The Content of Professional Training of Future Informatics Specialists in Kazakhstan: Process of Developing Educational Program

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Abstract. The article focuses on the training of future informatics specialists in higher education system of Kazakhstan. The prelude to the change in the educational program, analysis of Competence was described, Competence was analyzed and the competence-based model of the informatics specialist was built for Kazakhstan. An educational program has been developed on the basis of this model that includes requirements not only of normative documents, but also of other customers (employers, IT professionals). The development of industry in Kazakhstan gave rise to the inclusion of the industrial and engineering areas into the program, that will allow students in the future to access employment in the industrial sector of the economy of Kazakhstan.

Introduction

Now that the world is becoming more digitized and technologically advanced, the profession of IT specialist remains more demanded than ever. Constantly developing ICT require the necessity for innovation in education to meet the demands of ICT in the 21st century. Universities should clearly identify the IT skills that companies require from IT specialists, because ICT graduates need a strong support of technical competence, both in engineering and in the area of informatics, as well as in a wide systems perspective.

The most common educational program on the informatics model is Computer Science Curricula [1], developed through the combined efforts of the Association for Computing Machinery (ACM) and the IEEE Computer Society. It is worth noting that this document is primarily focused on the US, and is based on the knowledge and perspectives of the late 90s, early 2000s, and much has changed in the field of IT. Increased interest was seen in mobile and web applications, e-business systems, ERP systems, wireless communication systems, social networks and Web 2.0 [2]. In Kazakhstan, at the moment, the information society is booming: web services have been developed, such as e-government (http://egov.kz), the number of users of mobile applications, mobile banking, Internet of things are increasing. Therefore, these issues should be reflected in the training program for IT specialists.

There is yet another particular feature in the training of informatics specialists in Kazakhstan. North Kazakhstan is a large industrial region in Asia, where the oil refining, gas industry, processing of non-ferrous and ferrous metallurgy is concentrated. The industrial sector imposes its requirements to the informatics specialist, thus forming a social request, in which the specialist must possess a
non-standard set of skills, and special competence that enable him to work with industrial computers and equipment.

In addition to special competence, the informatics specialist must also know the basics of the business and be able to support users [3]. Students should reinforce their skills of teamwork and have real experience in projects where several activities are being developed at the same time. In addition, students should have basic knowledge in the area of economics, markets and companies. It is also imperative that ICT graduates have interpersonal skills, the ability to solve problems and learn, the keenness to determine the needs and mind of the client and colleague [4].

Therefore, IT specialists must acquire a wider set of skills that go beyond their traditional technical skills [5]. In so doing, the traditional competences, such as web development and management of new technologies, were less in demand [3].

Thus, there is a need for continuing adaptation and updating of the educational program in the specialty of "Informatics" to the changes in information and communication technologies, industry and the subject field of informatics. This is due to the fact that the universities of Kazakhstan are a party to the European Higher Education Area (EHEA), thus the development of educational programs is a matter of concern in our universities too.

The article is intended to substantiate the competence model and the educational program on the specialty of "Informatics" adapted for the conditions of Kazakhstan and corresponding to the world development trends.

The article is structured as follows: the next section reflects the analysis of the competence of IT specialist on the basis of a survey of the expert group and represents a competence model. After this, the model and content of the educational program are justified and discussed. At the end of the article, we discuss the advantages and disadvantages of the educational program of Informatics.

Development of the Competence Model of Informatics Specialist: Analysis of Competence

EHEA [4] promotes student-oriented learning approaches, where academic achievements are determined in terms of competence. Competences serve as the basis of the educational program.

Development of curriculum is a complex and iterative process with a large number of activities in which many stakeholders participate. Universities have many stakeholders [5], from which they collect invaluable feedback regarding their needs and requirements related to educational processes - the demands of society and the government, the demands of the professional society and the individual.

The Demands of Society and the Government. The development of the information society in the world and in Kazakhstan has shown that society and the government need "flexible" specialists. The stereotype of IT specialists is that attention is often paid to the "hard" skills needed to perform a job. But the demands of modern society require knowledge of outsourcing and off-shoring to become more flexible and contain costs, strategically using IT [6]. Business skills are required to apply technical knowledge to solve business problems, as well as managerial skills and abilities are required, in order to be able to work effectively with computer users. Therefore, IT specialists need to be trained on different skills, as employers seek to hire people with technical and non-technical skills [3].

We interviewed 47 employers' respondents (mainly from the industrial sector): "What kind of IT specialist do you need?". Thus, we received the following answers: "We need specialists working with industrial equipment", "... able to program industrial robots", "... able to create automated control systems in the form of an Internet application", "they must be competent in programming micro-control units for industrial computers", "... able to learn and self-educate ", "... able to think critically and solve non-standard tasks ".

Demands of the Individual and the Professional Society. Professional stakeholders have a broader interest in specific professions, the professional qualities of graduates, their working abilities and conditions, specialty career development, as well as in knowledge and competences.
To analyze competences, we used the method described in [5]. We have collaborated with stakeholders and conducted an open dialogue, in order to receive feedback, review and recommendations that can make a significant contribution to the integration of content and technology of providing an educational program of informatics to meet the needs of the wider community.

