# Technologies and Methods in Virtual Campus for Improving Learning Process

A. KYBARTAITE, J. NOUSIAINEN, J. MALMIVUO

*Department of Biomedical Engineering, Tampere University of Technology, Tampere, Finland*

**ABSTRACT:** This paper presents technologies and methods that have been used when developing a virtual campus for Biomedical Engineering. Modern educational technologies have been applied to produce video lectures for personal computers, iPods, media phones, and to integrate virtual communication system. It became possible to break traditional classroom boundaries and to develop a worldwide, low-cost, modern technology-based virtual campus. © 2010 Wiley Periodicals, Inc. Comput Appl Eng Educ 21: 185–192, 2013; View this article online at wileyonlinelibrary.com; DOI 10.1002/cae.20460

**Keywords:** e-Learning; educational technology; virtual campus; video lectures

## INTRODUCTION

Teaching and learning methods are changing in modern society. A virtual campus is becoming a prominent environment for distance education [1]. No single definition exists but, in general, virtual campus [2] can be defined as an environment that uses a metaphor of university and provides users with a range of different tools for learning, for example, online lecture notes, virtual demonstrations, online exercises and tests, examinations, lab works, forums, video teleconferences, video games, or video lectures, etc. [3–6].

A development of virtual campus is often based on social constructivism theory [7], which supports an idea that tools for learning should be applied so that dynamic and flexible environment is created and that learners can develop their knowledge also through virtual communication.

According to Debevc et al. [8] video-based online lecture is one of the most powerful and information-rich form for distance education. It can provide information, which is difficult to achieve through text, graphs, or verbally. Video lecture is a multimedia application with considerable promise for teaching and learning in higher education [9].

This paper presents technologies and methods that have been used when developing the virtual campus for Biomedical Engineering (BME). The work has been initialized in the project European Virtual Campus for BME, EVICAB, funded by European Commission January, 2006–December, 2007. The aim of the project was to develop, build up, and evaluate sustainable, dynamic solution for virtual mobility and e-learning in the field of BME [10].

Technologies and methods for developing the virtual campus, producing and sharing video lectures, providing virtual communi-

cation and for integrating all materials in a web portal are discussed in the following chapters. The nature of presented technologies is not unique but the way they are implemented and applied for BME education is new as compared to other similar initiatives. Although video lectures are offered widely, usually they are streaming videos as can be seen from several examples in Ref. [1]. We developed an optimized method for combining different elements of lectures into reasonable and versatile educational content—video lectures, which are accessible with commonly available modern technologies. We included different educational materials, for example, e-book, exercises, virtual models, etc., into open-access educational portal, which can easily be adapted by other educational disciplines. BME is a very multidisciplinary field combining engineering, medical, and biological disciplines.

In this study, we aim to answer a question: what are the current modern educational technologies (i.e., tools) that allow developing a virtual campus by anyone who is motivated? The purpose of this article is to explain these technologies and provide an example of the virtual campus.

## TECHNOLOGIES AND METHODS

### Video Lectures

*Motivation.* When starting to develop video lectures for BME, we considered the predominant factors. What is the purpose of video lectures and who is going to watch them? From the students' point of view the purpose of video lectures is to provide a possibility to review and revise course materials at any time, place, or pace. Also video lectures give the opportunity to study for those who are not able to participate in traditional classroom activities. Therefore, we focused on recording authentic video lectures in a

---

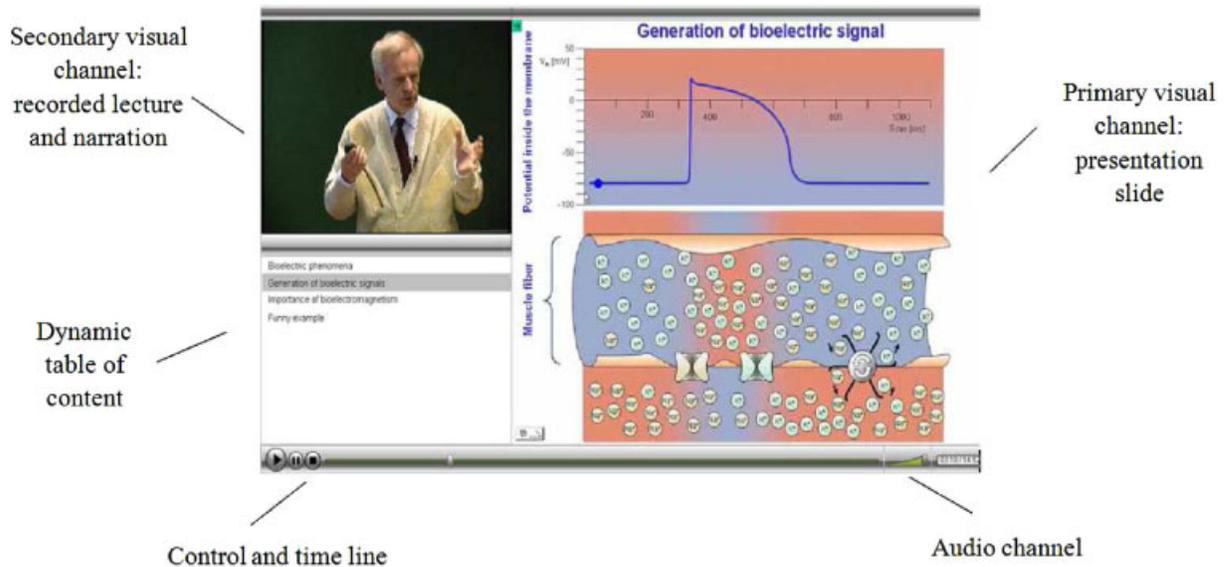Correspondence to A. Kybartaite (asta.kybartaite@tut.fi).

