E-learning as a Technological Tool to Meet the Requirements of Occupational Standards in Training of It Specialists[1]

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Abstract—We discuss issues of updating educational programs to meet requirements of the labor market and occupational standards of IT industry. We suggest the technology of e-learning that utilizes an open educational resource to provide the employers' participation in the development of educational content and the intensification of practical training.

INTRODUCTION

The problems of training professional personnel whose knowledge, skills, competences and proficiency level meet the employers' requirements most closely remain urgent for more than a score of years. The Institute of System Analysis and Management (ISAM) of Dubna State University provides training in the information technology field for six Bachelor's programs and two Master's programs. The learning process is supported by electronic training materials in the form of electronic textbooks, specific academic materials, lecture presentations, training assignments, self-instructional learning assignments, etc. accessible by the university students and faculty members via a password.

EDUCATIONAL PROCESS WITH THE PARTICIPATION OF EMPLOYERS

Schemes for cooperation with employers are developed enabling the target training of graduates whose competences satisfy the employers' specialized requirements in terms of having mastered certain software development technologies and knowing up-to-date architectures of software systems. For this purpose, education is organized within the framework of both curriculum subjects and elective courses. A special emphasis is placed on the students' engagement in the actual projects of the employers during practical trainings and industrial placement and on their performance of graduation theses for the employers' benefit. As electronic training materials are available for all curriculum subjects, such students as are offered employment before their graduation from the university will be able to combine work and studies according to an individual education plan. Naturally, such training schemes do not reflect the needs of the entire IT labor market, but they are conductive in meeting the regional market's needs.

INCORPORATION OF LABOR MARKET REQUIREMENTS IN ACCORDANCE WITH IT OCCUPATIONAL STANDARDS

Now that occupational standards (OS) for the IT industry developed under the auspices of the Association of Computer and IT Businesses (ACITB) are introduced in Russia, it solves, to a great extent, the objective of characterizing requirements a wide range of employers applies to the competence level of the employees they need. It explains the importance of making considerations for the provisions of occupational standards while developing educational programs. However, a practical implementation of this objective entails certain difficulties.

First, OS do not fully take into account the wide diversity of IT industry. Second, the system of OS updating in line with the high dynamics of the industry's changes is not clear. Moreover, the structures of the Federal state educational standards (FSES) and occupational standards (OS) considerably differ. The major difference lies in the determination of the training results, as there are broad wordings for professional competences in FSES vs. a detailed description of job functions in OS.

To achieve a conjunction of requirements to the training results in FSES and OS, the following solution can be suggested. Special attention shall be placed on the practical component of the graduates' training through which their vocational qualification largely

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manifests itself. The substance of the professional competences in FSES shall be clarified on OS basis from the viewpoint of their practical components. For this purpose, such generalized job functions in OS that are greater reflected in the wordings for one or more professional competences in FSES must be determined. Relevant job functions and job actions will define one or more components of the professional competences in terms of "know-do-master". The latter will enable to determine the list of curriculum subjects and their contents to make sure the students practice professional competences.

Let us give an example of the said algorithm. Consider FSES for the Bachelor's program "Information systems and technologies" and OS for "IT specialist".

The generalized job function "Performance of works concerning IS creation (modification) and support that automate organizational management objectives and business processes" as worded in OS corresponds with the following professional competence of FSES:

• Ability to install and debug software and to adjust hardware for placing information systems into trial operation (PC29);

• Being ready to assemble an information system out of off-the-shelf components (PC-30); and

• Ability to perform installation and debugging of software and adjustment of hardware for placing information systems into commercial operation (PC-31).

Let us consider the following job function out of the list of such functions: "Installation and configuration of operating system and application software required for the functioning of IS" and state requisite components of PC. For instance, "To have a good command of OS Windows Server 2012 R2, DBMS MS SQL Server 2008 R2, IS 1C Document circulation technology". Then the list of subjects that are requisite for mastering this component can be as follows: Operating systems, Database technologies, and Information systems for enterprise management.

When performing a target training at the employer's request, methods and technologies implemented while exercising the job functions (fulfilling specific applied objectives) may be particularized, which complies with the above scheme of specialists training in ISAM tailored to suit the employers' requests. Active engagement of employers in participation in the educational content generation will also enable to update requirements of PC.

FINDINGS

The following conclusions may be drawn out of the foregoing:

Targets of the higher education program extend beyond taking into consideration requirements of specific employers or a specific PC. Nevertheless, assumption of provisions of the occupational stan-

dards developed by the professional community itself is critical for the educational program's generation, as it enables to itemize the employers' demands for the practical training of graduates.

An important target of university activities is an immersion of the intended specialists into the complex, continuously changing business environment as early as in the training process. To engage employers in setting specific objectives and evaluating their fulfillment is one of the efficient ways to achieve this target.

Training of IT specialists must include learning to perform a complete cycle of handling up-to-date program systems, from installation and setting to implementation in practical problems solving.

Accumulated packages of specific objectives and ways to handle them comprise the knowledge that can be repeatedly used and replicated by means of e-learning technologies. Development of knowledge management methods in a university is becoming an urgent matter.

VIRTUAL COMPUTER LABORATORY FOR IT PROFESSIONAL TRAINING

A multi-component software and hardware system has been developed in ISAM and called a virtual computer laboratory (VCL).

Primary objectives of VCL are:

• To render computing resources in a form of "cloud" web-services as a request;

• To provide an access to the basic applications located at ISAM servers, without any supplementary installation and adjustment on the end-user devices, regardless of the user's location; and

• To make virtual servers available for implementation of a variety of projects.

Thus, VCL provides an opportunity to study handling up-to-date program systems, which enhances competitive capabilities of the graduates. Currently, a knowledge management system is being developed on the VCL basis. Requirements are developed for a knowledge management system that, in addition to the support of a complete cycle of knowledge management, allows a possibility of engaging employer representatives in setting, fulfilling and evaluating objectives in the system [1, 2]. To organize an access to VCL and the knowledge management system, a web-portal is presently created.

CONCLUSION

According to the Agency for education quality control and career development (AEQCCD), employers are interested in active cooperation with educational institutions, participation in the graduates' competences formation and scrutinize the matters of the education quality provision [3]. Advancement of the software and hardware system developed in ISAM will

produce mechanisms of efficient cooperation with employers.

In conclusion, we would like to point out that efficiency of the suggested solutions is confirmed by the public and professional accreditation that was provided, in line with ACITB requirements, to the training programs "Computer science and computer engineering" (Bachelor's degree level) and "Applied computer science" (Master's degree level) implemented in ISAM.

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