

Biomedical Engineering and Virtual Education

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Abstract— This paper briefly presents Biomedical Engineering (BME) in the virtual education. BME is a relatively new and highly multidisciplinary field of engineering. Due to its versatility and innovativeness, BME requires special learning and teaching methods. Virtual education is an emerging trend in the higher educational system. Technologies, learning theories, instructions, tutoring, and collaboration incorporated in the virtual education can lead to effective learning outcomes. European Virtual Campus for Biomedical Engineering (EVICAB) is the platform, where traditional biomedical education is transferred to the virtual.

Keywords — Biomedical Engineering, Online Education, eLearning, Open Access, Collaboration.

I. INTRODUCTION

Biomedical engineering (BME) is a relatively new field of engineering. It is under the process of continuous change and creation new specialty areas due to a large flow of information and advancements in technologies. Some of the well established specialty areas within the field of BME include bioinstrumentation, biomaterials, biomechanics, cellular, tissue and genetic engineering, clinical engineering, medical imaging, rehabilitation, and systems physiology [1]. The field of BME is very multidisciplinary as it brings together knowledge from many different sources, like medicine, technology and natural sciences.

An education can be seen as traditional and online. The traditional education is based on teacher's and students' face-to-face interactions in a class. Online education has the same meaning as virtual, internet-based, web-based, or education via computer-mediated communication. It is currently becoming popular in higher educational institutions as working students are not able to spend most of their time in a class. Meanwhile, they can attain all study related material on the internet; in the place and time which is the most convenient for them.

Due to its versatility and innovativeness a special educational environment is needed for BME. For this reason a common European Virtual Campus on Biomedical Engineering (EVICAB) is under the process of development.

II. TRADITIONAL AND ONLINE EDUCATION

Despite the totally different information delivering media, traditional and online education has still much in common. Books, lecture notes, exercises, laboratory works, and final exams are common elements of any class. Nowadays it is possible to convert traditional course elements to online without content modifications or loss of data. Examples of traditional and online class elements are listed in Table 1.

Although EVICAB project is in the beginning stage it already has experience in implementing the online material.

The exemplary EVICAB course, Bioelectromagnetism, refers to the book which is available for students in printed and in web edited format [2]. The web book can be accessed globally, by all students at any time. Also video lectures are provided. The lecturer's talk is recorded and compatible with alternating lecture slides. Students have the possibility to choose which lecture format to take so that their information retaining level would be the highest. The final online exam, a new dimension in learning, has also been tested. It was realized in the following way: the students attended the examination at the computer class. Their identities were checked before examination began and questions were opened on the computer. The computers were connected to the Internet and the students were allowed to use all the available material including the text books. Online examination primarily tests students' ability to understand and make conclusions on the material. The internet examination allows instructors/ lecturers to monitor the progress of the examination via the internet independently of their location.

It is not enough just to transfer the traditional material to online in order to achieve effective learning outcomes but also a pedagogical and technical support is needed as illustrated in Fig. 1.

Table 1 Traditional and Online Class Elements

Traditional Class:	Online Class:
Books	eBooks
Lectures	Audio/ Video lectures
Laboratory works	Online laboratory works
Exercises	Online tests, quizzes
Final exam	Online exam

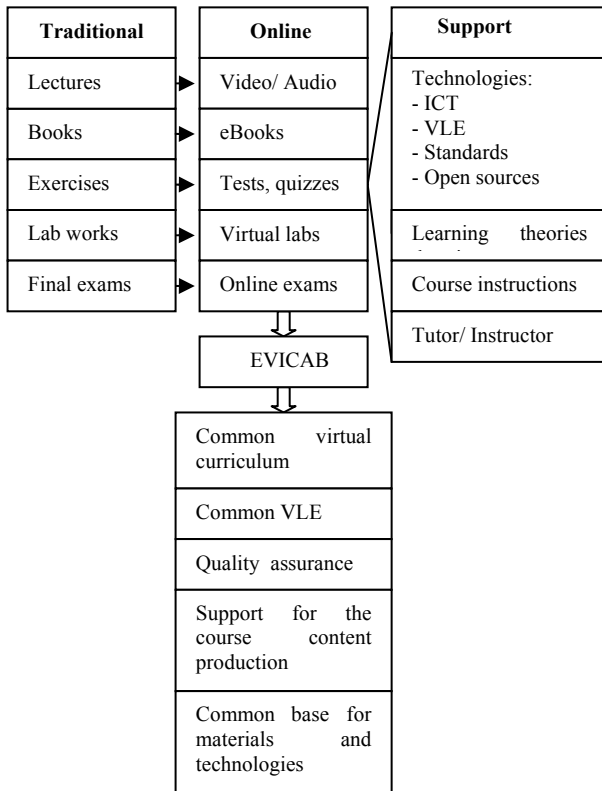


Fig. 1 Traditional and online class elements, support for the material transferring and expected outcomes by implementing courses in EVICAB

III. SUPPORT FOR VIRTUAL EDUCATION

Technology, learning theories, course instructions, and tutors/ instructors are the key elements that support online material implementation.