The Figure 1 reflects one of these events, during which the basic requirements for the qualitative training of informatics specialists were discovered: "We need specialists with competences in developing cross-platform mobile applications", "Developing Internet applications", "Developing 3D modeling, applications," "Using augmented reality for development of mobile applications".

Figure 1. The Expert Group of the Professional Community for the Development of the Competences of Informatics Specialist (at the Hakaton Event at the PSU)

Integration of the Competence Model

To determine the qualitative composition of the competence of the IT specialty, an expert commission of employers was created. Based on the work of the expert groups, the competences necessary for the future informatics specialist were determined. The basic document was Computer Science Curricula 2013 from ACM and normative national documents (model curriculum). Competences are presented in Table 1.

Table 1. Competences for Informatics Curriculum.

<table>
<thead>
<tr>
<th>Competences</th>
<th>Description of the competences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generic competences</strong></td>
<td>Ethical competences (C1), Communicative and social competences (C2), Leadership competences (C3), Development competences (C4), Organizational and societal competences (C5), Internationalization competences (C6), Competences of Entrepreneurship (C7), Learning competences (C8).</td>
</tr>
<tr>
<td><strong>Subject competences in Informatics</strong></td>
<td>Competences in algorithms and complexity (C9), Competences in architecture and organization (C10), Competences in computational science (C11), Competences in discrete structures (C12), Competences in graphics and visualization (C13), Competences in Human-Computer Interaction (C14), Competences in Information Assurance and Security (C15), Competences in Intelligent Systems (C16), Competences in Networking and Communications (C17), Competences in Operating Systems (C18), Competences in Platform-based Development (C19), Competences in Parallel and Distributed Computing (C20), Competences in Programming Languages (C20), Competences in Software Development Fundamentals (C21), Competences in Software Engineering (C22), Competences in Systems Fundamentals (C23).</td>
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<tr>
<td><strong>Subject</strong></td>
<td>Competences in object-oriented analysis and design (C24), Competences in agile IT project management (C25), Competences in managing digital organization</td>
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Based on a detailed description of competences and learning results, 46 courses divided into three general groups were identified: 36% of courses were classified as compulsory academic courses, 64% - as professional basic and specialized, practical courses.

### Structure of the Content of the Educational Program

Areas of knowledge with content are the basis for individual courses. To ensure full coverage between learning results and knowledge areas, we used the Gantt chart to compare each learning result with knowledge areas. Areas of knowledge with content are shown in Figure 2. As learning results, all areas of knowledge cannot be taught simultaneously. In Figure 2, we repelled the distribution of knowledge areas (M1 - M6) during the time and the competences formed (S1-29).

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
<th>Semester 3</th>
<th>Semester 4</th>
<th>Semester 5</th>
<th>Semester 6</th>
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<tbody>
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<td>M1</td>
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<td>M2</td>
<td>S1, S2, S3, S4, S5, S6, S7</td>
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<td>M3</td>
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<td>M4</td>
<td>S11, S12</td>
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<td>S13, S19, S20,</td>
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<tr>
<td>M5</td>
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<td>S14</td>
<td>S16, S17, S18, S25, S26, S27, S28</td>
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<tr>
<td>M6</td>
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<td>S1 - S29</td>
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Legend:
M1 - Entrepreneurship, leadership and communication.
M2 - Programming languages and technologies.
M3 - Methods of computer calculations and optimizations.
M4 – Software Products Testing and Deployment.
M5 – Industrial Informatics.
M6 - Professional practice and thesis.

Figure 2. Model of the Educational Program.

The module "Entrepreneurship, leadership and communication" includes following courses: Modern History of Kazakhstan, Philosophy, Leadership Psychology, Health and safety training course, Entrepreneurship Basics, Environmental Management, Marketing and Branding, Entrepreneurial law, Economic Justification of Startup Projects, Information-communication technologies, Professional Kazakh language, Professionally-oriented foreign language. All these disciplines provide the formation of the basic competences of the student of informatics.

Programming languages and technologies: Algorithms and structures of data, Programming languages and technologies, Object-oriented programming, Internet programming, Mobile application development, Programming on the 1C platform. Methods of computer calculations and optimizations: Mathematical analysis, Coding theory, Numerical computing, Parallel computations, Optimization methods,

Conclusion

We presented an educational program for bachelor's degree on specialty of "Informatics". The curriculum is consistent with the purposes and limitations of the Bologna Declaration and the Dublin descriptors.

The educational program was developed for students of Kazakhstan, where the industry is well developed, but at the same time is not advanced enough in the field of ICT development.

In developing the program, we had fairly intensive interaction with professionals and students of informatics, employers from the industrial sector. We organized expert groups, that allow employers, teachers and students to form the results of training with the professionals in the field of informatics. This activity was very fruitful and led to changes and improvements in the educational program. It includes courses from industrial informatics, robotics and other areas of ICT that will allow students of informatics, in the opinion of experts, to find jobs in the industrial sector of the economy of Kazakhstan in the future.

References


