

# Development of courses directed on formation of competences demanded on the market of IT technologies

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**Abstract**—Important feature of new educational programs, according to the State program of a development of education, is orientation to the results of training expressed in the form of competences. Approach on the basis of results of training displaces accents from the teacher to the student, from teaching to training. Results of training are focused on achievements of student, and also that student can show at the end of educational activity. Learning methods are chosen so that the assimilation of the material are held on the form: “Knowledge” → “Skills”. In this article approach of development of a training course is offered with using the following activities: training with the ability to apply the acquired knowledge; depth study of theoretical material; discussion with other students of actual issues on the current topic; material presentation skills; experimental skills; multimedia tools, tests for self-checking.

**Index Terms**—learning outcomes, competences, learning methods, student activities, multimedia tools, HyperCam, Moodle, tests for self-checking, Flash-animation, EJudge system.

## I. INTRODUCTION

KAZAKHSTAN is among countries that signed the Bologna declaration and implemented National Qualification Framework (NQF) as National qualification system (NQS). Currently in the Republic of Kazakhstan National Program of Education Development for 2011-2020 is implemented. National Program aims to radical modernization of the education system, a significant and sustained increasing in investment in education, and improving its quality. One of the actions aimed at the implementation of this program is the introduction to the

Labour Code of the Republic of Kazakhstan of supplement Chapter 10-1 "National Qualifications System". In accordance with the NQS Sectoral Qualifications Frameworks are developed, which are the basis for the formation of Professional Standards. Professional standards allow developing educational programs in accordance with the requirements of the labour market. NQS contributes to the construction of the model of profession and model of specialist on competence-oriented standards. Since December, 2012 Al-Farabi Kazakh National University implements EU Tempus project “Qualifications frameworks in Central Asia: Bologna-based principles and regional coordination”. The project envisages the realization Qualification Framework ideas in the Central Asian counties and the creation of the Guidelines for National Qualifications frameworks. It is planned to improve their educational systems by further development of existing requirements to educational standards in particular fields on the base on new European approaches and the Tuning Programme.

In March of 2012 in al-Farabi Kazakh National University the Project of Kazakh - Indo - US Collaboration for Engineering Education (KIUCEE) is started. Kazakh-Indo American project for faculty staff professional training and skills maintenance on natural sciences and technical disciplines is the project developed on the base of existing experience and expertise of IUCEE. The KIUCEE project provides an opportunity for KazNU faculty staff to share expertise of Indian and US professionals and further contribute to the enhancement of Engineering Science and Education both in Kazakhstan and Central Asian countries.

Since January, 2010 Kazakh National University named al-Farabi works according to the international "Teaching Competency and Infrastructure for e-Learning and Retraining" Tempus IV CANDI project. The main purpose of the project is development of infrastructure for electronic training and retraining of experts, and also formation of the skills, necessary for transfer of existing courses and training programs to electronic training environment. Today the development of infrastructure for E-Learning and retraining of specialists, and also formation of the skills necessary for transfer of existing courses and training programs in the E-Learning environment, is very actual. Introduction of the E-Learning for training of specialists at the companies allows the company executive to increase efficiency of educational process; to strengthen prestige of the enterprise, having raised the level of knowledge acquired by employees; to increase

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qualification of employees on the job; to spare funds for training. Within the Tempus IV CANDI project Kazakh National University develops methodology of composition of electronic courses.

al-Farabi University pays great attention to employment of graduates. The Employers' Council consists of representatives of various companies, institutions and other business structures, whose activities are in need of specialists in fields of computer science and software engineering, information systems. Construction of high-quality educational Degree programmes "Computer Science and Software Engineering" is of great importance, their orientation to the real professional standards governing the competency and qualification requirements for work performed by IT professionals. In this respect, the importance is the establishment, with the support of the Kazakhstan Association of IT Companies professional standards that clearly define the levels of qualification duties, professional competences, education requirements, work experience and certification. Objects and tasks of professional activity can be carried out pair of professional and educational standards and to carry out the detailed design of exemplary educational programs. Curriculum update process is to update the curriculums according to the feedback from students, graduates and employers. This process is accompanied with conduction of questionnaires.

Addressing issues of professional development in university is taken into account employers' requirements. University established communication link with employers via the Employers' Council and the Career Sector which takes active part in assistance of employment of graduates and expansion on practice base.

Development of the educational programmes is according current market conditions of globalization and competition in Kazakhstan. University is capable to define the content of educational programmes up to 50-80 %. Annually University conducts survey on "employer requirements" among University partners to define employment preferences. University defines its own list of disciplines and elective courses according to the labour market requirements. The results of the surveys influence also on the contents of elective courses which are included in the Annually Catalogue of elective courses.

## II. COMPETENCE-ORIENTED STANDARDS

An important feature of the new educational programs, according to the State Program for education development of Kazakhstan Republic, is to focus on learning outcomes, expressed in the form of competencies. Based on the experience of leading European universities, the designing training courses should begin with the definition of learning outcomes. That learning outcomes affect the design of training activities, content, sequence of presentation, preparation of assignments, selection of different types of media content, the development of knowledge assessment system.