**Figure 1** Elements of video lectures. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

traditional classroom environment instead of a studio-based environment. Also classroom environment is more natural for lecturing than a studio-based environment.

The field of BME is developing worldwide [11–14]. Therefore, not all BME education offering centers, and especially newly established ones, are able to develop and provide high-quality courses for all subfields or topics. Hence, video lectures and supporting educational materials available via the Internet may be used as an alternative for traditional classroom lectures.

When developing video lectures we divided the process into five main steps: plan, record, edit, produce, and share. Good planning involves defining objectives, analyzing technologies, evaluating students' and teachers' needs, finding possible problems, and studying best-practices. Planning ahead helps to prepare for recording and obtaining better quality of video data. When originally recorded data is in good technical quality it is easier to edit it. There is no need to enhance it manually, filter audio data, or compress video data. After editing it is possible to produce video lectures with lower digital space and time consumptions. When video lectures are produced in a user-friendly digital format and size, they can be more easily accessed and shared via the Internet. Therefore, each step is important for the quality of video lectures. These steps are discussed in the following paragraphs.

***Plan.*** Predominant factors boosted further questions. Where video lectures will be posted so that they are accessible by all potential users? What output format is needed? What is maximum file size or bandwidth requirement? What are the dimensions of video lectures? Small video dimensions mean small file sizes but poor visibility. Larger dimensions might not fit well for smaller screens without scrolling or scaling the content. Should video lectures include the lecturer's voice, PowerPoint Presentation (PPT) slides or portable document format (PDF), and video stream? How to combine all that data? What software programs are needed? How to set recording technique and environment? At first preliminary solutions were found and tested.

***Record.*** We decided to combine and synchronize three elements in one application: presentation slides, video, and audio data. Presentation slides, as the primary visual channel, are important elements in the lectures; they carry essential information, for example, graphs, relevant pictures, samples of code, etc. Recorded videos from a lecturer were integrated as the secondary visual and audio channel, and illustrated in Figure 1. Recorded live lectures include not only a speaking person but also incorporate examples, questioning, discussion, humor, gestures, and explanations written on the blackboard. These elements in teaching situations reduce complexity and supply more cues for understanding the matter [15]. Audio channel allows avoiding overloading of visual channels and makes the learning process more effective [16].

Presentation slides, video, and audio data were integrated using optimization principle; presentation slides took 2/3 of the frame and provided important visual information; recorded live lectures took 1/6 of the frame and provided sense of presence; and dynamic and synchronized table of content took 1/6 of the frame.

In order to include original presentation slides, we used screen capturing technology and recorded computer's desktop activity. The screen capture can be in the form of full motion video, still image, demonstration, or program application on lecturer's computer while showing it to the classroom audience. This required installing additional software to the computer. A screen capturing and casting software may be available as commercial and open software [17]. We selected Camtasia Studio by TechSmith Corporation [25]. Screen captures were saved in .CAMREC files [18]. When it is not possible to install the screen capturing software and to record information from the computer's screen, .PPT, or .PDF documents can be converted to graphic file formats, for example, JPEG and used instead [19].

Video recordings were stored to digital video format (DV) tapes and at the same time or later transferred to digital .AVI or .WMV file format [18] using a basic video creating and editing software, for example, Windows Movie Maker [20]. Recommendations for video recording are available elsewhere [21]. Also a short break should be taken every hour in order to reset attention of an audience [22].
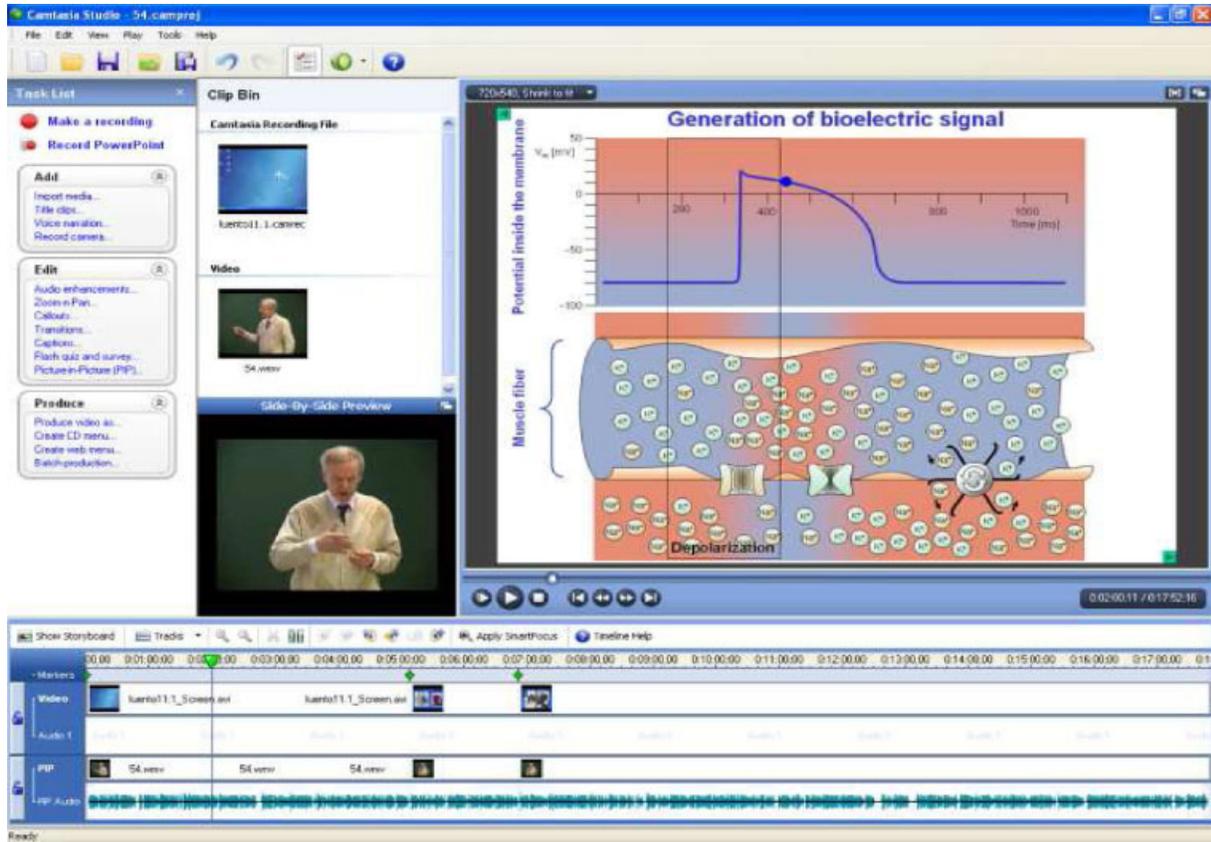
**Figure 2**   Editing window for video lectures. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

