Quo Vadis, e-learning?

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Abstract— The authors show their view on e-learning in the last ten years focusing on situation in Slovakia. Presenting their own experiences, they aim to provide relevant information about these issues, constraints and benefits related to e-learning way of engineering education. The authors are convinced that one of the biggest challenges in future e-learning is implementation of the principles of quality e-learning courses development according to the newest standards to use the golden opportunities in increasing the students’ motivation and effectiveness of engineering education. They are utilizing decades of practical experiences with the creation of courses for eLearn central portal and their implementation in praxis.

I. INTRODUCTION

In the year 2001, when 1st International Conference on Emerging eLearning Technologies and Applications took place, we had no idea how ICT progress would influence e-learning technologies by the year 2012. Multimedia learning [1, 2], cooperative learning [3], tutor-based telelearning [4], remote and virtual laboratories [5], ubiquitous/mobile learning, microlearning [6], virtual collaboration/classrooms [7], study supports with internal intelligence [8], 3D virtual worlds [9], massive open online courses [10], simulations [11], games [12], are becoming common parts of nowadays e-learning. You can hardly find anybody who does not have mobile phone, computer or access to internet in Slovakia.

How does this status of ICT reflect in e-learning usage in our education?

II. SHORT Recapitulation of E-Learning

Ten years ago the e-learning authors and enthusiasts were focused on software solutions as background of e-learning. Most of the past e-learning projects where built on platforms based on php, html… created by our own forces. Commercial systems such as Lotus [13] or Blackboard [14] were not easily affordable to our users. Open source systems where at that time in their infancy. All e-learning materials for engineering education were available in html, doc or pdf format, and we have started to develop the first online animations. These were intended to show the nature of chosen electronic effects and main working principle of basic electronic elements. Still there are also available materials on CD from abroad such as “The way things works” [15]. In the center of our effort was the creation of storage places for study materials. The communication between students and tutors was held mainly by e-mail.

In the year 2000, Claroline, an open collaborative eLearning and eWorking platform has started [16], in August 2002, LMS Moodle (Learning Management System Modular Object-Oriented Dynamic Learning Environment) a free source e-learning software platform was born [17], in March 2005 Sakai CLE (Collaboration and Learning Environment) a Java-based, service-oriented application has been launched [18]…

Open source e-learning management systems such as Moodle have been spread very quickly in the community of authors, followers of constructivist approach to education. These platforms have been growing up together with rapid progress in mobile phone, iPod and multimedia technology, as well as better accessibility and progress in Flash, 3D and Java technology. Implementation of all mentioned technologies to learning process is rising exponentially. Like in other areas so in e-learning is the technology one step ahead of the authors and users.

While in the first half of decade we have been focused on technical solutions, after e-learning management systems have come into focus we were free to turn our attention mostly on development and implementation of e-learning education in engineering study process. It was very helpful for many of us, since e-learning was no longer the domain of those with advanced computer skills. The pedagogues from various areas had new chance to enter the design process and they could create and exploit their own courses. The team teacher and computer expert is for sure the optimal choice for e-learning creation. But it is a great advantage, that there is available also an option for the teacher himself, even if he has only minimal level of computer skills.

Even the demands on creation of new e-materials have changed; short topical units are preferred. These are often created by students, then revised and completed by teachers. e-learning materials have become common part of standard education process; the content has to be available anytime and anywhere students need it, in synchronous and asynchronous way. This form of education has ambition to be continuous process, not only occasional thing.

Nowadays the most popular form of education combines both face to face learning and e-learning [19].

A. Short Recapitulation of eLearn central

We have started to create the first systematic e-learning materials for students in 2000. We have used our own interactive web pages for their publication [20]. In December 2004 we have created an alternate source of information - an educational portal called eLearn central [21]. Portal eLearn central uses the learning environment LMS Moodle and today is located on the server of the Institute of Electronics and Photonics, Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava. Currently
we are working with three portals based on Moodle called eLearn central [22].

eLearn central old: primary portal mentioned before eLearn central labelled as old created in 2004, accessible through the hyperlink http://ec.elf.stuba.sk (uses a CMS Moodle 1.9).

eLearn central journal: portal-journal created in June 2011, accessible through the hyperlink: http://kme.elf.stuba.sk/elearn (uses a CMS Moodle 1.9 with integrated author’s template).

eLearn central: educational portal created in June 2011 (Fig. 1), accessible through the hyperlink: http://kme.elf.stuba.sk/moodle (uses a CMS Moodle 2.)

