

# Active Blended learning in Medical Education – Combination of WEB 2.0 Problem Based Learning and Computer Based Audience Response Systems

Stathis Th. Konstantinidis<sup>1</sup>, Panagiotis D. Bamidis<sup>1</sup>, Eleni Kaldoudi<sup>2</sup>

<sup>1</sup>*Medical Informatics Laboratory, School of Medicine, Aristotle University of Thessaloniki, Greece*

<sup>2</sup>*Medical Physics Laboratory, School of Medicine, Democritus University of Thrace, Greece  
{cs, bamidis}@med.auth.gr, kaldoudi@med.duth.gr*

## Abstract

*During the last two decades, the scene in education is rapidly changing by the deployment of Information and Communication Technologies (ICT). Smart classes, virtual classrooms, online collaborative educational experiences and emerging WEB 2.0 applications are increasingly used, either as stand alone or blended with conventional education. Additionally, as emphasis is shifting from 'teaching' to 'learning', technologies that promote active, participative learning, such as computer based audience response systems, are employed in order to enhance students' participation and explore their degree of understanding. This paper presents our approach in combining online active learning and active learning in class in the case of medical education.*

## 1. Introduction

During the last two decades, the scene in education is rapidly changing by the deployment of Information and Communication Technologies (ICT). Smart classes, virtual classrooms, online collaborative educational experiences and emerging WEB 2.0 applications are increasingly used, either as stand alone or blended with conventional education.

It is possible to identify three generations of information technology supported 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, is 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 latest evolution 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 [1].

Another technological novelty often employed to support active learning in the classroom involves computer based audience response systems, in order to enhance students' attention and enthusiasm, to promote involvement and understanding, and to help in overall audience management.

But there is a little research on combining both learning techniques/technologies that represent the same idea, online active learning and active learning in the classroom. So, the purpose of this paper is to describe the framework that these techniques/technologies can be used as complementary to each other by defining the steps that should be followed for the provision of such active blended learning.

The reminder of the paper is structured as follows. In section 2 we provide a brief account on current trends and approaches in online Medical Education and WEB 2.0, as well as, collaboration approaches by means of computer based audience response systems in class; in section 3 the theoretical framework of achieving an active blended learning approach is described, while the following section focuses on a real scenario of implementation of this approach. Section 5 presents some of the evaluation results, followed by a discussion in the last section on key issues of concern and future work.

## 2. Background

In the last few decades we have experienced an explosive growth of information and knowledge in the area of health sciences [2] and in general. To confront this challenge, medical education is increasingly 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. On the other hand, information technologies are also being employed to harness information explosion and support teaching in various ways. Ultimately, these two different fields will join their contribution, with information technology effectively supporting active learning in medicine.

The origins of active learning and its most common deployment, problem-based learning (PBL), date back in the 1940s [3], when the idea that students may learn better by doing and by thinking through problems was first introduced [4]. After its introduction in medicine at the McMaster University, Faculty of Health Sciences in 1969, PBL and active learning in general has been applied in numerous curricula in health sciences, and has been the centre of considerable 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. [5], [6], [7], [8]. A recent study [9] [9] proposed the combined use of various web 2.0 technologies, namely wikis, blogs and forums to support deployment of PBL sessions 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. 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 there) 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. This web-based PBL has been extensively employed for undergraduate and postgraduate medical education, as well as for disseminating science to the public [10], [11], [12].

A different approach to enhancing active learning in the classroom is by the use of computer based audience response systems. An audience response system (ARS) is a tool that allows lecturers to incorporate questions and answers in conventional lectures to enhance interactivity. The system provides immediate and anonymous feedback, via personal handheld devices, that facilitate accurate audience responses to multiple-choice questions set by the instructor online. Audience

members are also able to compare their performance with that of the entire group, while the teacher can analyze the audience's response via elaborated statistics.

The usual approaches for employing a computer based audience response system include [13]:

- teacher managed assessments in prearranged questions, which take place within the lecture;
- teacher managed assessments with ad hoc and impromptu questions during the lecture (questions "on-the-fly"); and
- student managed assessments, where students enter their responses to questions provided in written form by choosing the time and the rank for each question.

There has been considerable research on the efficiency of the use of computer based audience response systems in the classroom. The majority of published reports agree that these systems can manage and/or increase classroom interaction, increase student participation, address students' misconceptions, enhance students' active learning, increase the communication between students and teachers and enhance class satisfaction [14], [15], [16], [17]. Learning outcomes in some cases do not seem to be affected, despite students' satisfaction and increased class interaction [18], while other studies report a considerable increase of learning outcome performance [19]. Literature reports certain disadvantages of these systems that could lead to system rejection, including lack of privacy, when students are named in the system, and time constrains that may lead to increased answer inaccuracy [20], [14].

### 3. Theoretical Approach

Literature suggests that both PBL and audience response systems serve well the goals of active learning, by increasing the students' participation and course effectiveness. Therefore, in this paper we propose a theoretical framework to combine both approaches. The ultimate goal is to achieve added value and increase the support of active learning in medical education.