*Edit.* Different software may be utilized for editing recorded audio and video data [23,24]. After initial editing, we applied Camtasia Studio [25] software for synchronizing video and presentation slides. Primary, secondary, and audio channels were adjusted as video, picture in picture (pip), and audio tracks (Fig. 2). Depending on the technical quality of data, editing can be quite time-demanding manual process. The process is faster when presentation's slides are available as screen captured animations instead of still images, for example, JPEG. It is easier to follow lectures when they are segmented into time intervals based on the topics. If the lecture is too long and there are too many topics, viewers may become distracted. Also file size becomes too large. The markers for tracking certain slides can be placed on a time line. Software [25] includes more features to enhance video lectures, for example, dynamic table of content, callouts, captions, zooming, flash quizzes, and surveys.

*Produce.* Adobe Flash player is widely distributed multimedia and application player [26]. It uses vector graphics to minimize file size and to create files that save bandwidth and loading time [27]. Flash has become a common format for animations and videos embedded into web pages. This player is built into recent version browsers or available as plug-in. Adobe Flash is supported on Macs, Linux, and Windows workstations. We selected a very common .FLV file format [18] for video lectures.

The display resolution for video lectures were selected so that it suits different computer screens and do not require scrolling or scaling the format too much (Table 1). The number of pixels of common computer screens usually varies between $640 \times 480$ and $2048 \times 1536$ pixels with aspect ratio 4:3 [28].

In the final production file (of each video lecture), we obtained the flash file and 10 supporting files. The total files' size averaged from 20 to 100 MB, that is, 80 MB is about 20 min of video lecture. All the files were placed on the server so that the lectures are accessible via the Internet.

*Share.* Not all viewers may have technology advanced skills and their computer set-up might restrict their capability to see the video lectures [27]. Therefore, the lectures should put as few technical constrains to the viewers as possible. We tested that the minimum bandwidth should be 350 Kb/s, but it is recommended 1 Mb/s to watch the lectures without buffering pauses. Larger bandwidths are becoming more and more available (e.g., DSL technologies [29]), but still this might be true only for certain countries. Using the global broadband speed test [30], we obtained the following data, for example, in Finland the average available bandwidth for downloading is 7.8 Mb/s, in Europe—6.4 Mb/s,

**Table 1**   Display Resolution of the Video Lectures

| Elements of video lectures | Dimensions (in pixels, height and width) |
| --- | --- |
| Total | $1040 \times 595$ |
| Primary video channel (slides) | $720 \times 540$ |
| Secondary video channel (video record) | $320 \times 240$ |

global—5.5 Mb/s, whereas in Asia, for example, Bangladesh (Dhaka city)—0.42 Mb/s. Another issue to consider is the bandwidth problem on the source site—what can happen to the server if it gets hundreds of requests at the same time for video lectures? We placed the lectures on the university server and did not experience related problems so far. It is also possible to upload videos on external servers [31,32].

Another way to reduce bandwidth is to minimize video resolution; but this may lead to a low quality of the video lectures, which cannot be watched anymore. These choices could be defined at the beginning of the production of video lectures and not modifiable; or dynamic—adjusted in response to the time and needs.

### Video Lectures for Personal, Portable, and Mobile Gadgets

We considered how video lectures can be further utilized. Streaming requires permanent Internet connection [33]. It is possible to make a downloadable compressed file containing lectures to be played later locally on the viewer's computer. Transferring the compressed file can happen at lower speed but when it is downloaded it can be played multiple times and does not require Internet connection. Another possibility is distributing the video lectures on digital versatile disks (DVDs).

