Development of an Educational Standard of Higher Education for ICT Sphere

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***Abstract*— Traditional development methods of structure and content of specialists' training, which are characteristic for many areas of sciences and technique, are ineffective for such *dynamic* area, as the sphere of ICT. He paper considers the formation questions of structure and content of the subject field of higher education for the sphere of ICT.**

Keywords— ICT sphere; professional education; content of education; educational standards; subject field

I. INTRODUCTION

The main objective of higher education is the training of the skilled employee of an appropriate level and profile, competitive on a labor market, competent and responsible, freely owning the profession, which is able to be guided in the adjacent spheres of activity, capable of effective performance in the specialty proper to the international standards and ready to continuous professional growth.

Over the previous decade the International Organizations for Standardizations developed and adopted series of standards for teaching information technologies in the higher and specialized educational institutions.

In 2001 within the framework of a joint project of Association for Computing Machinery (ACM) Education board and IEEE Computer Society Educational Activities Board the document Computing Curricula 2001 was created: Computer Science (CC2001), the aim of which was to develop recommendations for curricula of teaching computer science. In 2005 this document was completed and made amendments [1].

The document specifies, that the recommendations shall be useful for all world community. In spite of the fact that requirements to teaching curricula differ from the country to the country, it shall be useful for teachers of computer science around the world.

The description of the knowledge volume is organized in the form of three-level hierarchy. At the top level there are spheres of knowledge, which represent specific disciplinary areas and are designated by two-letter abbreviations. Each sphere consists of group of subject modules, which are designated by an abbreviation sphere with adding the sequence number. Each module consists of subjects, which are the lowest level of a hierarchy. The recommended number of mandatory lecture and optional hours is specified on each subject. The total amount of mandatory hours shall not be less than 280.

In 2004 the Guidelines for Undergraduate Degree Programs in Software Engineering (SE-2004) [2] was developed. Here, it is specified that "Program engineering" is one of the computing disciplines and is based on a number of disciplines. A theoretical and conceptual basis of program engineering is computer science; however this knowledge field goes beyond this subject.

Experts in the field of program engineering must be familiar with a number of concepts of other fields, such as mathematics, engineering, project management, and be capable to understand subject fields new for him/her, which is not connected to computing directly, and as well as must understand the significance of fine design. They must be based on an unconditional priority of the main task – satisfaction of the needs of citizens, society and states in the educational services connected to high-grade mastering of a profession and obtaining the appropriate qualifications, taking into account structure of the labor market and demands of employers.

At the end of the previous century, there was a diversification of activities of ICT experts, which led to formation of family of five disciplines [3]: "Computer, complexes, systems and networks" (Computer Engineering - CE), "Informatics" (Computer Science), "Information systems" (IS), "Information Technology (IT) and "Software Engineering".

Since the end of the XX century the reforms projects of the structure and content of ICT-education are discussed in the USA, EU countries and Azerbaijan. Taking into account these circumstances, it is possible to come to the conclusion that developing the methodologies for the formation of the contents and nomenclature of specialties in the sphere of ICT is an actual scientific problem.

The structure of higher ICT education in Azerbaijan, functioning on 01.01.2010 for tens of directions (specialties) and for different education degrees, is fragmented by 17 enlarged training groups. Among the directions functioning in the sphere of ICT-education there are directions duplicating each other, excessively narrow at the modern conditions and out-of-date.

In such situation, there was a pressing need for the development of a unified methodological approach to determination of the directions of training of specialists and the education content. Such methodology shall consider the development tendencies of information society in the

republic, the requirements of the international standards, the legislative base of the Republic of Azerbaijan and the national specifics, the national standards of sectoral normative and technical and methodical documents on ICT.

Obviously, it is impossible to train the student everything and for always for some years of study in higher education institutions. It is necessary to achieve advanced mastering of those technologies which are demanded and, supposedly, will be enough demanded for a long time. They include, for example, network technologies and the protocols used by them, the relational DBMS with ORACLE software, object-oriented programming languages, modern multimedia and WEB technologies etc. For an effective operation the experts possessing a broad outlook and owning adjacent IT specialties are required.

II. Program Statement

In present conditions of high dynamism and uncertainty of society functioning, there sharply occurs a problem of changes in the education purposes. In recent years, there exists a reorientation of an assessment of education results from the concepts "erudition", "good breeding" to the concepts "competency", "competence"; it is urged to organize educational process on the basis of a competence approach [4].

Taking into account the development perspectives of the content of higher education, and the formation and creation on this basis of standards of third generation, a competence approach is taken as the means of researching the problem of professional training of an expert. Thus, the competence approach is understood as the base for structuring components of training of the expert on basic, all-professional and special competences [7].

The set of competences and the generalized structure of the education content in the field of ICT is given in the Fig.1.