Approach based on learning outcomes shifts the emphasis from teacher to student, from teaching to learning [1-2]. Learning outcomes focus on the students achievements, as well as on the fact that the learner is able to demonstrate at the

end of training activities. Knowledge of the learning outcomes before the start of the course can help students to assess what they should expect from their course, and that they should be able to do for its successful completion.

The results of training courses also allow developers to connect clearly materials on learning, teaching and knowledge assessment at the earliest stages of the course development and also to create the conditions to ensure quality. Learning outcomes are closely related to the knowledge assessment. The evaluation strategy should address the provision of a number of opportunities for students to demonstrate the alleged development of learning outcomes.

### A. Learning outcomes

Learning methods are chosen so that the assimilation of the material are held on the form: "Knowledge" → "Skills" [3]. Learning methods can be classified as follows:

- theoretical training;
- students involving in collaborative learning process with the teacher;
- practical tasks;
- application of knowledge.

For theoretical training could be used the following learning strategies: summary of the main concepts in the form of theoretical material, providing reading materials to increase knowledge, a deeper study of the topic (tutorials); providing links to textbooks, which represent fundamental concepts; providing references to the scientific publications reflecting current researches and developments in this area.

To engage students in collaborative learning process with the teacher may be used: a discussion with the teacher of actual issues on the current topic; bilateral interaction in the form of "Question-Answer" between teacher and student.

For practical tasks could be used: a demonstration of basic processes, algorithms implementation, for example, using video and demonstration of practical tasks implementation, followed by comments on the used technology, approaches and methods; results analysis of practical tasks implementation, possible errors analysis, providing knowledge for practical implementation.

For acquired knowledge application by the student can be used: laboratory practice; games; tasks solving, case study; group projects. So, for example, for students of the computer science department of KazNU there is an opportunity to be trained in Intellectual Programmable Systems laboratory which provides to students the following equipment: sets of the CISCO network equipment; Lego robots; standard sets of the educational equipment PLK-Siemens, Theory of electric chains and electronics bases, Cryptographic systems, Access monitoring systems, Elements of systems of automatic equipment and computer facilities, Electronics basis.

### B. Possible types of student activities

For theoretical training could be used the following activities: training with the ability to apply the acquired knowledge; depth study of theoretical material; a discussion with other students of actual issues on the current topic.

To involve students in collaborative learning process with the teacher may be used: knowledge interpreting; a clearer understanding of the material; research training.

For practical tasks could be used: material presentation skills; experimental skills.

For acquired knowledge application by the student could be used: the application of theoretical knowledge in practice; a deeper understanding of the tasks given; research training; situations evaluation; making decision.

### C. Methods to assess the achievement of learning outcomes

To assess the knowledge could be used the following methods: essay writing; theoretical and practical tasks; interviews; presentations; test; tests for self-check; project implementation; execution of the project group; execution of tasks by case studies; reports on the practical and laboratory assignments implementation.

From learning outcomes, teaching methods, student activities and methods of knowledge assessment are formed interrelated chains, for example, such as:

"Skills application" ↔ «Performing of laboratory tasks» ↔ "Application of students' theoretical knowledge in practice" ↔ "Report on implementation of laboratory tasks" that give answers to the questions: "What is the student expects to receive as a result of training?" ↔ "What the teacher offers this as a learning method?" ↔ "What kind of activities will contribute to achieving this outcome?" ↔ "How evaluate the quality of training?".

## III. FORMATION OF THE COMPETENCES DEMANDED IN IT MARKET OF TECHNOLOGIES

According to the RK general education standards, and also educational programs of leading universities in the field of IT technologies, training of specialists in the field of information and communication technologies promote formation of the following competences: possession of basic mathematical apparatus; understanding and ability of operating by such concepts of informatics, as "algorithm" and "data processing"; ability to estimate opportunities and restrictions of algorithmic operations; ability to operate with algorithms, structures of data and models of the solution of tasks; basic understanding of structure and functioning of computers and key systems of informatics, such as operating systems, database management systems, communication systems; possession of methods of modeling, creation, check and software testing, with possibility of their application for the solution of tasks; ability to develop decisions for practical tasks with use of methods of informatics, taking into account technical, ergonomic, economic, legal and social restrictions.

At design and development of remote courses for formation of the competences demanded in the IT market of technologies, the emphasis for the next moments was placed.

### A. Theoretical materials

The material of each lecture of a course is, as a rule, broken into some separate small pages, supplied with links to additional sources of information for independent studying

[4]. The section of each subject included questions for self-examination. The special place is taken by video lectures which are an important element of modern educational and methodical complexes. Video lectures allow the teacher to introduce a wide set of control facilities cognitive activity of trainees, to realize rich possibilities of an illustration of the maintenance of a training course. Video lectures synthesize practically all types of information – symbolical, graphic, sound, broadcast in a complex and in a dynamic mode.

