisaged through the use of the Web 2.0 tools. 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 collaboration 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 educational 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. Course evaluation is completed via anonymous student questionnaires powered by an open source web survey tool. The depth of collaboration and its appropriateness was central to this evaluation. Table 1 summarises key feature elements of the taken approach.

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<th>Type of Feature</th>
<th>Comment on the approach</th>
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<tr>
<td>1</td>
<td>Instructors</td>
<td>The problem is being developed dynamically and remotely by experts from various institutions. Instructors initially collaborate via the wiki in order to develop the didactic problem. Instructors participate in all discussions with comments and cues.</td>
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<tr>
<td>2</td>
<td>Problem setting</td>
<td>Initial case/problem content is placed on main PBL wiki page. The didactic problem (case) is deployed in a number of consecutive steps. Steps (questions) are itemised.</td>
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<td>3</td>
<td>Student preparation</td>
<td>Once PBL is initialized, students get familiar with the environment and the procedure. This phase may spawn interesting side discussions on technical issues around web 2.0 technologies as well as on educational notions and approaches. A discussion forum is devoted to technical and procedural issues just for this reason.</td>
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<td>4</td>
<td>PBL step 1</td>
<td>Students: attempt tackling item/question 1; set out to find the answers to the questions asked; create personal blogs (tagged); work in personal blogs re understanding/answering the case; obtain assistance from relevant discussion forum.</td>
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<tr>
<td>5</td>
<td>Resolution of PBL step 1</td>
<td>Once finished, provide answers collaboratively in the wiki (enter answers/case resolutions) in the PBL class wiki. Final conclusion for each wiki entry is reached via a discussion for the specific wiki entry.</td>
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<td>6</td>
<td>Proceed to next steps...</td>
<td>Repeat above two items for steps 2 and 3 (or as many as the case/problem necessitates).</td>
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<td>7</td>
<td>Record process</td>
<td>Tacit knowledge can be recorded, archived and mined, via the blog.</td>
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progress entries of the participants.

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<td>8</td>
<td>Assessment</td>
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<td>Evaluation</td>
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8 Assessment Instructors may mark individual steps and/or final result depending on the envisaged learning outcomes.

9 Evaluation Anonymous evaluation surveyed key elements of the collaborative approach and their reflections on students satisfaction.

Evaluation results indicate that Web 2.0 technologies have a major role to play within the educational arena. Although we have applied them to a physically akin to them course, i.e. the EHR element of the medical informatics module, the methodology we have utilised is by no means exclusive to other courses. In the contrary, we believe the approach is directly applicable, and we intend to expand this effort to a number of medical curriculum courses over the next few years. Work in progress elaborates on mechanisms to process and analyze the learning process as recorded in student personal blogs so as to extract meaningful information about capturing the expert’s practical skills on one side, while monitoring the learner’s progress in learning on the other.

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