A video files converting software was used to obtain MP3, MP4, and 3GP [18,34] files for audio, video players, and mobile phones. It became possible to access files with free software, that is, iTunes and QuickTime player [35,36] and then upload them to personal gadgets.

We produced MP4 files with one visual channel, that is, recorded presentation slides and audio channel. These files were made to be accessible with iPods, for example, $320 \times 240$ screen resolution; also other players could be used [37]. Capability of mobile phones is increasing every day. So in addition, we experimented with media phones by producing and uploading 3GP file format. Nowadays, there exists different audio and video conversion software, which allow achieving various compatibility file formats [38]. When producing the video lectures it should be considered which file format is needed and can be used for a certain application.

### Virtual Communication

Interactivity is a critical component of teaching and learning [39]. It is especially important in a virtual education due to the distance and time difference between an educator, students, and peers. WordPress blog tool and publishing platform [40] was implemented as an asynchronous communication system. All users have the possibility to leave their comments, messages, and suggestions in the system as it does not require registration. A rating system was added so that the users could evaluate information within each lecture, which consists of several video records.

### Web Portal

We used Hypertext Markup Language (HTML) to implement learning materials in the web portal [41]. Its code maybe used as an open source. It is possible to contribute to the code development first downloading it to own computer. Layout of the portal has been considered so that accessibility and usability of the campus is as easy and user-friendly as possible. HTML can execute on a PC under Windows or OS/2, on a Mac, or on a UNIX worksta-

tion. The web portal has been optimized for the Mozilla Firefox browser.

### Feedback Questionnaire

The above-mentioned materials and methods have been applied when implementing Bioelectromagnetism course at Tampere and Helsinki Universities of Technology. Students with several different native languages attended the course. The course was offered both in the traditional classroom environment and in the virtual campus. A questionnaire was developed to collect feedback from 66 students, who participated in the course, for preliminary evaluation of the implemented methods. The questionnaire included 20 closed- and open-ended questions. Students had the possibility to express opinions by selecting one or more answers from multiple-choice questions and commenting in own words. Several answers had a grading system—Likert scale from 1 to 5; where grade 1 was for not useful and grade 5 meant very useful. Students were asked to answer questions as accurately as possible. The information obtained from the feedback was collated into charts; one of them is displayed in Figure 6. Average values were calculated for the answers, which had Likert scaling. The detailed evaluation and reflection of feedbacks will be prepared as a separate publication.

## RESULTS

### Virtual Campus

The virtual campus for BME has been developed by using the above presented technologies and methods. Architecture of the presented system is illustrated in Figure 3. The campus provides possibility to build up, implement, test, and prove importance of virtual education on the global scale. It is open for all students as they may access its content without any required password and no fee is asked for using learning materials. The campus provides a platform to share learning materials prepared by distinguished international lecturers. Modern information communication technologies (ICTs), for example, notebooks, video and audio players, or media phones may be applied to access the system.

### Learning Materials and Accessibility

We developed own method to produce the video lectures. In order to make the lectures independent of only one type of device, that is, PC, and to make them accessible anytime and anywhere, files were transformed to be compatible with personal, portable, and mobile gadgets. We were mainly interested in the application of iPods and media phones for educational purposes. The video lectures lack interactivity, for example, possibility to ask questions or express opinion, therefore communication and rating system was implemented.

We collected learning material and related information in to open-access and user-friendly web portal. Web Log-ins showed that the users mainly accessed the virtual campus via Firefox browser using Windows operating machines (Fig. 4). This information was important since not every browser on every operating system is able to correctly decode video files. The Log-ins system counted on average 40 visits coming from all over the world every day (Fig. 5). This information proved that the virtual campus has been accessible.
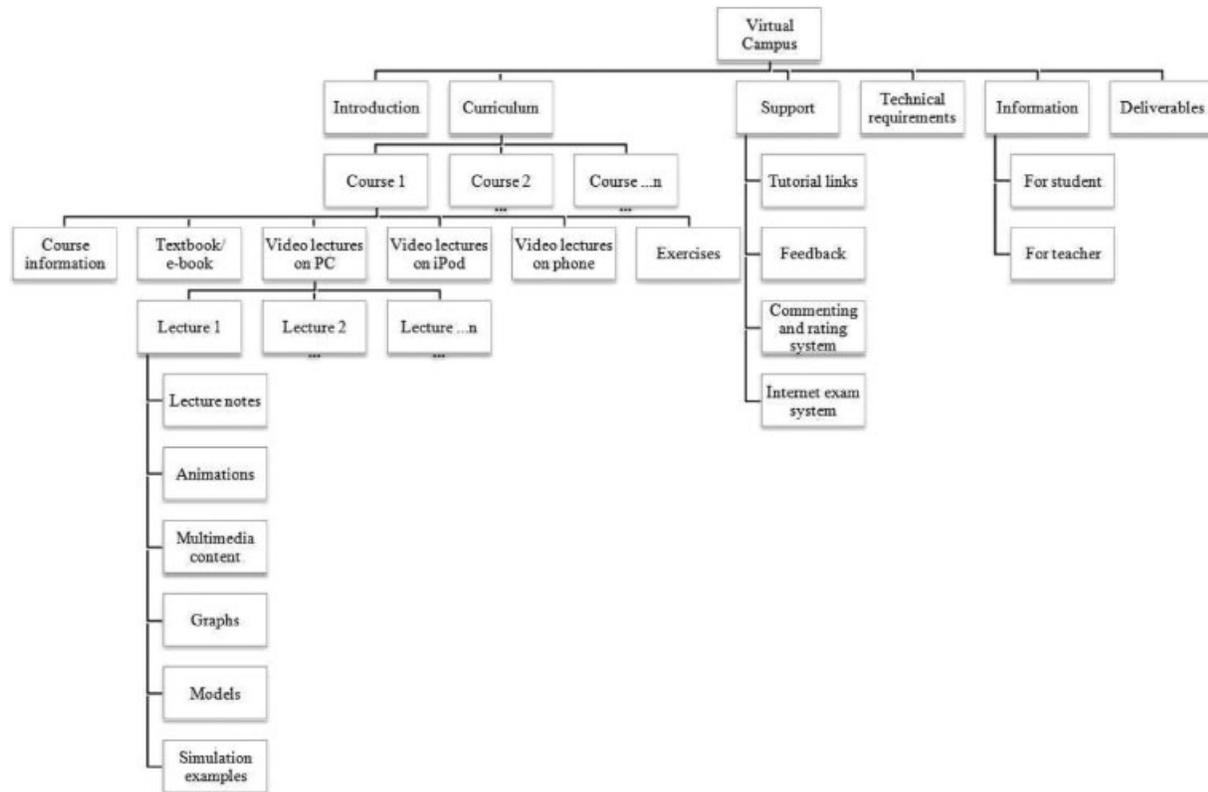
**Figure 3**  Main architecture of the virtual campus design.

