Web-based Supporting Material for Biomedical Engineering Education

K. Lindroos, J. Malmivuo, J. Nousiainen

Ragnar Granit Institute, Tampere University of Technology, Tampere, Finland

Abstract— **European Commission funded virtual campus project EVICAB (European Virtual campus for Biomedical Engineering) was launched in January 2006. The idea is to develop a virtual environment for students to study biomedical engineering by means of e-courses. The transfer from contact teaching to e-courses gave rise to a need for web-based learning material. In order to face the challenge a new project was launched in Ragnar Granit Institute to produce video lectures and other supporting material to the Internet. The produced material has been evaluated and implemented as a part of e-courses in EVICAB.**

Keywords— **Biomedical Engineering, EVICAB, E-learning material, Video lectures**

I. Introduction

Virtual campus project EVICAB -European Virtual Campus for Biomedical Engineering was started in January 2006. The goal of the virtual campus is to establish virtual curriculum in Internet for students in biomedical engineering. EVICAB has been build on a learning management system and will provide web-based applications for providing study material, communication system, supporting material, and assessment tools. Ragnar Granit Institute in Tampere University of Technology is one of the contributors in this project. [1]

Virtual campus will provide a variety of e-courses in the field of biomedical engineering. The transfer from classroom education to Internet-based education needs extensive study on available applications for supporting the process. The institute has provided learning supporting material in Internet for several years and used learning management system (LMS) for three years as an important part of the education. The experience in fore mentioned web applications has been vital in the process for providing all the course material in electronic form. For providing the needed material to EVICAB, a project was started for producing web-based learning material for supporting the students' learning process. The education in virtual campus is based on courses with no or at least very little contact teaching. This fact has given rise to specific need for web-based learning supporting material.

The different phases of the process will be discussed and different production methods will be presented. During the whole process the feedback and acceptance from students has been the driving force. Every method and new approach has been evaluated and changes have been done accordingly.

Biomedical Engineering is very technical discipline and for this reason the transfer from contact teaching into e-teaching is not as simple as providing text files or online books for student but needs variety of tools for student to support their studying. Lecture material, supporting study material, online quizzes and exercises, peer communication, and online tutoring have now been implemented into the education. Especially the combination of lecture material and activation of the student during the study process have been carefully considered. The example course used in this study is Bioelectromagnetism by Professor Jaakko Malmivuo.

II. Materials and methods

A. Modeling Phase

The process for creating e-learning material was started by evaluating the existing study material and comparing that to a student centered learning process model. (Fig. 1) The Model illustrates in very simple way the learning process. As an input for the process there are number of sources of information. In Internet education the text formats are the major source of information. Internet books and lecture material in electronic form is the basis for e-courses. The role of teacher is different in e-courses than in contact teaching. Teachers can be considered more as instructor or tutor for providing guidance and guidelines for students, how to study all the essential parts of the material.

The role of supporting material is emphasized in the environment with no face-to-face contact with the teacher. Supporting material in this study is considered to be all the material provided in addition to the primary study material.

All the sources of information are inputs to the study process. The most important role for supporting material in this process is to activate and instruct the student in such way that the course outcomes are achieved. Supporting material should also enable the student to do self-assessment during the process.

Finally the outcomes of the study process will be evaluated. These outcomes can be exam, exercise answers, writ-

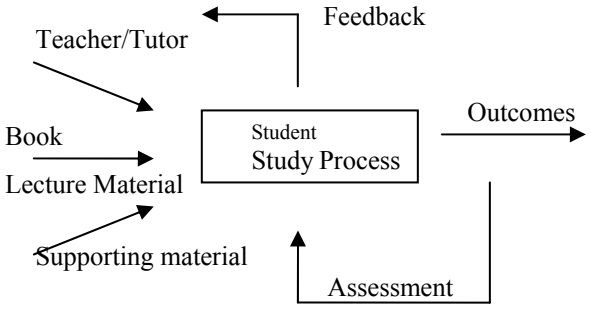

Fig. 1 Model for learning process

ten final report, learning diary etc. This is the way for the teacher to ensure that the objectives of the course have been reached.

The model can be applied in various stages in a course. One particular section or chapter may be analyzed and the objectives for that particular entity can be monitored. Also the whole course may be implemented to the model, containing all the study material and applications. Once a student has studied all the material and generated the outcomes needed, the study process may be evaluated in correlation to the course objectives.

