Research Article

Training of It-Specialists within the University Information-Educational Environment

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ABSTRACT

The relevance of the research is based on the need to find the optimal solutions to reform the modern system of Russian higher professional education by means of the system integration of innovative technologies both in the educational process and its management. In this regard, the paper is aimed at developing theoretical and methodological aspects of creating the information-educational environment of the university for professional training of future IT-specialists. The principal method of the research is a modelling method, that enables us to consider a complex solution to the problem of building the information subject module of IT-specialist training within the university information-educational environment using its model. The basic approaches for revealing pedagogical conditions of the model effective functioning are system, synergistic, costructivist and competency-based approaches, which open up new opportunities for the further development of IT-specialist professional training theory. A scientific assessment of a complex of conditions for building and application of the information subject module within the university information-educational environment for training IT-specialists is also presented. The suggested materials have practical value for more effective realisation of the process of integrating traditional pedagogical and e-learning technologies within the information-educational environment of training specialists in the university.
Keywords: professional standard, IT-specialist, information technologies, competency-based approach, information-educational environment (IEE), model, information subject module (ISM)

INTRODUCTION

Nowadays, when informatization of society, industry, economy, social sphere, etc. has a global character, and informational resources are becoming vital for the state and society, the information technologies industry is determined as a strategically key industry of economy. Taking into account the level of information technologies (IT) development, we can draw

conclusions about the state economy as a whole. In November, 2013, the government of the Russian Federation adopted a clear strategy for the development of the information technologies branch through 2020, which determines the development and perspective growth of the Russian IT-branch by 10% and more annually. One of the key tendencies of this strategy implementation is capacity building of personnel and development of professional education for purposes of the branch. To fulfill these large-scale challenges, a great amount of problems related to an innovative approach to professional training of highly-skilled IT-specialists needs to be solved (The development strategy of information technologies branch in the Russian Federation for 2014-2020 and through 2025, Circulation year 2016). Taking into account the demographic gap of 1990s, the growth of the qualified personnel shortage can achieve hundreds of thousands people, and that will be the key constraining branch development factor. Analysts of the branch in their predictions emphasize the fact that by 2018 no less than 350 thousand IT-specialists have to be trained in the system of education, of them no less than 125 thousand should be government-subsidized students in institutions of higher education. Therefore, it is necessary to look carefully into implementing a series of measures, which will increase the quantity of IT-specialists in the labor market. Nowadays, according to experts, only 15% of alumnis in engineering majors are qualified enough to be immediately employed in the sphere of information technologies (The development strategy of information technologies branch in the Russian Federation for 2014-2020 and through 2025, Circulation year 2016). The Strategy turns our attention to the fact that specialists with professions demanded in the labor market are either lacking or not trained at all (The development strategy of information technologies branch in the Russian Federation for 2014-2020 and through 2025, Circulation year 2016), especially in such majors as System Architecture, Product Management, Project Management and Internet Marketing. Therefore, synchronization of professional and educational standards in the sphere of information technologies is becoming increasingly vital. Special attention should be paid to the further implementation of the new generation federal state educational standards with requirements to the results of the core educational curricula acquisition. Hence, it is becoming particularly important for future IT-specialists to acquire the ability of applying new information technologies effectively. The development of economic sectors related to information technologies in Russia has an impact on the enhancement of human capital assets by means of the efficiency increase in professional education, and popularization of professions in this field. IT-companies have an urgent need for specialists with a high level of professional training. The leading companies train specialists on their own investing funds in the basic practical training of their personnel (Efimova, 2011). In view of this, we can state that the key trends in the implementation of the strategy in the field of the human capacity development and education in IT-branch, are: actualisation of educational programmes for bachelors and masters in Russian universities in accordance with the requirements of new professional and educational standards; providing timely and qualitative training of highly-skilled specialists for carrying out researches and elaborations in priority directions of the IT-branch development (The development strategy of information technologies branch in the Russian Federation for 2014-2020 and through 2025, Circulation year 2016). The focus of education on specific promising and even practical needs is one of the key challenges of educational institutions of all levels. In this regard, mutually beneficial cooperation of the leading educational institutions of higher education and companies conducting their business in the field of information technologies is the key one. They should cooperate on matters relating to both human resources and research activities. Thus, building professional competencies of alumni in the training area of «Applied Information Science» as IT-specialists in the field of information systems is becoming increasingly significant today. Such specialists should be competent in the integration of IT-

solutions with business processes for achieving strategic goals of enterprises. It is evident that specialists in the field of information systems are actually a link between technical specialists and managers (Belousova, 2013). The transition of the Russian system of higher education to the third generation educational standards calls for the development of integration mechanisms providing an effective interaction of higher educational institutions with employers and professional communities. In market conditions, the problem of meeting the requirements of future employer as a potential 'buyer' of a specialist is given higher priority. In view of this, the universities have to clearly define the volume of information they should give to their students and methods of its providing, so that later a future specialist will be able to find his or her place in society and a decent well-paid job according to obtained qualification. Therefore, elaboration of innovative approaches to the professional training of future IT-specialists in the university is of primary importance.