Our approach accounts for the entire educational process, as depicted in Figure 1. Indeed, the educational process starts with the design of the module (or course) itself, continues with the selection of teaching methods or strategies that will accommodate the design requirements, continues with the development of the content, and finishes with the evaluation (of teachers and students in general).

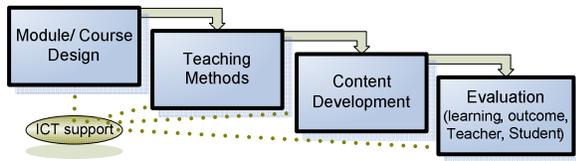


Figure 1. Generic steps of the educational process

Following these steps, the educational questions that will populate the classroom audience response system should be organized in the following categories:

- pre-course questions, to probe the audience and identify in an organized way the status of students' knowledge;
- during course questions to be used in order to (i) amplify the understanding of the topic; (ii) arouse interest in the classroom; and (iii) allow for students' self-evaluation; and
- post-course questions, to assess the understanding of the topic and to evaluate students and course alike.

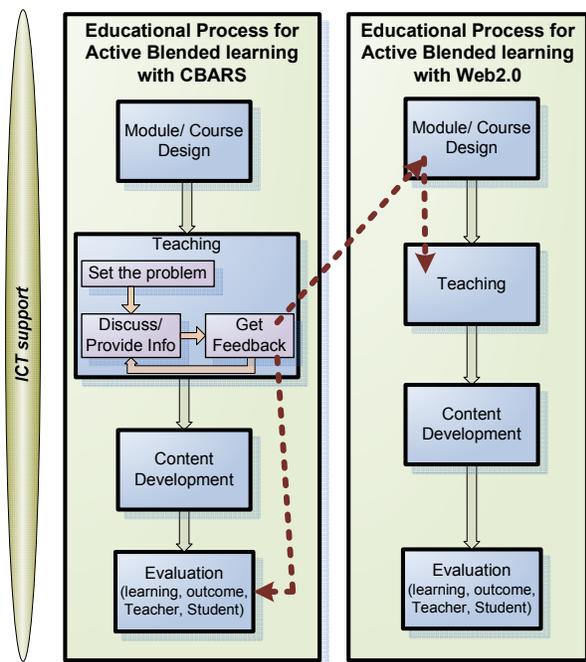


Figure 2. Generic steps of the Active Blended learning Educational Process

The initial feedback the students provide through the computer based audience response system can be used to guide the design of in-class teaching as well as active online PBL sessions. Analysis of the results from in-class and online responses of students can reveal thematic areas where the educational process has not succeeded to cover sufficiently, thus leading to course content reform and further development. Last

but not least the educational process concludes with the evaluation, of the teachers, students, and the educational process alike. Active learning evaluation assessments or quizzes should be clearly defined and not mixed with self-evaluation activities. Furthermore, evaluation of learning outcomes could show not only students performance, but teachers' readiness as well. Figure 2 summarizes the steps for this theoretical framework.

#### 4. A Case Study of Implementing the Proposed Theoretical Framework

The proposed framework was implemented for the design and delivery of a 3-hour seminar course on "Research and Evaluation of Medical Information on the Internet" in the context of continuing education for a group of 15 nurses.

The case study used the Classroom Performance System (CPS) ([www.einstruction.com](http://www.einstruction.com)) as the computer based audience response system, and collaborative tools wiki and forums for the PBL session. The CPS system consists of a small handheld eight-button "response pad" that transmits an infrared signal to a receiver connected to a computer. The software that accompanies the system records students' responses and provides in real time the answers in charts. At the end of each session the software provides a full statistical report. The online active learning was deployed on the open-source learning management system MOODLE ([www.moodle.org](http://www.moodle.org)), which exhibits rich web 2.0 functionalities.

Following the proposed framework, we divided the CPS questions in three categories: (1) pre-course questions to identify the knowledge of the audience; (2) in class preset and verbal questions to identify participants' understanding; and (3) post-course questions to evaluate achieved knowledge and to evaluate the course itself.

After answering each question (except the course evaluation ones) the answers were depicted in chart and the correct question was emphasized, while a short discussion regarding false answers was conducted.

Didactic problems for online PBL were set based on the false answers of the students. For example in a question regarding the quality of information in Wikipedia ([www.wikipedia.org](http://www.wikipedia.org)) the majority of students replied that it is valid and can be used as a scientific reference. So the problem that was set for the online PBL session, was relative to the quality of information in wikis which are publicly accessed and edited.

Course evaluation was based on anonymous student questionnaires answered in class conventionally and

via the CPS system. The majority of the students liked the opportunity to participate anonymously in the course and they believed that they understood better the topic when they had the chance to participate actively in the educational process.

