

Needs, Opportunities and Constraints on the Way to the Wide Introduction of Robotics to Teaching at Secondary Vocational Schools

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Abstract. The current situation of increasing European and global competition and the resulting downward pressure on prices and forcing at companies use modern automated and robotic manufacturing systems. After the state of the art analysis evaluation there were certain conclusions gained, showing lack of information from the field of robotics among graduates. Low level of education in the field of robotics is caused by poor material and technical facilities at secondary schools as well as by poor level of theoretical and practical experiences of teaching staff. Therefore, the staffs are not able to pass on important and satisfactory level of education in the field of robotics. This clearly demonstrates the need and necessity of education in the field of robotics that can be adequately insured by professionally trained teachers. Teachers will benefit in terms of gaining the latest information and knowledge from the field of industrial and service robotics, which is now highly popular and attractive giving them the benefit of professionalism. The paper presents the works within the RUSOS project, which is focused on educating of teachers of secondary vocational schools in the field of robotics.

Keywords: Robotics in education · Vocational education and training · Secondary vocational schools

1 Introduction

The current state in industry can be characterized by rapid development of robotics in almost all industrial areas. It is mainly focused on new generation of intelligent dual arm robots [1]. In terms of public life, here are service robots used for professional applications (e.g. health care, rescue operations) and personal assistance applications for humans, particularly for handicapped and older people. The number of robots deployed

in industry since 2010 is continually increasing. The main reason for the sharp increase of robot deployments in 2010 was the rapid development of automation with the aim to increase competitiveness, and thus achieve higher production and quality [2].

In 2016, the number of robots was exceeding over 200,000 [3]. In 2018, it would attack worldwide sale of threshold 400,000 industrial robots per year [4]. The focus on selected project priorities is designed based on development of robotics in all areas of industry with regard to project partnerships. The need for professional services is especially apparent in the automotive industry, where the most required employees are those with secondary vocational education working in sphere of service of automated and robotized equipment or at production lines. However, existing graduates are prepared insufficiently for these activities. Therefore, some employers provide the short-term courses in the supplier robotic companies or at universities due to profiling their robotic positions. They sometimes provide this type of courses themselves. The lack of these courses relates to their narrow specialization and superficial expressing the idea of robotic system [5].

One of the ways how to improve this situation can be seen in the introduction of such robotics subjects at secondary vocational schools that are missing today. Robotics is only part of certain subjects, without a coherent view. The need to resolve this problem should begin at substance of case, for example, by teachers training at secondary vocational schools in the field of robotics with the aim to have the relevant, innovative, high-quality and timely information from robotics. Primarily, RUSOS project focuses on teachers who will be able to transfer reached knowledge of robotics to their students at the professional level [6].

2 Background and Aims of the RUSOS Project

The RUSOS project focuses on the education of teachers at the secondary vocational schools in the field of robotics and on innovative, high-quality obtaining information from robotics. The most innovative part of the project includes the creation of the study materials for teachers of technical subjects that are created based on the essential as well as the latest knowledge from robotics [7]. Subsequently, the teachers transform obtained materials and knowledge into the contents of educational subjects, dual education or the optional courses. Planned innovative educational materials, ICT and a virtual laboratory platform are conceived as an interactive source of knowledge to enable interaction between the students and teachers.

Project outputs and activities are as follows:

1. An analysis of the requirements of engineering companies for recruiting the new employees, especially graduates of secondary vocational schools - finished output. The aim of intellectual output was to conduct an in-depth analysis in order to identify the needs and requirements of target groups, subsequently, implement in all countries of partnership. The representatives of target groups were directly contacted by the project partners, both via the personal meetings and the new form of data collection as online questionnaire survey. The evaluation of analysis was done for each country, but also globally.

2. A set of training materials for the secondary vocational school teachers in the field of robotics - ongoing output. Purpose of this output is the creation of training materials based on the requirements that are suggested by the production companies and the secondary vocational schools. Requirements have been obtained under output 1. The study materials will be compiled on the basis of underlying as well as latest knowledge of robotics. Their structure will be conceived as an interactive learning resource enabling interaction between students and teachers. Subsequently, teachers of secondary vocational schools will transform the obtained materials and knowledge into the curriculums of subjects, or include them as a part of related subjects.
3. An educational-training ICT platform for the secondary vocational school teachers in the field of robotics - ongoing output. Educational-training ICT platform is a major intellectual project output. Currently, it is elaborated into the stage of installation, administration and structure of e-learning portal Moodle. Moodle as a learning platform was created by a general concept of training course, defining respective roles and competences, as well as template of a standard lesson with the aim to test and comment by the project partners [8]. Moodle portal contains one sample lesson from industrial robotics.

