NEW TRENDS IN TECHNOLOGY AND HIGHER EDUCATION, ENGINEERING TECHNICAL PROFESSIONS (E-LEARNING)

Biljana GEMOVIC1, - Eleonora DESNICA2 - Natasa SUBIC3
1,3 Higher Education Technical School of Professional Studies in Novi Sad, Novi Sad, Serbia
2 University of Novi Sad, Technical Faculty “M. Pupin”, Zrenjanin, Serbia

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Abstract: Universities and their faculties and colleges have a very complex function in society today, so it is necessary for them to establish the right balance when executing their tasks. On the other hand, economy has a need and obligation to invest in university educated personnel able to apply and develop new technological achievements. The paper presents new trends in technology and higher education of technical engineers which could be of great importance in future development of distance learning (e-learning). It also underlines the attempt of using the innovative models of work, which are presented and experimentally confirmed, to show a gradual transmission from traditional to a new view to engineering graphics teaching. Statistical analysis of the obtained results has confirmed that a distance learning model in engineering graphics teaching has a statistically relevant effect on teaching efficiency.

Keywords: engineering graphics, computer aided design (CAD), education of mechanical engineers, distance learning.

1. INTRODUCTION

Modern design and engineering design in mechanical engineering, construction industry, architecture, traffic, electrical engineering and other is a complex task, which is today mainly supported by methods of computer technologies. Computer methods and technologies of the CAD/CAE (computer aided design/computer aided engineering) type have contributed to an essentially new approach to the process of designing and engineering designing in recent years. Knowing the theory of design should be an element of the general professional knowledge of each engineer of technical disciplines. (Lee, 1999)

Every engineer or technician needs to know how to express their ideas through technical drawing. As a means to express ideas, a drawing allows communication with all mankind. A concept of research carried out under the title of “Innovative pedagogical approach in engineering graphics teaching in higher technical education” is presented in this paper with the goal to establish the following: efficiency of engineering graphics teaching in higher technical education realized by means of a distance learning model and the outreach of the effect of a new educational orientation in teaching new contents by means of modern information technologies. The research was carried out in 2008/2009 and 2009/2010 (winter semester) academic year during Technical drawing with computer graphics classes at the Technical Faculty “Mihajlo Pupin” in Zrenjanin at the following departments: Industrial engineering and Engineering Management and High Technical School of Professional Studies in Novi Sad, the direction of mechanical engineering, in the academic 2009/2010. year (fall semester), the classes of cases CAD.

1.1. University and new trends of education of technical engineers

University and its faculties and colleges have a very complex role in society today. Designing a suitable educational process will best satisfy the needs for graduate mechanical engineers of great competence to acquire and develop new knowledge and become trained to solve technical and managerial problems.

Considering the fact that mechanical engineering belongs to the group of progressive sciences and that it is one of the pillars of technological development, that it permanently changes and improves, it seems necessary for engineers themselves to keep being intensively educated and to improve their knowledge and skills. There is an obvious need to revise education for engineers as a response to changes in society. Engineers dream to have everything they need for their work: a series of practical and theoretical data in electronic form, no need to use books, manuals, tables, etc. By using modern software this objective of engineers and technicians can certainly be attained.

2. ROLE OF THE BOLOGNA PROCESS IN DEVELOPMENT OF EDUCATION

The Bologna Declaration is a document which the European countries use to accord higher education programs of study in order to successfully compete and compare with other regions and to prevent lagging behind in research and development.

The reformed education is expected to increase professional and creational efficiency of studies, to decrease the duration of studying, increase mobility of students towards higher levels and forms of education and advancement, to assure that the students keep up with
development of science and master the skills and thus provide accordance of qualifications with work demands imposed by a particular profession.

Improvement of quality of teaching is an important task of any teacher in an educational institution. The aim of the Bologna Process is to assure the qualitative studies everywhere in Europe. (Cosic et al., 2010)

2.1. Experiences in distance learning

Thanks to its mobility, flexibility and effectiveness, distance learning is becoming an ideal model which allows for a combination of “old” and “new”, “traditional” and “modern”. Distance learning development has reached one of the turning points in the world today. A great number of world recognized higher education institutions have introduced this category of learning in their programs of study as a compulsory and contemporary manner of education. These are well-thought programs which involve a great number of students. In Europe there are important initiatives for distance learning development implemented through European Distance Education Network (EDEN) and European association of Distance Education Teaching Universities (EADTU). Open University in the UK has set some standards for this type of education which served as a model for institutions organizing distance learning in Spain, Germany, the Netherlands and Portugal. In its documents, such as e-learning Action Plan, the European Commission strongly supports development of distance learning, i.e. e-education in all EU member states. The European Commission has elaborated a precise plan to offer distance learning and e-education to students in universities in all member states. The resolution of the European Council gives priority to this kind of education in further development of education in the EU. (Desnica et al., 2010)