### Evaluation With Questionnaires

Feedback results revealed that students appreciate the advantages of the virtual campus, for example, "virtual class can be attended anytime and anywhere," "virtual class offers the possibility to revise concepts," etc. Despite that, still the majority of the students (67%) considered traditional class as the main learning method; the most common reason for that is: "it is easy to participate in traditional lectures and there is a possibility to ask." BME students would like learning material in video format, animations, and instructions in written format to be included in a virtual course (Fig. 6). Nowadays all students claim to have access to PCs; 38% of them use audio and video players for their studies. Progressively teachers and students become more and more interested in the possibilities that virtual education may provide, that is, "it would be nice to have more virtual courses."

### DISCUSSION

Presented methods and technologies for developing the virtual campus are not new endeavors. Video lectures have been developed by many educational institutions [42–45]. They provide collections of academic videos for different scientific fields. These videos show a lecturer and what he/she presents on a blackboard. Most of these videos are directly recorded from a lecturing hall presenting the lecturer and a set of PPT slides. Some of these videos form lectures, which are the material for a certain course, but there is no information on credit units and about the possibility to take an examination.

We were looking for innovative implementation and application methods of video lectures for BME discipline. The virtual campus, EVICAB, provides edited video lectures in a form of combination of recorded live lectures, accompanying sound, and synchronized presentations. They form certain courses recognized by International Universities. Students can take the exam after following these lectures and earn credits for their studies.

We agree that video lecture is a multimedia application with considerable promise for teaching and learning in higher education [9]. In general, the main advantages of video lectures for students are (also for teachers): (1) grasping students' attention and motivating them to learn, (2) providing highly realistic depiction of situation which students would not otherwise have possibility to see, for example, medical procedure, (3) providing possibility to watch again/later recorded lectures until a skill is mastered or information is comprehended, (4) allowing students to catch up if they miss a live lecture, (5) enhancing flexibility to choose learning place, time, and pace, etc. Video lectures also have disadvantages such as: (1) watching video lectures may become a dull and repetitive process, (2) no direct interaction with lecturer and peers limits possibility to ask questions, (3) computer access or Internet connection might not be available, (4) fast accessing of information might diminish the importance of constructing knowledge, etc.

