E-LEARNING – NEW APPROACH IN QUALITY EDUCATION OF CNC MACHINE PROGRAMMNING

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SUMMARY
The expansion of computer techniques and new CA technologies gives very power tools for education enhancement to university teachers. The paper is focused on actual information and communication technologies utilized in e-learning educational process at Faculty of Mechanical Engineering, University of Žilina, for study branch -"Automation of Production Systems".Article presents mainly multimedia course and educational software from the area of technological production preparation mainly CNC machines programming and technological process planning areas which were created at the Department of Automation and Production Systems.

Keywords: e-learning, CNC machine, education

1. INTRODUCTION

E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked or not, serve as specific media to implement the learning process. The term will still most likely be utilized to reference out-of-classroom and in-classroom educational experiences via technology, even as advances continue in regard to devices and curriculum. E-learning is essentially the computer and network-enabled transfer of skills and knowledge. E-learning applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio [4,3].

The development of microelectronics, computer technique and communication means directly influenced on mechanical engineering too. One of the most quickly developed computer techniques area is computer graphic, multimedia, professional visualization, animation and information technologies. The computer support of visualisation allows new seeing on education.

The Faculty of Mechanical Engineering at the University of Zilina offers a technical education and produces university-educated experts, who are able to solve complicated technical problems with reasoning in all views of social, ethical, economic, ecological, cultural and historical matters. The faculty consists of 10 departments, which in cooperation with the other parts of the faculty and University guarantees the pedagogic process and scientific and research activities. The pedagogical activities of the faculty involve specialized continuing education courses and courses attuned to the particular needs of industry. Computer-aided methods are relatively widely integrated into the process of education.

Department of Automation and Production Systems (DAPS) focuses on the issues of computer support and automation in the engineering industry with an emphasis on programming NC and CNC production machines and industrial robots, working with CAD systems, CAD / CAM, CAM, CAPP and CAQ, solving technical production using CAx systems and technologies , and the application of microelectronics and microcomputers in engineering practice. This paper is focused on actual information and communication technologies utilized in e-learning educational process at Faculty of Mechanical Engineering, for study branch -"Automation of Production Systems". Article presents mainly multimedia course and educational software from the area of technological production preparation mainly CNC machines programming and technological process planning areas which were created at the Department of Automation and Production Systems.

2. CATEGORIZATION OF MULTIMEDIA

Multimedia may be broadly divided into **linear** and **non-linear** categories. Linear active content progresses without any navigation control for the viewer such as a cinema presentation. Non-linear content offers user interactivity to control progress as used with a computer game or used in self-paced computer based training. Non-linear content is also known as hypermedia content. Multimedia presentations can be live or recorded. A recorded presentation may allow interactivity via a navigation system. A live multimedia presentation may allow interactivity via an interaction with the presenter or performer. Multimedia finds its application in various areas including, but not limited to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial temporal applications. *Several examples are as follows*:

- **Education** - in Education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books like encyclopedia and almanacs. A CBT lets the user go through a series of presentations, text about a particular topic, and associated illustrations in various information formats. Edutainment is an informal term used to describe combining education with entertainment, especially multimedia entertainment. Learning theory in the past decade has expanded dramatically because of the introduction of multimedia. Several lines of research have evolved (e.g. Cognitive load, Multimedia learning, and the list goes on). The possibilities for learning and instruction are nearly endless.

- **Engineering** - software engineers may use multimedia in Computer Simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as collaboration between creative professionals and software engineers.

- **Industry** - in the Industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers. Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technologies [4].

3. METODOLOGY OF CNC MACHINES PROGRAMMING EDUCATION BASED ON MULTIMEDIA SUPPORT

In the field of machining the current trend is wide deployment of CNC machines incorporated into the construction - technological chain (CAD-CAM-CNC) so that their potential to best use. For the actual production and its productivity have a direct effect mainly, properties of CAD / CAM system used for programming of CNC machine, own production at CNC machine, which should be in terms of time as efficient as possible, but not least qualified technologists, programmers and CNC machine operators.

The multimedia systems have becoming very significant elements of education process. The target of their utilisation is not only to teach to work with computer (current customer activities) but especially to offer quantity of the different type of information. The multimedia systems with graphics and sound outputs become more users friendly to the customer. They are simplifying solving problems. The advantages of multimedia have been already evaluated in the mechanical engineering area too. The tasks of education with multimedia support are solving at the DAPS some years. Several multimedia programs for the education support were created in frame of researcher activities. The main areas of their utilization and application are mainly:

- *CNC machines and their programming, and utilization of modern CAD/CAM systems,*
- programming and application of industrial robots and manipulators,
- process plan creation for cutting technologies as well as for creation and formulation of methodical proceeding at the activities in product preparation stage from this area.

Next the attention will be address to the first mentioned area. Created multimedia programs are at the DAPS currently used as a support at teaching of courses: Programming of production machines and robots, Automation of technological production I, II,.

3.1. Multimedia for support of education on training machines EMCO MAIER
At DAPS the education of courses for CNC machine programming take place in the new laboratory equipped with control panel from Siemens, where students can try a working at a real training machine EMCO. (Fig.1). There students can obtain the classic information how to prepare the enter data for control system of training machine, they tune the developed NC program and verify the correction of NC program at manufacture.

