New concepts in engineering education through e-learning

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Abstract

This paper deals with new concepts in engineering education regarding global trends in economical and information environment and their influence on engineering education, and also with possibilities of ICT deployment for integrating face-to-face and on-line learning. There is presented system approach in education and its impact on new chances of e-learning.

Keywords: Engineering education, role of teacher, role of experiments, e-learning, collaborative learning, quality of education.

1. Introduction

In the traditional approach not only to engineering education, the teacher lectures and assigns readings and convergent single-discipline problems, the students listen, take notes, and solve problems individually. Nowadays shifts demand on university education to new wave in tutorial, to ability work in team (e.g. at projected teaching), cope with changes, be flexible and innovate. In addition it is necessary to concentrate on scientific work and on quality them providing information and knowledge, which will be measured so, what students know, and how they can use it practically.

Nowadays modern information technologies are going to enhance development of new methods of searching, acquiring, organizing, processing, sharing and using of information from various sources and disseminate it to users. This paper is not aimed at giving a new method, a technic or a tool to solve current problems, but it is an experiment to look into the future. The applications enable automatic access to informations anytime and anywhere. By modern ICT it is able informations and knowledges share and effective use. Now it isn't problem access to computers and the Internet, but growing number of leaders in higher education see it more in necessity to increase of information literacy. It means the ability to find relevant informations accordance to needs.

2. Changing concepts in engineering education

Role of engineering education in the development of information and knowledge society is in active approach to learning and possibility to use own practical experiences in process of education.

In past time universities being asked especially to create and disseminate knowledges, now shapes demand on university education to new wave in tutorial, to ability work in team (e.g. at projected teaching), cope with changes, be flexible and innovate. Now these roles can be enhanced by promoting learning that ensures that people can take advantage of the information resources available to them. Such efforts can and should include both improving the ease of access to information and educating people to evaluate and use information effectively.

Fig. 1. A holistic view of active learning (by John Wiley & Sons, Inc.)
Economic prosperity of universities will depend on quality of education and research and on their proactive behavior. Universities go to lifelong education, because in information society information processing and their sharing and presence takes part in everyday life. The focus in new concepts in European education system is changing from learning to do (or know) towards learning to learn. The concept lifelong learning also corresponds with the broad political efforts and initiatives on developing education related to ICT, in individual countries.

3. COLLABORATIVE LEARNING

Collaborative learning is based on the teachers help students respond to literature by taking a more active role in their own learning. The cooperative learning tradition tends to use quantitative methods which look at achievement, i.e., the product of learning. The collaborative tradition takes a more qualitative approach, analyzing student talk in response to a piece of literature or a primary source in history. Cooperative learning is defined by a set of processes which help people interact together in order to accomplish a specific goal or develop an end product which is usually content specific. It is more directive than a collaborative system of governance and closely controlled by the teacher. While there are many mechanisms for group analysis and introspection the fundamental approach is teacher centered whereas collaborative learning is more student centered. [5]

Active learning is classroom instruction that involves students in activities other than watching and listening to a lecturer. Working individually or in groups, the students may be called upon to answer questions, solve problems, discuss, debate, reflect, brainstorm, or formulate questions. Cooperative learning is instruction that involves students in team projects under conditions that meet several criteria, including positive interdependence (the team members must rely on one another to carry out their responsibilities) and individual accountability for every part of the project.[7]

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4. DISTINCTION OF ENGINEERING EDUCATION

In the past century appears growing number of innovative programs and instructional methods and materials in engineering education. But the changes, that will move engineering education in the desired directions, may be grouped into four categories: [1]

- revisions in engineering curriculum and course structures
- implementation of alternative teaching methods and assessment of their effectiveness
- establishment of instructional development programs for faculty members and graduate students
- adoption of measures to raise the status of teaching in society and in institutional hiring, advancement, and reward policies

In addition important in engineering education are discussions about technical problems. It can be able by modern ICT, the informations and knowledges share and effective use. Now it isn't problem access to computers and the Internet, but growing number of leaders in higher
education see it more in necessity to increase of information literacy. It means “the ability to know when information is needed, and to be able to identify, locate, and effectively use that information for lifelong learning and problem solving.”

**System thinking**

In connection with this fact system thinking together with system dynamism offers in education common frame for preservation cohesion, sense and motivation on all levels of education, at first. Second element is emphasis on active student cognition, which imbeds into tutorial new challenges and interests for learning, how it is common in experimental laboratories. These two innovation, gathered together, help to enhance creativity, inquisitiveness and life energy of young people. There is necessary to systematically learn and use system thinking like common tool for everyday activities. Strong attribut of system thinking is there a connection philosophy, policy and culture with everyday work.

**Brainstorming – making creative ideas**

Brainstorming is a group technique for generating new, useful ideas and promoting creative thinking. It can be used to help define what project or problem to work on, to diagnose problems, remediate a project by coming up with possible solutions and to identify possible resistance to proposed solutions. I tested this method in one new subject with students in distance form of study (teachers from practice). I gave them some material on web, and they together prepared lessons for whole course. We checked it out on tutorials. But, in my opinion, this way it is able only with experienced people.