In order to utilize advantages and to find solutions for disadvantages of video lectures we combined supporting materials, that is, lecture slides, online quizzes and exercises, animations, e-book, virtual communication system, etc.
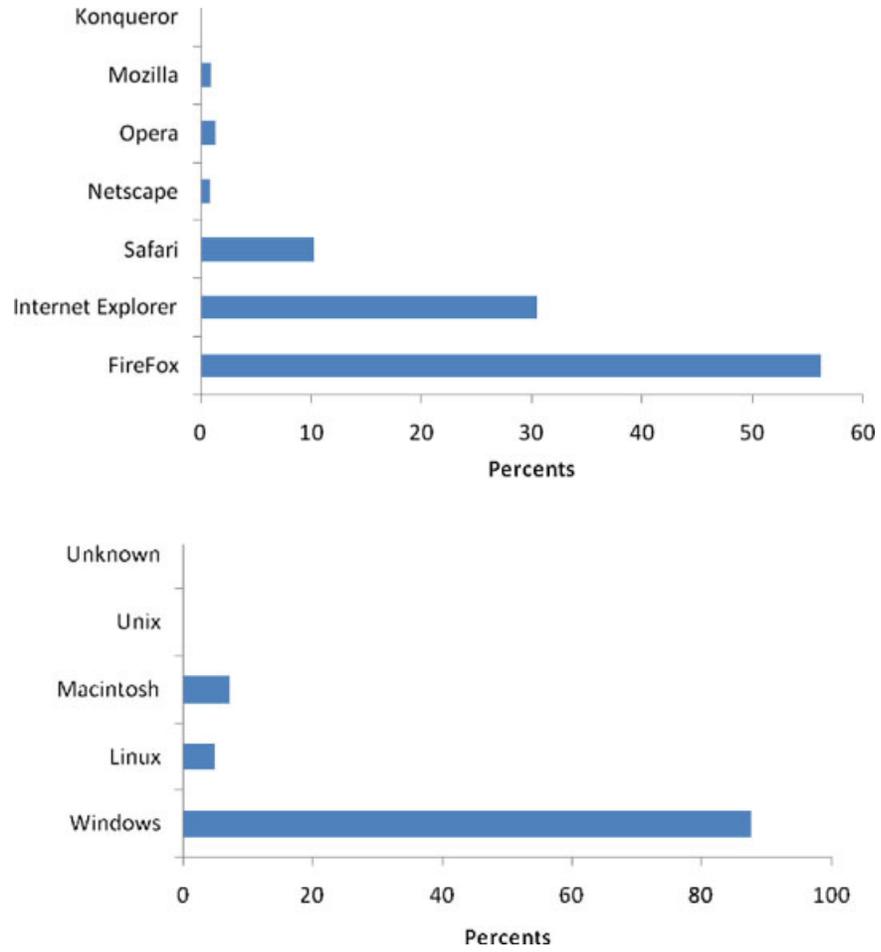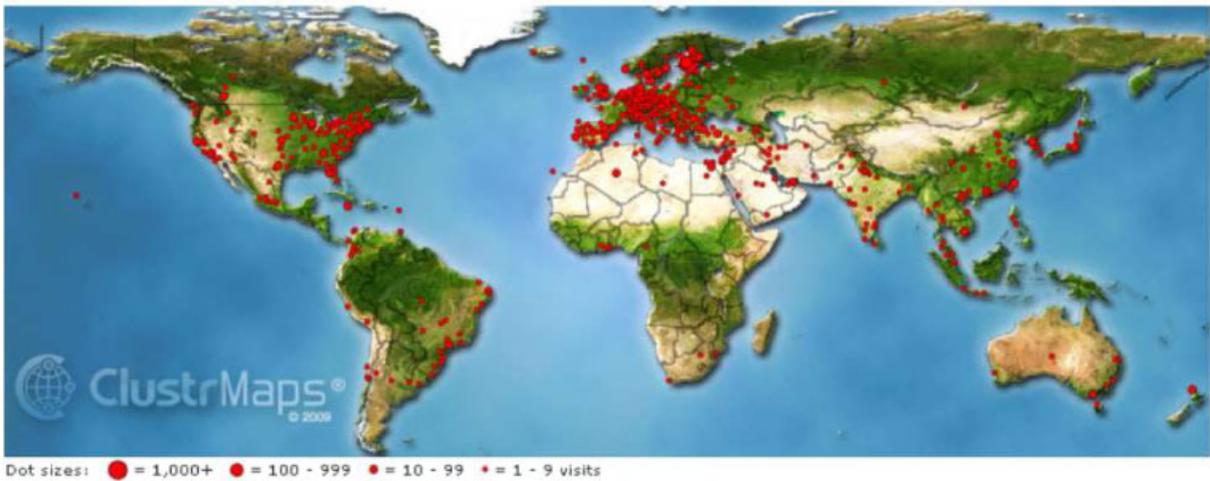
**Figure 4**  Browsers and operating machines used to access virtual campus.

**EVICAB**



Dot sizes:  ● = 1,000+   ● = 100 - 999   ● = 10 - 99   • = 1 - 9 visits

From 12 Feb 2009 to 13 Feb 2010: Total: 2,958

**Figure 5**  Statistics about EVICAB virtual visits since February 12, 2009. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]
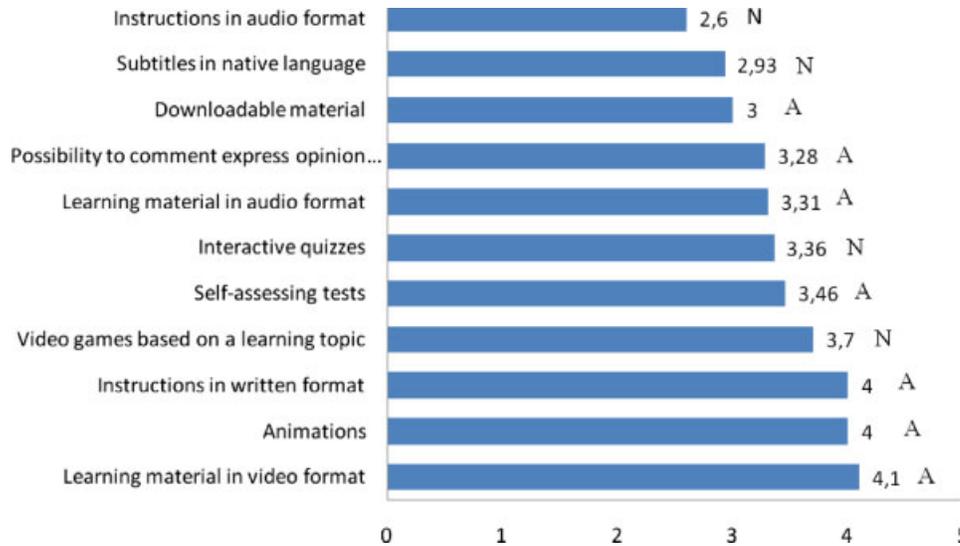
**Figure 6** Anticipated usefulness of learning elements within the virtual course presented as averages. Evaluation scale was from 1 (not useful) to 5 (very useful). A: Learning elements were available in the virtual campus; students have possibility to test them. N: Learning elements were not available in the virtual campus; students anticipate their usefulness.