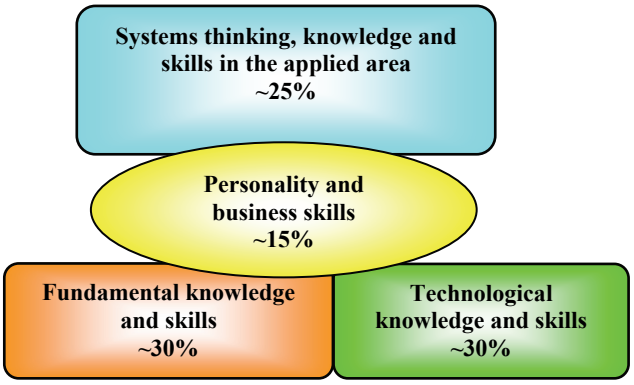

Figure 1. Structure of competences of ICT education (the picture is taken from www.career-space.com)

The aim of the system of professional education (all its steps and degrees) consists of the preparation for the economy of the republic and, in particular, for each of its sectors of the professional personnel, who are capable to provide accompaniment of each object of professional sector activity at all stages of its life cycle [6].

For the realization of life cycle of any object of professional activity of the universities in the republic, shall train the experts, capable to execute the following functions, within the specific field of economy: research and development, project and constructive, project and technological, production and technological, production and operational (repair and technological, setup, utilization) and renovation.

The bachelor and master degrees of professional activity on same ICT-specialty often match, however, types of activity, character and level of solved tasks differ fundamentally. While the bachelor degree of ICT- specialty has to know the standard techniques well, to carry out the practical task set before him, the master expert should demonstrate the ability to make crucial decisions independently in the conditions of uncertainty, based on the deep analysis of the object of his professional activity. These distinctions in thr nature of activities of the bachelor and master degrees are reflected in different competency models for these levels of training.

In higher professional education system the bachelor degree is trained to execute project - design and (or) project - technological service and operational, production and technological functions, but the master – to execute scientific-research, experimental and research, project - design, project - technological, test-experimental, design-technological, organizational administrative and pedagogical activities (preproject researches, technical tasks, sketch projecting, etc.).

The functional interaction of two models is required to set up discipline content on ICT orientation: the subject field model and the model of "ICT-specialty".

Setting up the subject field model the following restrictions are superimposed for the period of training on the discipline:

- the maximum volume of an academic load of the trained shall not exceed 54 academic hours a week, including all types of academic and extracurricular (independent) study on mastering the main educational program (MEP) and facultative disciplines set by higher education institutions in addition to MEP, which are optional for students [5].

- the maximum volume of academic studies when mastering the main educational program in a full-time study course makes 32 academic hours a week for a bachelor degree and 20 for a master degree.

The training content in the sphere of higher ICT education shall correspond to the training orientation and to the selected specialty. An information model of the sphere of knowledge on each specialty is described in the form of three-level hierarchy. At the top level includes the knowledge spheres representing specific disciplinary areas and consist of:

• fundamental (basic) disciplines;

• professional disciplines;

• special disciplines.

Each sphere consists of a group of subject modules possessing a certain logical completeness in relation to the set objectives and training outcomes. Each module consists of the subjects, which are the lowest level of the hierarchy. The recommended number of mandatory lectures and facultative academic hours is specified on each subject in the international educational standards [1].

Implementation of competency model of the bachelor degree in IKT-specialty requires the separation in the structure of the main educational program of the following educational cycles:

– mathematical and scientific cycle;

– professional cycle;

– various field (profile) cycle.

The educational cycle in the specialty consists of a basic (mandatory) part and profile, set by the institution and providing the disciplines at the choice of the student. Profile disciplines give the chance the trained students to obtain profound knowledge and competences for future professional activity and to continue education in a master degree.

Disciplines of a mathematical and scientific cycle form the competences of the academic (knowledge) activities and create the appropriate fundamental basis for the professional cycle disciplines.

The basic (mandatory) part of the professional cycle of the bachelor degree shall provide studying the following disciplines: Computer sciences; Database engineering; Open Information systems; Instructional design; Management information systems; Multimedia design; Network engineering; Software architecture; Software engineering; System administration; System security and privacy; Web service design and etc. [9].

Enhancement, advancement and development of the created competences are carried out sue to the profile part of the educational program.

General scientific and professional cycles, as well as the practice and research shall be provided in the competence educational program of the master degree in ICT-specialty. The program of the master training also provides pedagogical practice, which enables to form pedagogical competences.

System and application-oriented specialties are a part of training activity and specialization of the students in one or several areas. Within the specialty, the students shall study the material much more deeply than the basic one. They can specialize in one subject field or on several application fields. For each application field the students shall obtain the idea of the related knowledge fields.

III. Conclusion

In the early 2009, the Ministry of Communications and Information Technologies of Azerbaijan developed the State program on the development of communication and information-communication technologies for 2009-2012 years. The program was the continuation of "Electronic Azerbaijan" program. The new program objective is to realize completely the potential of ICT-sector with deduction it on a leading position (along with oil and gas sector) in the economy of Azerbaijan and will be considered for 2009-2012 years [8]. To achieve these objectives it is necessary to change existing educational programs cardinally at informative level, and to develop standards for IT-education proper to adopted international standards and to consider the modern innovative technologies, as well as the specifics of the republic and personnel need.

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