The study process may be considered as an outcome in course design. In course design all the sections in the course has been represented. In the example course Bioelectromagnetism the sections have been divided into four: 1. Preparation, 2. Literature, 3. Video lectures, and 4. Internet Exam.

In preparation section all the information on the course will be provided for the students. Contents of the course, prerequisites, learning material, contact information, and learning outcomes are all presented in the beginning of the course. Course literature will be the primary study material in the course. Internet book and lecture slides are provided. In addition to text-based material, video lectures are produced. Video lectures combined with quizzes and self-evaluation tests will support the learning process. Exercises have also been added in order to guide the students to focus on the facts that the teacher sees essential. At the end the Internet exam will test whether the objectives of the course have been achieved or not.

B. Implementation Phase

The implementation of the study process model is a challenge for all the partners providing e-courses to EVICAB platform. For creating and evaluating different methods and applications that can be used in the implementation, a study has been launched.

Different parts of the model in figure 1 have been supported in the learning environment. The communication between teachers and students are supported by the discussion forums in learning management system and via e-mail. Also the lecture material is available on the Internet in form of online book and written files in LMS.

The most problematic part in the process of students learning in virtual environment for our case was how to support the learning process and how to provide such an interesting material that student feel comfortable for studying without face-to-face contact with the teacher. The idea of supporting material is to activate and stimulate students by providing interactive study material, quizzes for self-assessment, and exercises.

Production of lecture videos in different format started the production of supporting material. Lecture videos were considered to be good format for mostly theoretical courses. First and perhaps the easiest way to provide lectures on the Internet is to combine PowerPoint slides with narration or with audio file. This method was first considered because of the simple and fast production. At the same time shooting of lectures was started. The captured video was combined with screen capture from the PowerPoint slides in order to provide more convenient way for students to follow the lectures. (Fig. 2) In this production type the lecture video and screen capture were recorded separately, edited and combined later by using SMIL, Synchronized Multimedia Integration Language.

Hypermedia laboratory in Tampere University of Technology provided the SMIL code. The benefit from the custom made code was the possibility to change lay-out, table of content and size of any window in the video. These features are commonly considered quite limited in commercial versions.

The next step was to embed interaction to the videos in order to maintain students' interest and activate them during the process. The need for interactivity was met by adding

Fig. 2 Screen capture from Bioelectromagnetism lecture video http://butler.cc.tut.fi/~malmivuo/bem/bembook/in/vi.htm

quizzes and surveys to the videos. The video will be paused until student answers the quiz. In this way we provide a pause for the student to process the information and time to think the key issues in the particular section.

III. Results

All the methods introduced in previous section were analyzed and evaluated. The method with only narrated ppt-files was not very well accepted by the student because of the lack of interactivity and it was considered even boring.

The combination of screen capture and video on the other hand had very positive feedback. In the very first survey on the matter the feedback was 100 per cent (19/19) positive varying from average to excellent. The video lectures were also evaluated in relation to contact teaching and the result was surprising; in some cases the videos were preferred because of the possibility to rewind and pause. These features were especially valuable for those who have not fluent English or are easily distracted in classroom education. The negative feedback was related to usability of the videos. For watching the video students needed Real Player and one plug-in that was considered little awkward procedure.

Due to the negative feedback on the file format the production was rearranged so that the outcome was in Flash format (.swf). Other feature which lead the production to Flash format was the possibility to add quizzes and surveys into the video. This feature was considered very important for activating students while they are watching the videos (Fig. 3) Production of Flash videos is at the moment in progress in Ragnar Granit Institute and no evaluation data has been analyzed yet but the experience has been promising.

Due to the absence of contact teaching in e-learning the role of supporting material and especially self-assessment methods is important. In the example course in EVICAB, Bioelectromagnetism, for this purpose a set of quizzes has been created for every topic. Once a student has finished reading a chapter he/she has an opportunity test how well the concepts were understood. This gives the student opportunity to do self-assessment and get instant feedback whether some topics need more careful study or not.