We realized that the students are not so willing to communicate via the virtual communication system. This may be due to a fact that the students are not familiar with such a system; they assume that nobody will respond or it is faster and more probable to get a feedback when communicating directly to a person than through the virtual system.

In Engineering education deeper learning and longer retention of what has been learned can be achieved by making laboratory works. Real laboratories are not accessible for virtual students, therefore, interactive experiments using software tools can help students to grasp difficult theoretical concepts and develop certain skills. There is a wide range of examples when commercial or open source software programs have been applied in a virtual course. However, often it is difficult to implement software programs in a suitable and pedagogical way; that requires good software skills and consumes a lot of time. Another problem with software programs for teaching and learning is their relatively short life cycle (often <5 years) [46]. So far, we have been researching different software programs and started to collect them under tutorial links in the web portal. These practices can provide insights what virtual laboratory works are necessary for BME students and how to develop them.

The Internet has significantly changed the distribution of information. Nowadays information is accessible worldwide, real time and free of delivery cost. That ensures wide audience and publicity for learning materials on the Internet. It is possible to identify at least three groups who are direct beneficiaries from virtual education; they are students, instructors, and university administrators [47].

## CONCLUSION

Nowadays technologies and methods are available and relatively user friendly for developing the virtual campus for higher education. Anyone who is interested in developing or contributing to the virtual campus is able to do that. Thus, new technical boundaries

may appear. They can be diminished by considerate technology analysis and design.

Findings of this study for BME discipline proved that the virtual campus for higher education is feasible.

## REFERENCES

[1] Re. ViCa, Virtual Campus, updated Fall 2009, www.virtualcampuses.eu/index.php/Virtual_campus (accessed on November 2009).

[2] M. Fominykh, E. Praslova-Forland, M. Morozov, and A. Gerasimov, Virtual campus as a framework for educational and social activities, 2008, www.idi.ntnu.no/grupper/su/publ/fominykh/fominykh-cate08.pdf (accessed on November 2009).

[3] D. Dwyer, K. Barbieri, and H. Doerr, Creating a virtual classroom for interactive education on the Web, Comput Netw ISDN Sys 27 (1995), 897–904.

[4] M. L. Maher, B. Skow, and A. Cicognani, Designing the virtual campus, Des Stud 20 (1999), 319–342.

[5] S. Schultze-Mosgau, T. Zielinski, and J. Lochner, Web-based, virtual course units as a didactic concept for medical teaching, 2004, informahealthcare.com/doi/abs/10.1080/01421590410001679028 (accessed on November 2009).

[6] M. Karami, N. H. Heussen, T. Schmitz-Rode, and M. Baumann, Advantages and disadvantages of electric assessment in Biomedical Engineering, IFMBE proceedings, World congress on Medical Physics and Biomedical Engineering, 25 (2009), 61–64.

[7] A. Moore, Teaching and Learning: Pedagogy Curriculum Culture Routlege, London, 2000, p 189.

[8] M. Debevc, R. Safaric, and M. Golob, Hypervideo application on an experimental control system as an approach to education, Comput Appl Eng Educ 16 (2008), 31–344.

[9] J. Whatley and A. Ahmad, Using video to record summary lectures to aid students' revision, Interdiscip J Knowl Learn Objects 3 (2007), 185–196.

[10] J. Malmivuo, EVICAB, www.evicab.eu (accessed on November 2009).

[11] C. Brancaleone, R. Tranfaglia, L. Mirarchi, and M. Bracale, An e-learning experience for medical education in Mediterranean coun-

tries, 2009, IFMBE proceedings, World congress on Medical Physics and Biomedical Engineering, 25 (2009), 271–274.

[12] N. D. Khambete, Biomedical engineering education and training in India—A need for new approach, IFMBE proceedings, World congress on Medical Physics and Biomedical Engineering, 25 (2009), 368–371.

[13] X. Weng, W. Niu, and Y. Fan, Educational development of biomedical engineering in China, IFMBE Proceedings, World congress on Medical Physics and Biomedical Engineering, 25 (2009), 101–104.

[14] M. Wasilewska-Radwanska and P. Augustyniak, Multidisciplinary school as BME teaching option, IFMBE Proceedings, World congress on Medical Physics and Biomedical Engineering, 25 (2009), 200–203.

[15] Y. Fritze and Y. T. Nordkvelle, Comparing lectures: Effects of the technological context of the studio, Educ Inf Technol 8 (2003), 327–343.

[16] R. E. Mayer, The Cambridge handbook of multimedia learning, Cambridge University Press, Cambridge, 2005, p 5.

[17] Wikimedia Foundation, Inc., Comparison of screencasting software, 2009, en.wikipedia.org/wiki/Comparison_of_screencasting_software (accessed on May 2009).

[18] Video files, 2005–2009, www.fileinfo.com/filetypes/video (accessed on November 2009).

[19] J. Miano, Compressed image file formats. Addison-Wesley, Massachusetts, 1999.

[20] Microsoft Corporation, Windows movie maker, 2009, www.microsoft.com/windowsxp/using/moviemaker/default.mspx (accessed on June 2009).

[21] Learn video production, digital video editing, camcorder reviews, videography, 2009, www.videomaker.com (accessed on May 2009).

[22] P. Aarabi, The art of lecturing, Cambridge University Press, Cambridge, 2007.

