

PRODUCTION SYSTEM CONTROL LABORATORY AND PROGRESSIVE METHODS OF EDUCATION

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Abstract: The paper describes the importance of e-learning in education process in control system laboratory and present the objectives and impacts on professional and key competence increase of our graduates. The laboratory will be used for teaching the automatic control principles and programming in flexible production via various control modes. We select the most often control modes and will be applied real elements of control systems used in the technical practice. Teaching will be connected with progressive education methods including e-learning.

Keywords: AUTOMATION, CONTROL, E-LEARNING, PRODUCTION SYSTEM, PROGRAMMING

1. Introduction

The grant project KEGA 3/7131/09 – *Program production system control laboratory building* being solved by the Institute of Production Systems and Applied Mechanics at the Faculty of Materials Science and Technology of the Slovak University of Technology in Bratislava in years 2009 – 2011 represents an opportunity of graduates to obtain higher level of professional abilities and skills expected by employers. The project objective is to create a laboratory of control systems and a suitable teaching system supporting the students in acquisition of key and professional competences and skills that would increase the level of their preparation for practice. This paper's mission is to indicate objectives of this grant project and expected benefits.

2. Competence requirements for future employees

An important requirement of possible employers is the „proper“ ratio between *professional competences* (high level of professional knowledge and overview of actual trends in the branch) and *key competences*. [1]

- *Professional competences* ensure good management of work tasks

- *Key competences*, as widely utilizable competences, e.g. ability to decide, solve problems, work in team, communicate in foreign language, learn, work with information,...[2].

Of course, special, professional knowledges are inevitable and key competences help use them better in practice. The most frequent competence requirements for future employees – engineers include: [1].

- Creativity
- Knowledge of foreign languages
- Self-action
- Computer skills
- Responsibility
- Flexibility

All these competences can be acquired and developed by working both in virtual and real control system laboratory. Especially, it can be used in a job appraisal.

Identified competences that can be integrated into professional competences of an engineer are:

- Necessary habits and skills in experimental and laboratory works;
- Systematic approach to solving technical issues;
- Ability to apply special knowledge and skills in practice;
- Social responsibility (graduates should be aware of social, moral, legal, economic and environmental connections of their profession and consequences of their activities). [1]

Work in the laboratory develops and improves computer literacy that is so important at present and last but not least definitely supports acquisition of other key and professional competences of graduates of our University.

Project goals

Development of cognitive operations (knowledge, skills and habits, i.e. improvement of key and professional competences) and

also join with practice would be achieved by designing and modeling various manufacturing devices and their control systems in the laboratory by students. For that purpose a special software will be installed which will actuate various elements of industrially used (see Fig. 1), (PLC, step motors, various types of sensors,...). At the same time students will have an opportunity to prepare specifications and projects for various subjects taught in our curriculum to obtain their specialization and to prepare so for a real problem solving in practice what is really top-rated by employers.

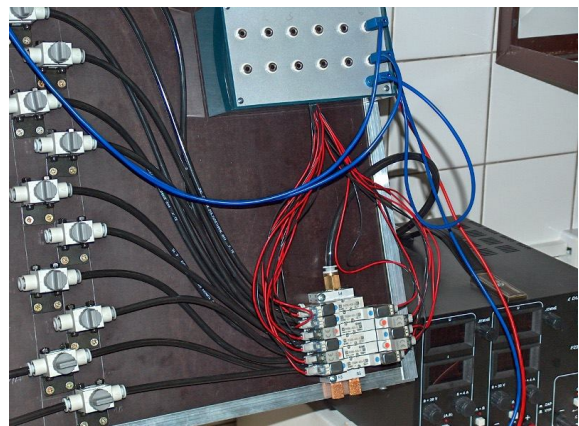


Fig. 1 Real industrial parts connection in the laboratory.

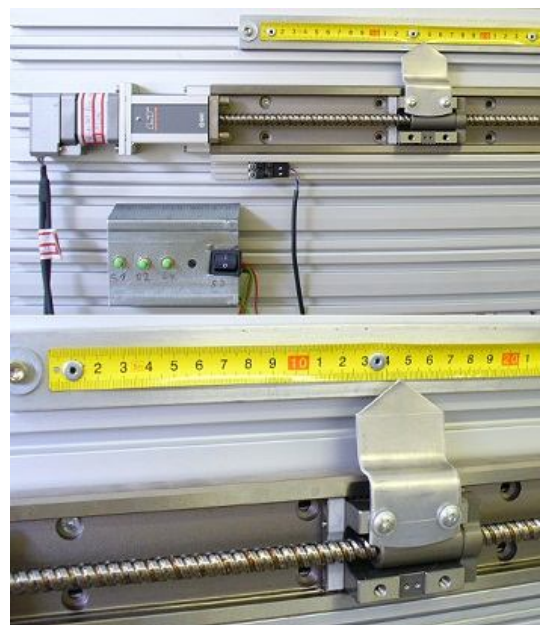


Fig.2 Teaching process stepper drive control

The project also includes and makes available on internet study materials enabling effective working in a laboratory and serves at the same time for further development of knowledge and abilities of our graduates.

These instructions will serve as supplementary study literature

for students of internal and distance study forms to be able to design control systems in industrial production. (see Fig. 2).