IV. Discussion

The challenge set in model for the study process has been taken seriously in EVICAB project. The format of all material is initially based on students' feedback. The experience and feedback has been very positive on the lecture videos. The role of supporting material will be even more important in e-courses but its role also in contact teaching should not be neglected. In EVICAB course, Bioelectromagnetism, the students are advised to use the provided material so that they will follow the lecture videos and the e-book simultaneously and even try to find the answers to quizzes and exercises while reading. (Fig. 4) By combining the provided materials as an entity the student will be active participant of the lecture and will focus on the essential parts of the information flow. [2]

The produced lecture videos are only one part of the e-course. During the process many other aspects were taken into consideration. Both online and offline tutoring has been considered. In EVICAB courses students have possibility to discuss with the tutor or with peer students via discussion groups on specified topics or use chat for online communication. This is a way to provide guidance for students

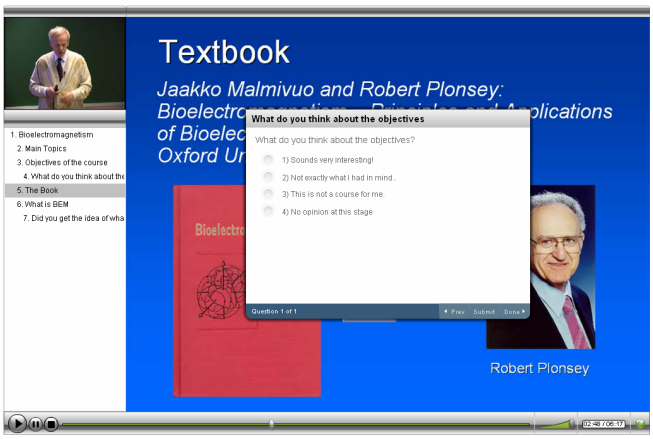

Fig. 3 Screen capture from Bioelectromagnetism lecture video with quiz http://butler.cc.tut.fi/~malmivuo/bem/bembook/in/vi.htm

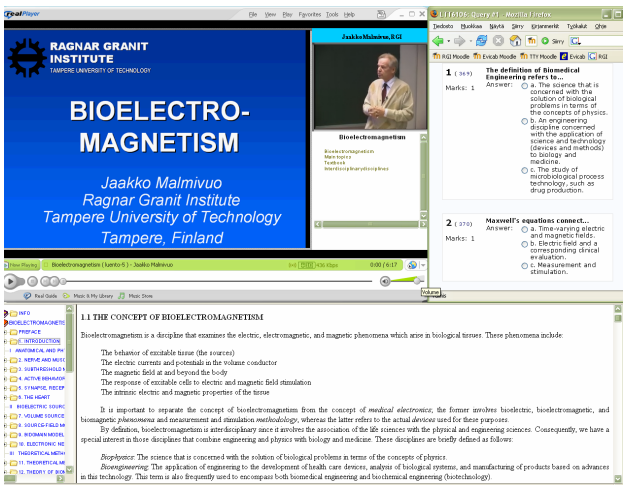

Fig. 4 Screen capture from Bioelectromagnetism lecture in EVICAB

through Internet. In addition, peer communication will strengthen the feeling of solidarity.

V. Conclusions

European Virtual Campus for Biomedical Engineering - project has a challenging approach to e-learning. The approach is to "develop a framework for a sustainable Internet-based virtual biomedical engineering curriculum" This task will be faced by developing and producing e-courses with up-to-date tools and content. [1]

Ragnar Granit Institute is one of the contributors to the EVICAB curriculum. For this reason an extensive study and production of e-learning material has been started. Lecture materials are now available in electronic form. Also the importance of supporting material has been realized. The Internet-based tools are not only considered as tools for e-courses but they have also shown to be valuable asset in contact teaching. The current work at Ragnar Granit Institute has focused on video lectures and development of interactive study material. Videos have been accepted well by the students. The main benefits are the possibilities to rewind and pause if some concepts are not fully understood. Videos are also preferred in situations when students do not have time to attend the classroom lectures. The student may watch the lecture later at home. Quizzes and surveys are embedded to the videos for adding interaction, so that the student is more active participant of the lecture and not only passively listen to the teacher.

Video lecture production is a challenging task and has to be designed well before the shooting. The teacher has to be motivated and well prepared because the editing and reproducing the video is time consuming. If the topic of the course is developing fast, other production models should be considered. Changing the content of particular period of time in the video is inconvenient. The production methods represented here have worked well in Bioelectromagnetism course. The course is very well prepared and the professor has years of experience lecturing the material. Well prepared lecture slides ensure the successful video production and there has not been need for changing the content afterwards. The products of this study have been implemented to EVICAB -learning managements system.
(www.moodle.fi/evicab)

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Author: Kari Lindroos
Institute: Ragnar Granit Institute
Street: P.O. Box 692
City: Tampere
Country: Finland
Email: kari.lindroos@tut.fi