[23] Wikimedia Foundation, Inc., List of free software for audio, 2009, en.wikipedia.org/wiki/Free_audio_software (accessed on May 2009).

[24] Wikimedia Foundation, Inc., Comparison of video editing software, 2009, en.wikipedia.org/wiki/Comparison_of_video_editing_software (accessed on May 2009).

[25] TechSmith Corporation, Camtasia Studio, Screen Recorder Software, 1995–2009, www.techsmith.com/camtasia.asp (accessed on November 2009).

[26] Adobe Systems Inc., Adobe Flash Player, 2009, www.adobe.com/products/flashplayer (accessed on November 2009).

[27] M. Ronchetti, Requirements for video lectures: Which system is the best for you? 2009, latemar.science.unitn.it/segue_userFiles/LODE/RequirementsForVideolectures.pdf (accessed November 2009).

[28] Wikimedia Foundation, Inc., List of common resolutions, 2009, en.wikipedia.org/wiki/List_of_common_resolutions (accessed on November 2009).

[29] P. Golden, H. Dedieu, and K. Jacobsen, Implementation and application of DSL technology, Auerbach, New York, 2007.

[30] Speedtest.Net—The Global Broadband Speed Test, 2009, www.speedtest.net (accessed on November 2009).

[31] TechSmith Corporation, Screencast.com, 1995–2009, www.screencast.com (accessed on November 2009).

[32] Yovisto—Academic Video Search, 2006–2009, www.yovisto.com (accessed on November 2009).

[33] G. Conklin, G. Greenbaum, K. Lillevold, A. Lippman, and Y. Reznik, Video coding for streaming media delivery on the Internet, IEEE Trans Circuits Sys Video Technol 11 (2001), 269–281.

[34] Audio files, 2005–2009, www.fileinfo.com/filetypes/audio (accessed on November 2009).

[35] Apple Inc., iTunes, 2009, www.apple.com/itunes (accessed on November 2009).

[36] Apple Inc., QuickTime Player, 2009, www.apple.com/quicktime (accessed on November 2009).

[37] Wikimedia Foundation, Inc., Comparison of portable media players, 2009, en.wikipedia.org/wiki/Comparison_of_portable_media_players (accessed on November 2009).

[38] Wikimedia Foundation, Inc., Comparison of container formats, 2009, en.wikipedia.org/wiki/Comparison_of_container_formats (accessed on November 2009).

[39] K. Siau, H. Sheng, and F. Nah, Use of a classroom response system to enhance classroom interactivity, IEEE Trans Educ 49 (2006), 398–403.

[40] WordPress.com, wordpress.com (accessed on May 2009).

[41] Web files, 2005–2009, www.fileinfo.com/filetypes/web (accessed on November 2009).

[42] Webcast.berkeley, 2002–2009, webcast.berkeley.edu (accessed on November 2009).

[43] MIT open course ware, 2002–2009, ocw.mit.edu/OcwWeb/web/home/home/index.htm (accessed on November 2009).

[44] Video lectures—Exchange ideas and share knowledge, 2009, videolectures.net (accessed on November 2009).

[45] Free video lectures. World's best professors are teaching here. Where are you? 2009, freevideolectures.com (accessed on November 2009).

[46] S. Tabakov, E-Learning development in medical physics and engineering, Biomed Imaging Interv J (2009), www.biij.org/2008/1/e27 (accessed on December 2009).

[47] L. Ma, D. Vogel, and C. Wagner, Will virtual education initiatives succeed? Inf Technol Manage 1 (2000), 209–227.

## BIOGRAPHIES

**Asta Kybartaite** received the M.Sc. degree in biomedical engineering from Tampere University of Technology (TUT), Tampere, Finland, in 2006. Currently she is finalizing her Ph.D. dissertation at TUT. Since 2006 she has been working as researcher at Ragnar Granit Institute and later at the Department of Biomedical Engineering, TUT. Her main research interests are in computational modeling of physiological systems and modern educational technologies.

**Juha Nousiainen** received the M.Sc. degree and Ph.D. degree in Technology in 1983 and 1991, respectively. Currently he is working at the Department of Biomedical Engineering, Tampere University of Technology, Finland as a senior lecturer. His research work has been connected to electromagnetocardiography and recently to e-learning.

**Jaakko A. Malmivuo** received the M.Sc. and Ph.D. degrees from Helsinki University of Technology, Espoo, Finland, in 1971 and 1976, respectively. From 1974 to 1976 he served as researcher at Stanford University. In 1976 he was appointed as Associate Professor and in 1987 Professor of Bioelectromagnetism at Tampere University of Technology (TUT), Tampere, Finland. He has served as Visiting Professor at Technical University of Berlin (West) (1988), Dalhousie University, Halifax, Canada (1989), Sophia University, Tokyo, (1993), and University of Barcelona (2006). He has over 600 scientific publications and he has co-written with R. Plonsey, "Bioelectromagnetism" (Oxford University Press, New York, 1995). Dr. Malmivuo was President of the Finnish Society for Medical Physics and Medical Engineering in 1987–1990. He is Founder Member and was President of the International Society for Bioelectromagnetism 1995–1999. He is founder of the International Journal of Bioelectromagnetism and was Editor in Chief 1999–2006. In 2003 he was appointed Fellow, International Academy of Medical and Biological Engineering, and in 2007 Fellow IEEE. In 2008 he was appointed as Honorary Member of the Finnish Society for Medical Physics and Medical Engineering.