Since 2004 we have developed numerous educational materials which are stored on these portals eLearn central.

In 2010 we have proceeded the plan to develop our own template. Such authoring tool has to comply with specific criteria for developing the engineering education e-learning materials. One of them is also the review process that we have integrated to Moodle 1.9. This modified Moodle has been installed on new hardware and so the eLearn central journal has originated. This template acts as a support to create courses - the authoring tool for authors with no further experience in creating professional e-learning educational materials (Fig. 2). The author has very intuitive and easy-to-use tool to prepare quality e-learning materials with strong technical background.

In 2011 we have finally decided for the newest Moodle 2. version which unfortunately is not fully compatible with Moodle 1.9. So for now we are not able to integrate our authoring tool to the new portal eLearn central but we are working hard on some suitable solution. On the other hand Moodle 2. provides us new options which are very useful by developing courses for face to face learning support.

By working on these portals we have gained a lot of experiences and valuable know-how.

The main aspect of development and implementation of courses on the eLearn central portals is effectiveness in education. We have to create courses full of interactivity, multimedia elements, animations, self-tests, discussion forums and wiki modules. Platform CMS Moodle enables and allows us to focus on important things - learning content and context, development of explanatory flash animations, creating eye-opening tests, tutoring of discussion forums… Our authors and teachers now have to concentrate their attention on the quality of prepared educational materials in the first place. They have to ensure the effective use of these materials in educational process.

The courses and e-learning projects located on three educational portals eLearn central are successfully implemented in education process at our university since 2005. These courses mainly serve students at the Faculty of Electrical Engineering and Information Technology as an alternative source of information and support used in a blended form of study since 2005 (face to face and e-learning), students team work since 2005, a distance study since 2006, the popularization of Science and Technology between kids and young people since 2009 and team work in projects realization since 2009.

The response of our students and users is very positive [23], and e.g. students use these portals as educational source even after finishing their study course, for example as information source when they are preparing for their diploma exam. The number of our visitors is dramatically rising before examination and tests.

To mention not only positive aspects, the greatest disadvantage of described portals is a weak information campaign – people do not know, that such options are available.

III. E-LEARNING IN ENGINEERING EDUCATION

The life in 21st century is highly influenced by new technologies and rapid progress in the sphere of science and research. The effort of society to be successful enhances the focus on quality of engineering education [24].

A. Challenges and Solutions in Engineering Education

Quality assurance in engineering education is one of the most important challenges today. It is by our opinion the effective answer to three key problems in engineering education: global problem with the continuous decrease of young people’s interest in study at technical schools, necessity of constant update of the subjects’ content and serious problem with students who came from secondary schools to the university with different level of knowledge.

One more highly important challenge is need of cooperation and coordination. Mr. Herbert A. Simon [25] has formulated this challenge following: "Improvement in post-secondary education will require converting teaching from a solo sport to a community based research activity."

All above mentioned facts evoke the need for continuous development of effective education methods not only in technical subjects. It is essential that the process of teaching adapts to the newest trends and tendencies and that this process is made as quick as possible to achieve the best results in the teaching strategies.

Modern Information Technology has opened up many new possibilities in learning [26]. Education is information transfer and it is radical changing: Digitize everything! Not only educational materials (multimedia [1, 2, 7] – content and assessment, electronic textbooks-flexbooks, ebooks, ibooks- multimedia content – videos, 3D models, image galleries, interactive animations [27], review assessment, highlights and notes – user-made flashcards, distribution), but also actor and content (social networks and MOOCs - Massive Open Online Courses [10], 3D virtual worlds [9], Augment Reality and Games [12], digital image of Persons and content) and the educational process.
Technology trends in engineering education in a blended and distance learning head towards Virtual labs, Simulators and Remote labs, games.

Virtual labs are software or simulations that allow students to carry out experiments in virtual laboratory environment. In the case of remote web labs, students hand real measuring equipment through Internet. This has yielded to a big interest in remote laboratories design in order to enhance their performance.

Very effective tool in engineering education is also Game. New trends in the serious games research are trying to take more advantage of their potential – new game mechanics, learning analytics with games, applying e-learning standards in games, what means to improve reusability and interoperability.

We want to keep up with rapidly evolving e-learning technologies but we face difficult question, whether the development of educational materials using extremely high technologies is worth trying globally, although it does not reflect in education efficiency. Each kind of technology has its own area of implementation, for that it is optimal.