### B. Multimedia tools

According to researches of experts from Open university (Open University), difference of electronic materials from traditional educational resources consists available visual means and attraction of additional resources, such, as the glossary, animations, screencasts which can be used in an interactive mode. For example, the videos created by the HyperCam program can be used for demonstration of opportunities of the software (fig. 1, 2).

For good understanding of logic of program writing in a course a large number of the interactive components which are clearly demonstrating work of algorithms is added.

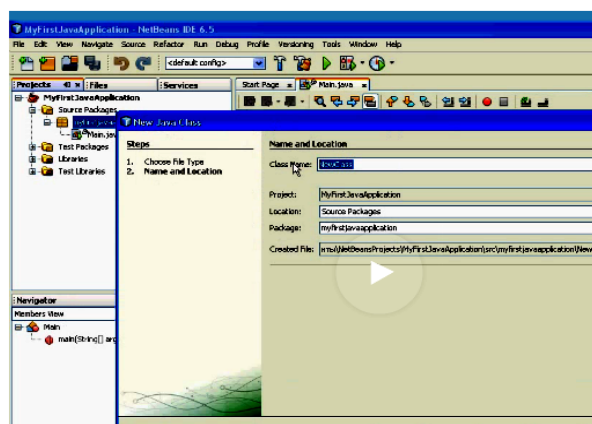


Figure 1. HyperCam movie showing development of a program application in the environment of NetBeansIDE

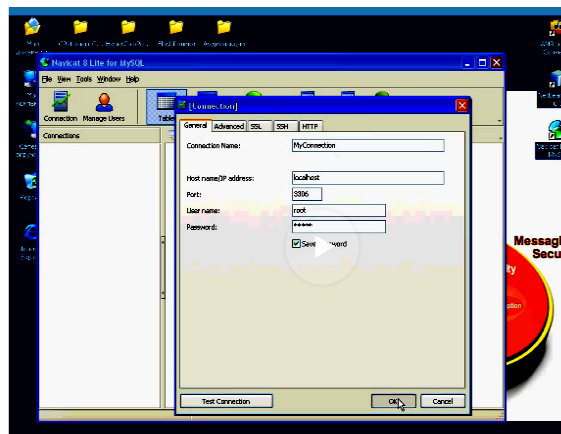


Figure 2. HyperCam movie – work demonstration with DBMS

By means of tools and opportunities of Flash examples (fig. 3) were created convenient for understanding and assimilation [5-7].



Figure 3. The Flash-animation showing an exchange of open keys and confidential messages in the unprotected network

### C. Practical tasks

For students of IT specialties of a task are most often formed in the form of laboratory works. For example, on the subject "Introduction to Operating Systems" the task to investigate a configuration of an operating system, to study parameters of system, opportunities to change settings is given. On the subject "Network Technologies" the task to adjust a network is given. For successful performance of a task rollers with examples of performance of similar tasks (fig. 4) are offered the student.

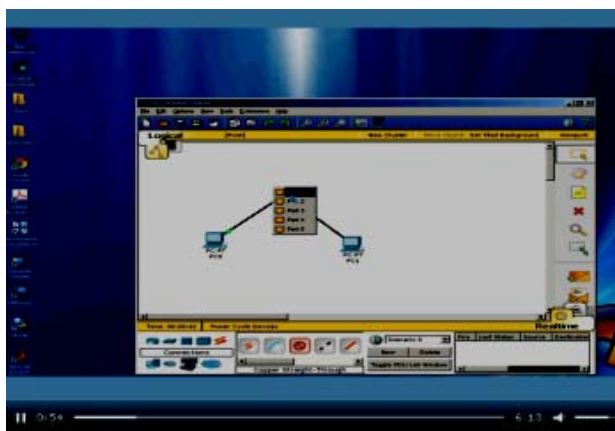


Figure 5. Instructions to performance of laboratory work

### D. Self-assessment tests

Training effect in courses is achieved not only by the content and the friendly interface of educational material, but also through the use of assignments and tests for self-assessment, allowing the learner to evaluate the degree of material mastery. Self-organization and self-control conducted by a student gradually develop the ability to "see" the prospects for his development, to participate directly in building of their educational activities. Training control exercises and assignments allowing independent of level assessment contribute students' competence formation.

### E. EJudge system

EJudge system is very useful in teaching students programming. EJudge is a system for conducting competitions on programming and support training courses. EJudge system consists of several programs; thus the participant and

administrator interface is provided through the Web. EJudge system is included in the curriculum of KAZNU Moodle platform and is used to support a variety of programming courses, "Algorithms and Data structures", "Programming languages and technologies" and others.

## IV. CONCLUSION

Development of courses directed on formation of competences demanded on the market of IT technologies helps to create good quality engineering specialists, remarkable in IT technology market, contributes to the process of formation competitive experts in Kazakhstan and global labor markets.

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