3 Analyses of Needs and Requirements of Target Groups

Many secondary schools are not adequately equipped and hence cannot provide adequate training in robotics for students. Similarly, they do not have adequate and timely information from this field [9]. Therefore, it was prepared a depth analysis for identification of needs and requirements of target groups. Basic axioms for realisation of this analysis were characterized in the following points:

- Must be realized based on needs from automotive sector,
- Insufficient preparation of operators graduates in the field of automated and robotized equipment and production lines,
- Missing profiling subjects from robotics at secondary vocational schools with a coherent perspective,
- The need for training teachers at secondary vocational schools to obtain relevant information from the field of robotics,
- Short-term courses of firms and companies are specifically addressed only to a narrow range and low depth of robotics conception.

The analyses consist of two parts. First, an analysis of the requirements of engineering companies for recruiting of new employees - graduates of secondary vocational schools. Second, secondary school teacher's needs analysis for training in robotics. Analyses were carried out in all countries of partnership (Slovakia, Poland, and Romania). All partners were involved in the project and evaluations were carried out both for each country separately and for all partner countries globally [10].

It was aimed to obtain information about real needs of participants. To achieve required quality indicators, it was necessary to reach a minimum of 20 companies and

20 secondary vocational schools in each country of partnership. To sum up, it fills about 240 questionnaires, which can be regarded as sufficient sample to obtain relevant information. The results of these analyses were used directly for creation of intellectual output 2.

4 RUSOS Training System

RUSOS training system is an education system designed for training at automated and robotized systems for the teaching staff of secondary vocational schools, companies and students. It is focused on information from the field of industrial and service robotics that will be processed and available for the learners of ICT platform in the form of e-learning lessons [11].

4.1 Educational-Training ICT Platform

Educational training ICT platform is main intellectual output of RUSOS project. It is based on e-learning, whose main advantage is its availability strictly according to time and space that a user needs. This educational platform allows controlled and continuous access to study materials as well as the opportunity to exchange their knowledge and experience with other course participants through the implementation of various communication modules such as forum, chat and other [12].

4.2 E-Learning Course

Concerning to the development of e-learning education, e-learning course was created with a focus on industrial and service robotics [13]. It is implemented into the Moodle portal and divided into lessons. Prepared e-learning course is mainly focused on providing the essential as well as the latest knowledge from robotics concerning to three target groups:

- teachers,
- students,
- employees of companies.

These target groups were chosen because in case of the teachers, they do not have sufficient information from robotics. In case of students, it would be useful, if they obtained at least basic information from robotics. Finally, in case of employees, they will receive benefits in the form of access to the training materials, coaching and unlimited advantages of e-learning course.

Each lesson contains a theoretical part which explains relevant topic. It also includes appropriate images, presentations and also video files. At the end of each lesson, control questions for users of course can be found. Only after successful mastering of control questions, one can be passed to the next lesson. To complete the lesson, it is necessary to obtain minimum number of points [14].

4.3 Virtual Lab with Industrial and Service Robots

Special part of ICT platform will include a virtual laboratory with robotic technique that will be used for evaluation of practical knowledge resulted from the study. Virtual laboratory will be created of several virtual 3D models of various robots and other automated equipment. Individual virtual models of robots and other devices will be compiled into different configurations and thus, it is possible to create various robotic workplaces in virtual reality [15]. Virtual lab allows the users to work from their homes and to verify obtained knowledge of industrial and service robots simulating real workplace conditions. So, they can use virtual lab equipment which is not usually available to all persons for testing. Authorized users can access into laboratory at anytime from anywhere.

5 Future Development

To ensure a correct entrance into the virtual laboratory, it is necessary to allow entrance by only single user at predefined time. Therefore, this activity requires a schedule of individual users concerning to access of virtual laboratory. In order to avoid unauthorized entry, each access into the virtual laboratory has to be monitored and archived by software in form of log files, respectively by storing data into the database. We expect that it will need to store following information:

- login that will be associated by administrator of virtual laboratory and has to be unique for each user,
- user password with sufficient length,
- time of user access into virtual laboratory,
- time of activities in the laboratory,
- type of user activity during operation in virtual laboratory.

6 Summary

Project activities are intended to improve cooperation in the field of robotics education for teachers at secondary vocational schools as well as students and employers. Another aim of project is to improve cooperation and preparedness of successful graduates of secondary vocational schools and their integration into the labor force of companies. Secondary school teachers will benefit from a project by acquiring latest information and knowledge in the field of the industrial and service robotics, in order to amend themselves education in this highly attractive, innovative and demanded field. This will enhance their job and allow them the possibilities for career progression and better enforcement in the labor market.

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