B. Benefits related to e-learning way of engineering education

E-learning is becoming highly popular and progressive form of education. e-learning as educational method is motivational, practical and allows learning more information in shorter period [28]. Demonstrative features, such as interactive animations, can be implemented in its content, which can be easily updated and shared over Internet. While before the use of animations was limited in file size, this is no more a factor as the internet connection has improved. Thanks to this, we can exploit multimedia and streaming in communication at conferences and for education purposes.

Major change has brought Google (began in January 1996) and Wikipedia (was formally launched on 15 January 2001). Googlemania is present everywhere. Who does not type google.com as his first choice by searching the internet for some information? The Wikipedia project and similar satellite projects have grabbed all the attention in the sphere of education. Many keywords are prepared so exact, that they can represent the initial information about desired theme.

New possibilities in e-learning were opened by YouTube entering the web (in February 2005); whole lectures from prominent Universities such as Stanford... and animated processes are located there. Therefore today it is possible for the teacher to make online course even without creating these materials. He can easily create complex of hyperlinks to free available online education materials. If the platform such as Moodle is used, the real financial costs of the course could be really minimal.

Nowadays, e-learning offers user-friendly authoring tools, which enable to bring user-generated content, teaching demands and education scope into line. To give an example, we can mention, that in 2010 we have started to develop our own template [22]. This authoring tool has to comply with specific criteria for developing the engineering education e-learning materials.

Figure 2. Portal eLearn central journal - Section Application from course “IGBT” with picture, cited reference and navigation elements.

C. Today’s e-learning

Today’s e-learning is according to [29] typically characterized by following keywords:

- Shorter: Averaging in length of time from two to 15 minutes (versus 30 to 120 minutes); In the year 2008 we have started to design interactive eLearning modules with appointed topic prepared with different level of educational content (uninitiated and university students) for portal eLearn central. The educational content of the modules is delivered in a very motivational and demonstrative way to capture students’ attention and to awake their interest. This is achieved by the unique structure of the modules as well as various features implemented throughout all of the modules such as attractive pictures or interactive content. Following the same trend we are starting to update the interactive animations in Adobe flash with use of effective graphics creation strategy [30]. In this way we are preparing database of open education materials, which can be used in education process. This granularity is very effective not only for students, but also for teachers.

- Media-Driven: Incorporating increased use of rich audio and video; Multimedia components for courses and modules on portals eLearn central are e.g. original and unique interactive animations (Fig. 3). The flash animations have been designed in such a way that they will show animated details of a given object and so help obtaining the knowledge much easier and faster. More than 30 interactive animations were initially developed for education purposes among them animations of passive devices, passive filters, diodes and their usage in electronic circuits, as well as BT, HBT, FET transistors, amplifiers, real and ideal MOS structures, examples of planar technology produced diodes, bipolar junction
transistor and CMOS gate, optical storage media, digital circuits and gates. These interactive animations are free accessible in a library of interactive animations: Course “Interactive flash animations” [27] on eLearn central portal for everyone interested. Some of the courses are linked to Virtual tours representing real laboratories located on our Institute [31]. Videos and photo gallery are included.

Social: Explicitly leveraging learning through online collaboration, as well as learner generation and sharing of ideas and content with other learners; We use the “News Forum” and Discussion Forum in CMS Moodle on portal eLearn central as an effective tool for students [23], student’s team work since 2005 [32], but also for project coordinators and all members of project team in projects realization since 2009 - for their communication, sharing ideas, information retrieval and solving problems. Forum in Moodle is a proper tool for goal analysis, communication and solution searching, specifically for team projects.

On-Demand: Available at the learner’s direction in support of a learner-defined need; all our e-learning materials were created as response to demands of our students and users.

Environmental: Delivered via multimodal learning environments, today’s Web 2.05. The platform Moodle enables to use all resources.

Mobile: Available to the learner wherever needed, via mobile devices (e.g. smart phones, e-book readers, tablets, et al). Our educational modules have study materials also available in pdf format, for students to download and to be used in e-book. Good accessibility via mobile devices is eLearn central’s big challenge to the future.

High-Fidelity: Taking advantage of intrinsic motivation, which is possible when simulations and games are used to present learners with realistic situations. On our portal, we can ensure high fidelity by Virtual tours and numerous prepared interactive animations already mentioned above.

D. Engineering e-learning in Slovakia

Study materials prepared in Slovak language are by far not as rich as in other languages. But new generation is growing up in our country; these children are raised in time of computer games with English language localization and most of them are taught English already in nursery school. Exactly in English language the online education materials are most commonly to find. In Slovakia there is quite small target group speaking of engineering education. Therefore, if we are developing courses on our own, it is more effective for us to create both Slovak and English version.