Taking into account the ages of the students (25 – 55 years old) and the fact that they stated that although they use information and communication technologies their confidence level is rather low, they found the CPS system easy to use without spending too much familiarization effort. This is depicted in Figure 6, where it is shown that 67% of the participants are strongly positive about the easiness of the CPS system, another 27% were positive, while only 6% were neutral and none was negative. Figure 4 shows the interesting juxtaposition of the preferred allowed time to answer a question as opposed to the actual time needed for the answer. It is evident that the majority of the students required a very short time to answer each question, while they initially thought that they would require more time.

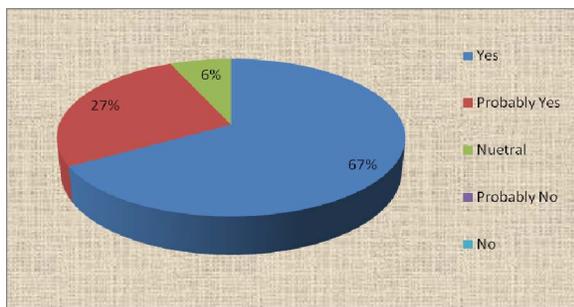


Figure 3. CPS Ease of use

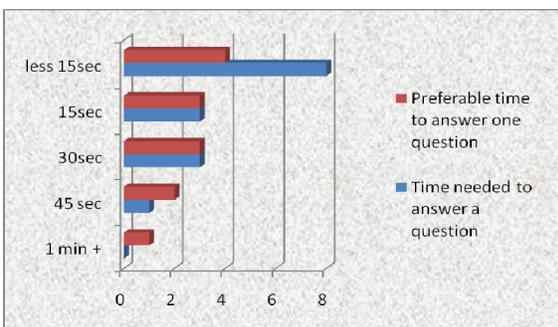


Figure 4. Response Time needed for an answer

Additionally, the students thought that viewing the results of the other students' answers helps understanding and increases their interest for participation (Figure 5).

Last but not least, the majority of the students expressed their willingness to use a computer based audience response system and active blended learning in other seminars as well (Figure 6).

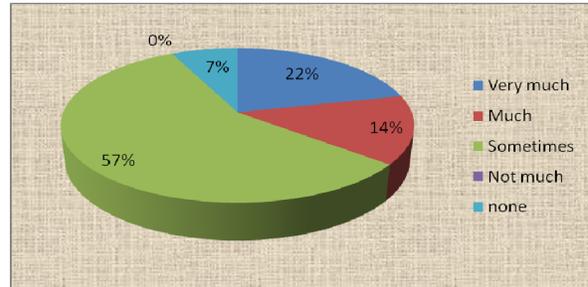


Figure 5. Knowledge of other students' answers helps the understanding

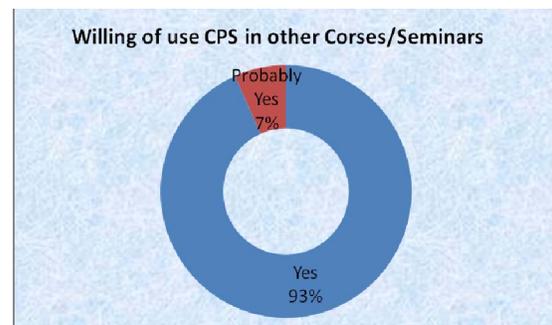


Figure 6. Willingness to use computer based audience response systems again.

## 5. Discussion

In this paper we propose an approach for medical education in which active and collaborative learning are combined so as to achieve an active blended learning through the use of a computer based audience response system and an approach facilitating web2.0 (online) PBL.

Instructors collaboratively develop a course with preset and verbal questions to which student answers are envisaged by means of the CPS. The course is re-modified by taking into account the student answers. These answers are then used upon the design and definition of the “problem” in the class wiki shaped and dedicated for this purpose. Discussion on the problem’s issues is initiated via dedicated 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 both in class and online. The entire educational episode and all its steps are recorded, commended on and monitored via the CPS and the Wiki.

Course evaluation is partially completed in class via anonymous student questionnaires powered by CPS

and classic online questionnaire forms, investigating students' willingness to use new collaborative Technologies.

The evaluation results obtained herein are comparable to those of other studies. For example, they indicate an improvement for increased participation when compared to [19] and [21] while are similar to [22]. Results are also motivating when the students impression of "improved course understanding while using the system" or the "ease of use of the system" were evaluated. Overall student attitudes towards using a computer based audience response system was very positive as was in other studies too [14], [22].

Although the sample of the users involved in this study is quite small, it nevertheless indicates a promising fact, that is, the use of active learning in class combined with the web2.0 analogous of PBL implies a high involvement and active interest from the users/students side. Such results may feed and complete the scene of online active blended learning.

Obviously there is still much to be done in this field and this approach is nothing but a mere initial approach. Although we have applied them to a physically akin to them course, i.e. the "Research and Evaluation of Medical Information on the Internet", the methodology we have utilised is by no means exclusive to other courses. On 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 answers from CPS and automatically create the problem in Web 2.0 PBL sessions through ontologies, semantic web services and "smart" systems, while at the same time monitoring each student's performance and needs.

## 7. Acknowledgement

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