Students learning in this laboratory will acquire necessary skills and know creation methodology of several control systems increasing thus significantly their value at the labour market.

Project Benefits

We expect benefits as follows:

- Improvement of teaching process quality
- Teaching process will be more attractive for students
- Teaching process will be more effective for students thanks to its illustrativeness
- Students will adopt and strengthen their technical knowledge, skills and abilities
- Teaching process in this laboratory covers several subjects of several study programmes accredited in our Institute
- Competitiveness increase of our graduates at the labour market in Slovakia and Europe
- Utilization of tools, instruments and equipment that represent current industrial standard
- Students get familiar and will work with real industrial elements
- Visualization and promotion of technical fields of study at our University and Faculty

3. E-learning

The system includes several *functional roles*.

Thus, there may be one or several *Educators* interacting with *Student* (Trainee) on a specific subject or part of the training course.

Then there is *Supervisor* who monitors the learning process and checks its quality as well as Educators' performance.

Organizer is authorized to represent the educational institution's *Administration*, while *Administrator* ensures uninterrupted operation of the software/hardware system.

Courses Authors and *Tests Authors* can collaborate on the same content. [4]

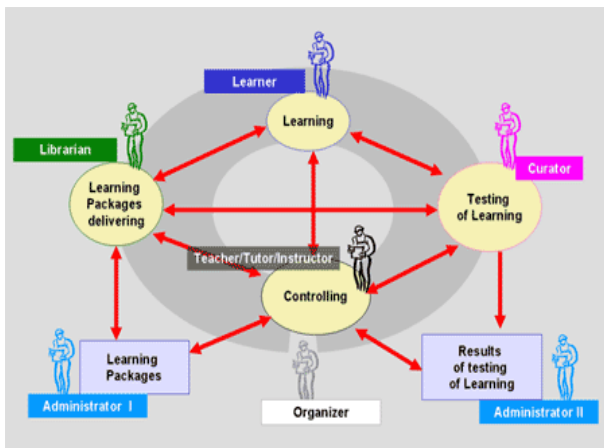


Fig.3 Content of e-learning [4].

Technology used by e-learning [5]

Mobile technologies – In the long term, learning solutions and services are also likely to be integrated into electronic appliances, machines and information interfaces.

Simulations in e-learning process – Today's the simulations are being implemented as a broad range of skills and competence development. Technology and cost barriers are continuing to shrink, opening up the potential for wider implementation of simulation technology.

Adaptive learning environments – A learning environment is considered adaptive if it is capable of: monitoring the activities of its users; interpreting these on the basis of domain-specific models; inferring user requirements and preferences out of the interpreted

activities, appropriately representing these in associated models; and, finally, acting upon the available knowledge on its users and the subject matter at hand, to dynamically facilitate the learning process.

E-learning means effective application of information technologies in the education process. E-learning as a progressive education form opens many new opportunities. This form can be used at all levels of formal education and also in life-long learning. Content of e-learning is shown at Fig. 3.

Information and communication technologies present new dimensions in education at all levels. Education becomes the primary factor of national prosperity. New education technologies offer a wide space for further learning and life-long learning; remove barriers and ruin national frontiers, supporting at the same time advisability of learning with the main emphasis on utilization in practice and global way of thinking. [3]

E-learning, as a new didactic method, facilitates distance learning and provides new possibilities for other education forms. Teachers become authors of educational, instructional documents with a specific mission – to transform the quality of all attendance forms of study into rationally configured documents in electronic form.

Computers and other facilities gave rise to world wide communication network – internet. In present time internet represents the most extensive and most massive information and communication technology that enables both general and addressed bidirectional communication.

Asynchronous Education

Under the term „asynchronous education“ we understand all tools and procedures without „face-to-face“ communication between the teacher and the student that means without direct contact in any way. Asynchronous education involves e.g. individual courses, self-study of materials, preparation of specifications, participation in conference and e-mailing.

Synchronous Education

Under the term „synchronous education“ we understand all methods including direct contact of the student with other students and the teacher, e.g. chat, audio/video conference, application sharing, common board.

For instance, students can be electronically „pre-trained“ also for areas where the personal contact with the teacher is considered to be inevitable. Such students come then to the teacher with a lot of information and questions and the teacher can deal only with the interesting or difficult parts of education and to shorten so the training time significantly.

E-learning brings along a lot of communication tools starting with e-mails up to video-conferences enabling teachers to work with individual students. Based on feed-back the teacher is exactly informed about student's progress in individual lessons, the place and number of points achieved and time spent in individual education fields. Thanks to many communication channels the cooperation with the student can be more intensive compared with the classical education lessons.

4. Conclusion

The present situation in the Slovak economy needs our graduates to be experts in production system control. The production system control makes use of control units like various PLC types or industrial computers controlled by electrical actuators via the relay. These actuators are usually pneumatic, hydraulic (most often rectilinear but also rotary) or electric (most often step motors and servomotors).

E-learning and virtual/real laboratory represent modern ways of applying IT in various areas of our life and significantly and positively influence the qualification level of future leaders of our industry. However, education in this laboratory will increase competitiveness of our graduates at the present labour market in the Slovak Republic and within globalization also at the European labour market.

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6. References

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