2.2. Educational Trends in Universities in Serbia

Implementation of distance learning in Serbia is not strategically founded and has no detailed plan of development. Certain institutions have started their own distance learning systems; however, most of those projects have failed due to financial reasons or poor organization of the project itself. Individual cases which can be found in our environment: Technical Faculty in Čačak, master studies for electronic learning-www.e-lab.tfc.ka.ac.rs; Faculty of Mechanical Engineering in Kragujevac - www.mfkg.ka.ac.rs; Faculty of Mechanical Engineering in Belgrade, electronic classroom - www.mas.bg.ac.rs; Faculty of organizational sciences - www.fon.rs. (Desnica et al., 2010)

Estimating the importance of distance learning for development of education in our country, the Higher education technical school of professional studies in Novi Sad, which is a state higher education institution, was accredited in 2010 for distance learning for the programs of study Information Technology and Fire Protection, www.dl.vtsns.edu.rs.

3. ENGINEERING GRAPHICS TEACHING AT FACULTIES IN THE COUNTRY AND ABROD

Graphic communication is one of forms of communication and all graphic forms are especially important for an engineer and technical science. Engineering graphics is a language used by engineers to transfer ideas and information necessary to design new technical appliances and systems. This language includes drawings, sketches, plans, arrangements, diagrams, remarks and instructions. In engineering, graphics has three main goals: to analyze and show designs, transfer information about designs and note development of designs and all the changes in it. Engineering graphics includes formal sketches and informal sketches, all diagrams and plans and sometimes relations of non-physical ideas also, if those relations can be graphically presented. (Βολτγχη, et al., 2001; Gligoric et al., 2004)

3.1. COMPUTER usage in technical drawing

Technical drawings demand a lot of efforts and time. People have always strived to simplify and shorten the procedure of making a drawing because it makes a significant item in overall expenses of production of an object or a machine. Computers and possibility of their mass exploitation have started a real revolution in technical drawing. Among other things, computers are machines for drawing and a place for storing drawings.

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CA (computer aided) technologies are one of the greatest engineering achievements in the 20th century. Development of information technologies, especially computers and corresponding software systems which made an important support to a designer during designing process, conditioned a new way of thinking in designing process. Today designers have a powerful tool which assures selection of the best solution in all steps of designing process at a particular time and in the particular conditions. In every moment a designer must have a clear vision of a series of actions which lead him in as quick and rational manner as possible to a desired model, i.e. standard technical documentation. (Devedzic, 2004)
Three-dimensional objects in engineering are often created by means of drawings. The process of modeling begins with a conception (idea) by describing an object by means of a 2D (two-dimensional) drawing and its specification (fig. 1).

Apparently, engineering graphic communications is a first-year basic course studied in all faculties of mechanical engineering in Serbia as well as in European countries under similar names. This shows how much this course is important in education of future technical engineers.

### 3.2. Electronic Teaching Material

Educational materials are the most important element of distance learning. With traditional education they are only a support to teaching process where a teacher has the main role. However, in distance learning educational materials are the main source of new knowledge and skills. They are at the same time means of control of teaching process because they lead each student through the training process and towards desired goal. Their role is very complex and the effect they have on quality and result of distance learning is crucial.

For the course Computer Graphics and CAD at the Technical University of Applied Studies in Novi Sad, in the accredited study program of distance learning materials is made to several sections:

1. presentation of the theoretical part of the subject which is divided into 15 teaching units
2. of tests that allows students to check their knowledge after each mastered teaching units
3. material for application software packages and Indesign CorelDraw and AutoCAD, which consists of:
   a. explanations of individual options and tools of
   b. examples for the development and practice of students.

Students are required to access the weekly lectures and exercises. Lectures and exercises will be available each week to students in the order that was given. Every week new content is set and is available until the end of the semester. Within each week at the end of the exercises will be forums and assignments for practice (which the students are obliged to do by the end of a specified time limit-up to the end of the week). 2 hours per week is a professor at online so the students can communicate via chat rooms. (Gemovic, 2007)

### 4. EFFICIENCY OF ELECTRONIC LEARNING IN ENGINEERING GRAPHICS TEACHING

The research involved 127 students of technical programs of study (1st year of study, Industrial Engineering, Engineering Management) at the Technical Faculty “Mihajlo Pupin” in Zrenjanin where the sample size was sufficient. The problem of research was efficiency of modern engineering graphics teaching, while the subject of the research was theoretical and empirical study of students’ achievements obtained by application of innovative models of teaching engineering graphics.