Traditional and online class elements, the support, and expected outcomes by implementing courses in EVICAB are illustrated in Fig. 1.

In order to provide and apply the online material, sufficient information communication technologies (ICT), i.e., computers with internet access and software programs are required.

A virtual learning environment (VLE), in general, is defined as software to facilitate teachers in managing educational course for students. Moodle [3] was chosen as the virtual learning environment for EVICAB courses. It serves as the common platform to all courses; the material can be accessed by teachers and students at any time. Moodle also allows tracking its users' activity as every user can access the environment under own password. This VLE is not the only that can be used in EVICAB. If other course

providers have already implemented their materials on the other VLE, Moodle can serve as a link to that.

Open source tools and open access learning materials are applied in preparing EVICAB courses. For example, when producing audio/ video lectures, accessing the material (e.g., flash players) or communicating and collaborating (e.g., Skype).

So that the material prepared by different authors and tools would be compatible and possible to use within VLE, Scorm [4] standard will be applied.

Lecture materials in EVICAB courses are divided into segments. Students can navigate through the whole information and choose certain parts to study. The material also can be reused and modified by adding extra information, implementing quizzes or self assessment tests.

Online materials can have a disadvantage, which is passive online reading. In order to avoid that, the online education should be based on learning theories and reasonable pedagogy, like constructivism. This approach gives students the opportunity to construct their own meaning from the information presented during virtual sessions. Learning based on constructivism is seen as active, goal oriented, self-regulated, and depended on prior knowledge and experience.

Every EVICAB course will have instructions so that students could know what prior-knowledge is needed, what are the requirements to pass the course, what can be expected after completing the course, and how will it be related with other courses. Based on this information students could plan their further studies with more motivation.

A teacher as a physical person disappears in the virtual education as all information is available online. Thus, a role of tutor/ instructor becomes important. As students will always have questions related to the course material, assignments, practical issues, organizational matters, etc., there is a need for a contact person who can answer their questions in a short time.

A direct student-to-student communication is restricted in online education. Thus, it is strongly recommended to students to communicate, collaborate, and solve common problems using any online communication technology, like discussion groups, forums, or wiki.

IV. OUTCOMES

This chapter outlines what outcomes have already been achieved and are expected in a long term in EVICAB. These are also illustrated in Fig. 1.

Common curriculum. Since BME is a multidisciplinary field, which brings knowledge from many different sources,

it requires a wide educational background. EVICAB aims to create an open access common curriculum for all cycles of BME education. This is achieved by collaboration between partner institutions and universities, BME programmes. Currently, five partners are involved in curriculum development; they are represented by Ragnar Granit Institute, Tallinn University of Technology, Kaunas University of Technology, Linköping University, and Brno University of Technology.

Virtual Learning Environment. EVICAB uses Moodle as the virtual learning environment. It is also the platform for tutoring and communication between students and teachers. In the future the interface will improve as more courses will be available there; more teachers and students will use VLE.

High quality of online education. Since the standards for preparing and selecting the course materials are under the process of developing, the education in EVICAB has the aim to be at the highest level. This is guaranteed by quality assurance system build in EVICAB.

Support for course content production. Course designers and providers are encouraged to share their experience and tools to prepare high level online materials (e.g., experience in producing video lectures, teleconferencing).

Common recourses. EVICAB aims to create and maintain bases for open access lecture materials and for tools (e.g., software programs) used to create online courses. Course designers and providers could modify, improve, comment, and apply materials and tools for their need.

V. CONCLUSIONS

The online education is a relative new approach in learning and teaching, thus it encourages collaboration for

promoting BME education. EVICAB will serve as the environment for that.

The virtual education is a challenge both for teachers and students. The effective implementation and application of BME education in the virtual environment requires not just transferring the traditional material to the online but also efficient application of technologies, learning theories, pedagogies, human assistance and collaboration between teachers, institutions, and students.

The main advantage of the virtual education is the global open access. The global learning community can be at the fingers of teachers and students. Application of learning technologies, tools, open access materials can provide a new dimension in the education and lead to effective learning outcomes.

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