Financial sources are the existentially important factor. As already discussed, if the platform such as Moodle is used, the real financial costs of the course could be really small. The hardware can be rent or it is possible to host for free on existing portals such as eLearn central that is supported by community of “positive e-learning deviants”.

On the other hand, the teacher has everything needed to create highly professional courses supplemented by multimedia elements; revised and implemented into educational process and this is not possible without at least minimal budget.

Business companies are primarily developing and offering e-learning courses in following areas: IT, teaching directives and regulations, sales and marketing, company induction trainings, product trainings, software and language courses. But education courses supporting technical and mathematical subjects [33] are not commercially attractive. So even that we have hardware base quite comparable with commercial institutions, the creation and implementation of education courses is very demanding.

The interest in technical education is decreasing rapidly, except for informatics. It is true even despite the
fact that graduates from our Institute of electronics and photonics reach 100% employment rate. We certainly don’t stand in front of question how to commercialize our e-learning materials. We are successfully using these in blended learning and our effort now is to popularize technical subjects by opening the materials to wide public.

This strategy corresponds with the aims of MOOC technology: Support better learning and instruction with high-quality, scientifically-based, classroom-tested online courses and materials [34, 35]. Share our courses and materials openly and freely so that anyone can learn. Develop a community of use, research, and development to allow the continuous evaluation, improvement, and growth of courses and course materials.

E. Future of Engineering e-learning in Slovakia?

We fully agree with words of assoc. prof. Matilda Drozdová cited in the document E-learning in the higher education reality [36]: “My opinion is, that we need a coordinated solution for e-learning projects at the national level. Many projects are successfully completed, but nobody has access to them except of project coordinators. If these coordinators are also members of the authorization committee for future projects, they will reject all new ideas to similar solutions and so people are discouraged from work. Let's give everyone a chance. But let us do it together and let's learn from what already exists. That all should be a bit coordinated and financially supported from the management level. Otherwise, it is a long-distance run.”

Very positive example of perspective cooperation is project Mefanet (Medical Faculties NETwork) [37]. This project is aiming to develop and to strengthen the cooperation among Czech and Slovak Medical Faculties, as regards the progress in education of medical and health care disciplines using modern ICT. The primary objective of the MEFANET project is to facilitate the cooperation among teams from different faculties, and to ensure a horizontal accessibility of electronic teaching tools for both teachers and students of medicine universities.

There is also one big challenge – to train new authors and students for active use of e-learning technology. To fulfill this vision we have created portal eLearn central journal with integrated template for preparing new courses [38]. In this way we offer the space for creative work, interconnecting our long-term e-learning experience and pedagogical preferences of authors with little ICT skills. All new authors are welcome in our e-learning family – only a quick formal registration is needed. You can start to create new courses now: http://kme.elf.stuba.sk/elearn.

Our dream is to realize similar project as MEFANET for engineering education “Network of Universities of Technology”.

IV. CONCLUSION

Modern Information Technology has opened up many new possibilities in learning. Exactly International Conference on Emerging eLearning Technologies and Applications is that kind of forum, where the authors are sharing their ideas and experiences in the field of e-learning. They can discuss everything starting with the simple e-learning solutions, followed by remote laboratories and concluding with visions of Prof. Bebo White of alternative worlds/environments, including telepresence, augmented reality, and virtual worlds, as some of the technologies, which show great potential in shaping future teaching and learning spaces [7].

e-learning has become one of the most popular and progressive forms of education and easiest way for accessing a huge amount of information.

Present position of e-learning in engineering education in Slovakia is not acceptable. The use of e-learning is in most cases solved by bottom-up method. Some of the main reasons are the absence of coordination, active support and pressure from above as well as mutual cooperation of project coordinators.

On the other hand, the number of e-learning projects successfully implemented in praxis is increasing. These projects actually contribute to better informatisation of education and to increase the efficiency of education process. Still many of these projects are lacking adequate information campaign – people do not know what kind of courses and how many of them are to get and if they can afford it. Such impression is created that in Slovakia there is insufficient offer of e-learning courses.

Taking into consideration decades of our practical experiences with the creation of courses for eLearn central portal and their implementation in praxis, we are convinced that one of the biggest challenges in future e-learning is implementation of the principles of quality e-learning courses development according to the newest standards to use the golden opportunities in increasing the students’ motivation and effectiveness of engineering education.

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