Multimedia program for support of education at EMCO is divided for individual steps which allows for student to gets up the basic problematic from manual and automatic programming of CNC machines. The structure of program besides basic definition of NC programming contains the concrete examples of programming on training NC machine EMCO.

Figure 1. Laboratory of NC machines programming

3.2. Multimedia support for Computer Aided Manufacturing (CAM)
Developed multimedia program for computer support NC programming using CAD / CAM system allows to students customizing mentioned problematic, mainly programming with big

CAD/CAM systems that are favourable utilization nowadays. *This program includes mainly areas of* Computer aided programming (CAM), general knowledge about CAD/CAM systems (history, classification) and main representants of CAD/CAM systems, their tools, applications and technological possibilities. For support of teaching curses "*Automation of technological production preparation"* were created multimedia programs for computer-aided manufacturing with CAD/CAM system Pro/ ENGINEER - version - WildFire3 (Fig.2). Program includes two basic technological methods of cutting operation – turning and milling and divides to the two main parts that contains information about modules of system Pro/E:

- *Pro/Modelling* – this part contains the basic information about design module of Pro/E (functions - sketcher, extrude, revolve...)
- *Pro/Manufacturing* – create the main part of multimedia program and contains information about the creation of manufacturing process in Pro/E (creation of NC sequence – for turning and milling operations (enters, machines, parameters, tools, simulation, visualisation...)
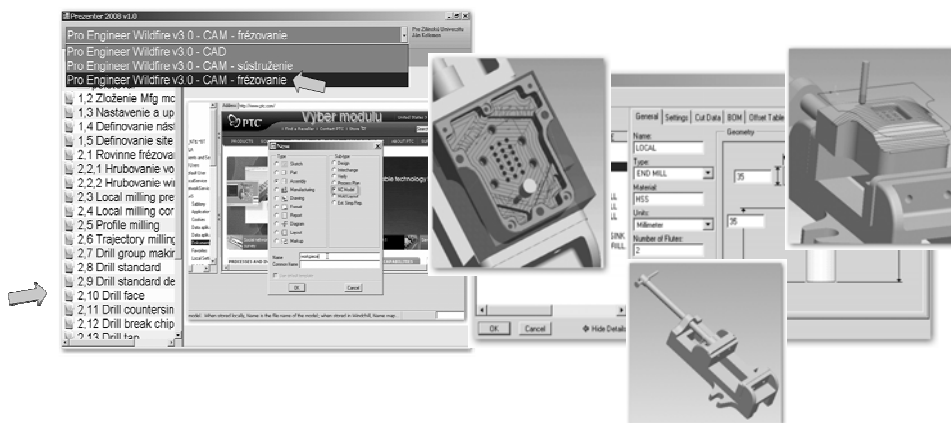

Figure 2. The screen of multimedia program for work with CAD/CAM system Pro/ ENGINEER

3.3. Support software for Computer Aided Manufacturing for sheet part production

Some CAM or CAD/CAM systems for sheet part production offer module for punching, bending, notching, shaping shearing or nibbling. Lantek Expert Punch is a CAD/CAM system specially designed for automating the programming of CNC punching machines. This system is used at our Department for education of the courses aim mainly at technical preparation of production. As a support for teaching of system was developed presentation CD called softLAN (Fig.3). CD consists from 4 parts with the cut up theory of materials information, theoretical information about CAD/CAM system, theory about system LANTEK and its simple form of hyperlinks. The most important part of the SoftLAN is the part with the 4 examples of the production of sheet metal parts. These parts are developed from the easiest to the heaviest. Moreover, this part includes video about the production of the examples of sheet metal parts. The video simulation brings possibility where the students can compare simulation of the specific part in the system LANTEK with its real production by using the real machine.The participation at solving a new proposal, new products, and parts from practice give the students possibilities for improvement of theoretical knowledge in practice.
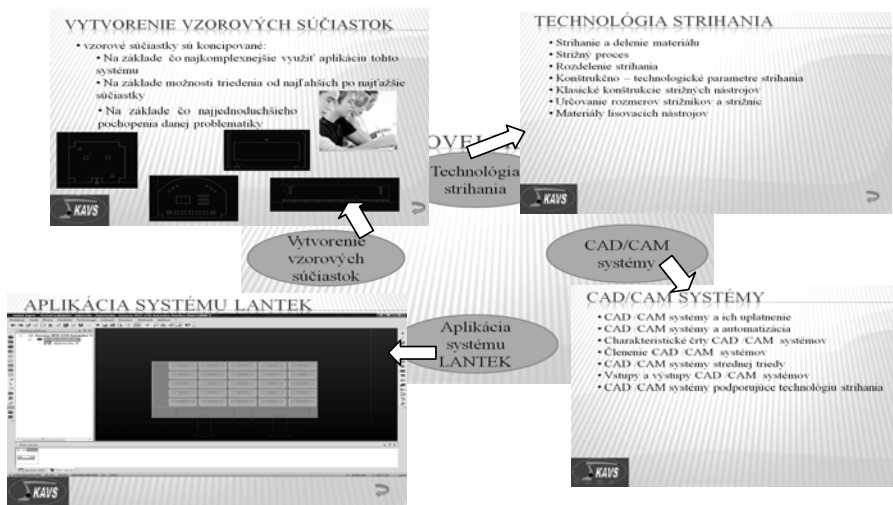
Figure 3. The main screen of support CD - SoftLAN