An experimental program was created for the needs of the research which comprised teaching contents of engineering graphics, teaching units Computer drawing and design (CAD) created according to the innovative teaching models. Within the research conducted, the teaching was weekly-based and lasted for seven days. The students’ activities and tasks were defined in advance. Online activities comprised the following: the students had to review the teaching units planned for the current week (teaching topic I: adjustment of basic CAD parameters, teaching topic II: basic and auxiliary drawing methods, teaching topic III: stylization and text editing on the drawings, teaching topic IV: methods of object modification on the drawing, teaching topic V: forming and editing of figured dimensions, teaching topic VI: graphic communication in engineering, teaching topic VII: preparation and printing of technical documentation, teaching topic VIII: practical exercises-exercises, exercises for self-control, teaching topic IX: exam questions); for each teaching unit the students had to solve a series of problems which allowed us to collect data about effectiveness of their learning; tutorials; after a teaching unit had been reviewed their work was based on self-testing. (Letic et al., 2007b)

The students of all experimental groups could find the material on the website of the Faculty. Within experimental part of this research distance learning via the Internet was organized which involved testing and measuring parameters relevant for efficiency of this type of learning.

Research hypothesis – distance learning model in engineering graphics teaching has statistically significant influence on teaching process efficiency in higher technical education, that is learning model in engineering graphics teaching contributes to advancement of students’ professional knowledge in finding solutions to real technical problems. (Desnica et al., 2010)

Research techniques and procedures:

- questioning – to establish the extent of knowledge and insight of teachers and students in possibilities of distance learning before and after the experiment, obtaining the students’ opinion on advantages and disadvantages of this type of teaching organization;
- testing – to establish prior knowledge of students about engineering graphics teaching, i.e. initial knowledge test, as well as to establish the acquired knowledge after application of experimental program, i.e. final knowledge test.

Research instruments

- questionnaires and
- knowledge tests.

For the needs of this research the initial knowledge test was created in a form of a series of questions and the aim of this test was to establish initial state of experimental and control group (each question was worth a certain number of points used to from the final mark for each student, from 5 to 10). Initial test involved contents about descriptive geometry which the students acquired during their previous schooling. A good knowledge of this material was a prerequisite for understanding the contents which are a part of the experiment.
The final knowledge test was created for the needs of this research as a series of objective type questions and the aim of this test was to establish the final knowledge of experimental and control group (each question was worth a certain number of points used to from the final mark for each student, from 5 to 10).

Questionnaires for students and teachers – a questionnaire before research with the aim to show how much the students knew about distance learning, the questionnaire after research for experimental group students had the aim to offer an insight of students’ impressions about performance of experimental program, i.e. innovative methods of work and learning. The questionnaire for teachers had the aim to establish the extent to which the teachers were ready to prepare and create educational material needed to implement a model of electronic learning. The questionnaires were anonymous so that the students and teachers could express their opinion more freely.

Measuring of relevant parameters and analysis of the obtained results were performed by means of standard statistical methods. To test the hypothesis Mann Whitney U test and Wilcoxon’s test were used to establish statistically significant difference between initial test results and final test results. The data were processed by means of SPSS 8.5 software.

5. DISCUSSION OF THE RESEARCH RESULTS

The general conclusion about the conducted research is as follows: the adequate application of innovative models of work in engineering graphics teaching based on a model of distance learning (learning by independent problem solving, learning by discovering, research-aimed learning,...) leads to a significant increase of students’ success and accordingly contributes to greater efficiency of engineering graphics teaching. The quality of students’ knowledge is improved because of insistence on professional knowledge advancement in solving real technical problems.

6. CONCLUSION

Information technologies in higher education may become very powerful teaching aids to support lectures and practicals because they encourage easier learning and understanding of presented teaching contents and contribute to high degree of motivation for work on formation of individual knowledge of students. Due to distance learning system the Higher education technical school of professional studies in Novi Sad has seen qualitative changes in course syllabus and development of interactivity.

Further work in this area is possible, primarily in its improvement and in personalization of proposed teaching methods. Moreover, the future will see a possibility to further develop educational software and electronic textbooks and their application in all spheres of education, which will be assured by development of technological base, but also by development of awareness of our society that we live in the era of turbulent development of science and technology.

REFERENCES