**Benchmarking in high education**

Currently this method is used for measurement quality of education. We can find it e.g. on web page www.sibis-eu.org. For some years now statistical indicators on Information Society have been central in the policy making process. This has been best demonstrated through the benchmarking exercise of eEurope Action Plan as a key activity. Having recognised this need and driven by the difficulties in obtaining reliable and appropriate statistics, the IST programme supported a pan-European research effort during Framework Programmes. The prime objective has been to develop and make available methodologies, tools and new statistical indicators which can help remedy the deficit in this field. It is in this context that the SIBIS project was launched. There are at least two main reasons that make this document interesting. First, it is one of the few original attempts to have a coherent and comprehensive approach in measuring the information society. As such it is expected to stimulate further debate and research among the professional statistical community, leading to an improved statistical competence in Europe. Second, it provides a unique single source of data on real time which supports many of the new ICT research areas. I see the advantage in application of benchmarking in collaboration among universities and learning from some best, like it is in business. To create a cooperative environment where full understanding of the performance and enablers of “best in class” processes can be obtained and shared at reasonable cost. [4]

5. **INTERNET IN EDUCATION**

Nowadays universities offer high quality opportunities not only in engineering education. ICT skills were obtained through formal education and training or more informally through using ICTs and gaining experience with them. High standards in mathematics, science, and informatics in most that countries were promising for the future supply of highly skilled professionals. The promising medium and longer-term supply of ICT professionals was associated with increasing numbers of young people in higher education and vocational schools.

![Fig. 4. Technology-based training (by Back, 2001)](image)

One of modern learning methods is e-learning. All educators approach this new paradigm with varying degrees of enthusiasm and concern. It is important to consider both, the pros and cons, about on-line learning. So we can be better prepared to face the challenge of working in this new environment as well as embrace the new opportunities that it has to offer. In all countries rapidly changing information and communication
technologies, and growth of ICT-related activities, in all sectors led to shortages of highly-qualified ICT professionals. Recruitment difficulties indicated imbalances between existing skills and company demands. ICT skills were obtained through formal education and training or more informally through using ICTs and gaining experience with them. Prospects for preserving and building ICT capabilities and skills was complicated by mobility of professionals. There are many valid reasons why online programs are rapidly becoming a popular form of distance learning in higher education today. The online environment offers unprecedented opportunities for people who would otherwise have limited access to education, as well as a new paradigm for educators in which dynamic courses of the highest quality can be developed. While online programs have significant strengths and offer unprecedented accessibility to quality education, there are also weaknesses that can pose potential threats to the success of any online program. Especially in engineering education I would prefer blended learning. [9]

In our university we are embarked in high-powered work on preparations choice subjects for combination forms studies in virtual educational environment WebCT, and for full-time forms of studies like supported materials. We also make up videoconference, but in my opinion not very suitable for education. [8]

In e-learning tutorials are a way, where teachers supplement on-line learning with a face-to-face component. Typically, a teacher will organise a time where students can come and see him or her, or arrange for students to work in a learning centre with assistance from a tutor. [10]

6. E-LEARNING - PROS AND CONS

It is important to consider both, the pros and cons, about on-line learning. So we can be better prepared to face the challenge of working in this new environment as well as embrace the new opportunities that it has to offer. First e-learning course was created in our university in the year 1998. Since the year 2001 our faculties embarked in high-powered work on preparations choice subjects for combination forms studies in virtual educational environment WebCT, and for full-time forms of studies like supported materials.

Inter – universities studies

University of Hradec Kralove has devoted its attention to the problems and issues associated with e-learning since the beginning of 1997. As early as then, voices could be heard calling for cooperative and collaborative ventures between university-level institutions in the creation of distance e-learning courses or unified study programs.

Interesting possibility for collaboration was identified at the e-learning in higher education on 2003 conference organized by university in Zlin, which involved the sharing of courses - including the relevant teaching staff, and providing these to the students of partner institutions, leading to the exchange of students through the intermediary of e-learning supported distance courses. Since 2005 the first Czech virtual mobility has been realized in the project RIUS (the start-up of inter-university studies in a network of selected universities in the Czech Republic), in which cooperated three universities (Hradec Kralove, Plzen and Zlin). It involves the sharing of both the courses and teaching staff of the universities participating in this project possibility of absolving part of study programme at university. The courses were provided in a distance education form with e-learning support. This e-learning courses are organized in the form of an introductory tutorial in face-to-face of both teachers and students at the students’ alma mater university, directed self-studies supported by a virtual educational environment and, as may be required, by further interim face-to-face meetings, combined with live examinations. The face-to-face meeting can be replaced by synchronous video-conferencing using the Internet. Depending upon prior agreement with a partner university, students can choose these courses within the context of their compulsory elective subjects. Through making the best use of the range of inter-university studies on offer to them, students can not only enrich their own study plans with topics attractive to them, but also get to know new educational methods and instruments, and have a share in the genesis of an expanded system of inter-university studies in the Czech Republic, enabling mutual sharing of study subjects and experts across university network. Due to these projects much students were given chance to study at least one out of 164 subjects in a virtual learning space in academic year.

7. PROBLEMS IN ENGINEERING EDUCATION

There exists some specific problems especially in engineering scope:

- disparity between believed important needs and amount of coverage in receives in the classroom
- lack of expertise

(Most people with a software engineering, managerial, and teaching skill are in industry or other mostly for financial incentives.)

- lack of relevant text and multimedia teaching materials

(Each book is different. It must be confusing to the technically oriented instructor to see such an incredible diversity of methods, approaches, and complex non-standard forms.)

- inadequate computer technique
(All computers, technique and materials should be closely associated with teaching of concrete subject)

8. CONCLUSIONS

In my opinion impact engineering education in information society depend on quality of lessons, learning material and especially on quality of teacher – each instructor must develop own style, using those techniques that best suits them and seem to achieve their objectives, but on-line learning cannot replace face to face education. In engineering education there is similar situation like in case education future teachers – there is needed direct dialog and practical experiences.

On base the experience it seems, that in full-time forms education, we must think about, if in all cases is necessary introduce e-learning.

In case of engineering education it seems, that blended learning, which combines on-line and face-to-face approaches (in accordance with our experiences), is more appropriate method of learning.

9. REFERENCES