4. CREATION OF DOCUMENTS AND THEIR INCORPORATION TO THE E-LEARNING EDUCATION IN ŽU ŽILINA

For the area of programming NC machines were developed materials for teaching a subject Programming of production machines and robots (PVSR-Programovanie výrobných strojov a robotov) and placed on the university website e-learning education system Moodle (Fig. 12).
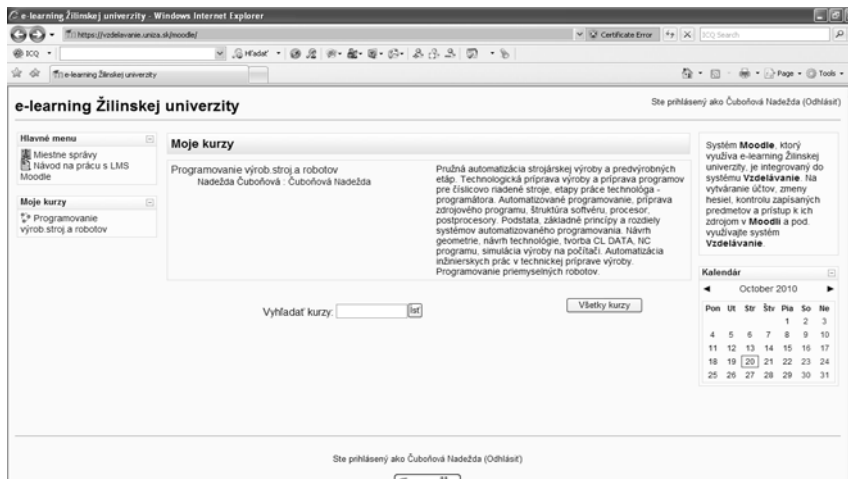

Figure 4. Home web page of the course PVSR - e-learning education University of Žilina

Preparation and production of documents include for each subject in e-learning *education:*
- *Specification of course presentation* (number of lectures, exercises, tests ...), *inputs* (sets of lectures and exercises) and *outputs* (tests, homework).
- *Preparation for e-learning education* - creation of lectures and exercises, test and final test of intermediate tools using MS Word - Power Point and Excel (Fig.5).
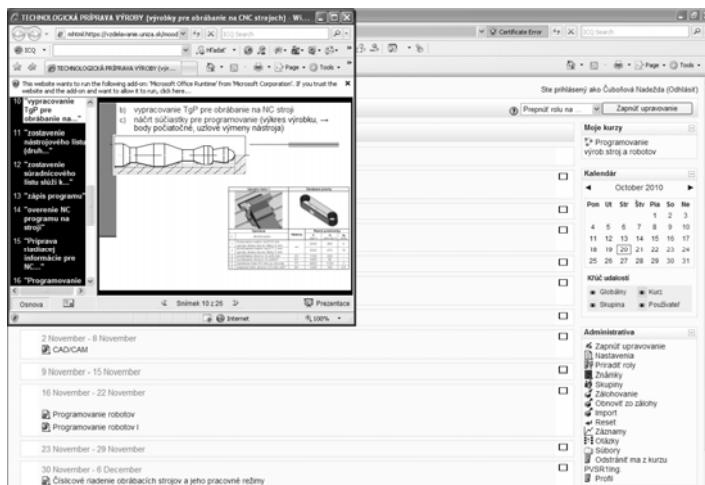
Figure 4. Screen of course PVSR with a weekly overview and open window with lecture

5. CONCLUSIONS

Presented programs was created at the DAPS and are based on the requirements of teaching, respectively practice. Creating, utilization and presentation of this support programs are the main goals of the project KEGA – „*E-learning and implementation of advanced information technology in teaching of programming CNC Manufacturing Technology*". Solved problem supports too a partial solution of EU Operational Programme – Education: "*A Flexible and Attractive Study on University of Žilina for Both Employment Market and Knowledge Society Requirements*"; Code ITMS 26110230005. Real integration of electronic materials into individual units by focusing respectively curriculum subjects and their use in the complex process of teaching is different. Some of the programs and electronic materials are already applied in teaching, the inclusion of certain materials into teaching, however, still requires an additional modification to the current conditions. This process also requires constant updating. Mentioned educational support programs as new and unconventional tools in teaching methods with their illustration and a certain degree of interactivity enables students to understand better explained technical problems, and therefore better prepared students for the practical implementation of knowledge acquired. Students receive very positive presentation of such programs and are appropriate for them recovery lessons. These programs bring to students and teachers, effective support in education of object from area of NC machine programming, relative time-saving of education process – wider area for the students practical tasks solving, improving of educational process and individual education aids at the others university workplaces in Slovak and Czech Republic.

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