Many Russian researchers raised the problem of professional education: examined and analysed various approaches to the problem of professional training management, focused on the scientific assessment of the competency-based approach and problems with pedagogical quality control (Bazhenov & Luchaninov , 2014; Kurzaeva *et al.*, 2016; Nazarova et al., 2016). We understand professional training to mean a complex of knowledge, skills and abilities reflecting a professional sphere of the future specialist activity. Nevertheless, we should take into account means of conducting professional activities as well. In the framework of the competency-based approach, professional training is becoming more practice-oriented, and aims at building competencies which help to apply the acquired knowledge, skills and abilities in practice. The implementation of the programmes aimed at informatization of education is carried out within the framework of fulfilling the tasks outlined in the Modernization Concept of the Russian Educational System (The concept of long-term socio-economic development of the Russian Federation through 2020, Circulation year 2017). Strengthening the

efforts of all concerned parties has drastically changed the attitude to equipping institutions of higher education with new technologies and their integration into the university information-educational environment (IEE).

Various existing researches in this field prove the fact that the problem in question is one of the highest relevance. The leading academics, educators, psychologists, specialists in the field of information technologies examined many significant parts of the professional training of specialists challenge through IT-potential, including highly important theoretical and practical issues, such as (Anderson & Krathwohl, 2001; Vexler, Bazhenov & Bazhenova, 2014):

- issues regarding the methodology and practical elaboration of the information environment for training of specialists;
- psychological and pedagogical aspects of applying the information environment for training specialists;
- specific features of the information environment application in the educational process;
- providing the information environment with automated software developments.

However, to sum it up, these are mainly the theoretical elaborations on the problem of IT-specialist professional training within the university IEE.

METHODOLOGICAL FRAMEWORK

There exists a number of factors that hinder the efficiency and quality of future IT-specialist professional training. The key issues of them are the following: future IT-specialist professional training should comply with the new regulations, educational and professional standards; an increase in the number of hours on disciplines offered for education, provided that a period of studies at the institutions of higher education is steady; enhancement of fundamentality of education, combined with practical orientation; intensification of the educational process by means of an optimal combination of traditional and innovative forms, methods and educational tools; setting clear didactic objectives and their realisation in

accordance with goals and content of education; informatization of education, based on the creative implementation of modern information technologies of learning (Mahmutova & Ovchinnikova, 2009; Davletkireeva, 2008). In addition, the system of professional training of IT-specialists in the university lacks a unified methodology of using the information technologies potential. Thus, it consequently results in a great number of urgent and unresolved problems in all spheres of activity, starting from creating a university informatization infrastructure to applying all pedagogical software products in the educational process. The solution of this task is feasible only if the unified IEE is ensured (Davletkireeva, 2008). Training of IT-specialists in the university is carried out in compliance with a complex of requirements, which is formed by the three groups of sources (The Russian Federation Government Resolution No.751 of 4 October (2000), Circulation year 2016). The specialist belonging to the first group should meet the requirements of society, which implies the development of IT-industry, IT-business and specific features of the environment in which they function. The second group of requirements is represented by the active professional environment that needs a highly-skilled employee of the correspondent level and speciality. The third group of requirements is formed on the basis of the state educational standard of higher professional education in such majors as «Applied Computer Science» and specialities related to it. The complex of requirements ensures a high-quality training of IT-specialists, which, in turn, implies an active use of innovative technologies during the educational process; implementation of integrated and inter-disciplinary courses and curricula as elements of the information subject module; creating conditions for sustainable professional development of the future IT-personnel, ensuring continuity between different levels of professional education and creating an effective system of supplementary professional education; optimisation of teaching methods; participation of business-partners and other concerned organizations in solving the problems

of professional training of IT-specialists in the university (Mahmutova & Ovchinnikova, 2009). The aforementioned complex of requirements for training future IT-specialists is fundamental for ensuring information-educational environment during the university professional training of IT-specialists. The authors, who formulated the conceptual system of the informatization of education widely discuss such terms as information environment, educational environment, information-educational environment, information-educational space. The irrelevant technical orientation, specific to formulation of some notions, has been eventually resolved by a number of researchers who gave pedagogical meaning to the notions. This enabled us to determine, with reasonable accuracy, some features typical for the term 'information-educational environment' (Mahmutova & Ovchinnikova, 2009).Despite the differences in definitions, one similarity in their interpretation is that the environment is considered as a complex of various subsystems and support tools. Information, technical and educational tools are aimed at providing the entire process of professional university training of IT-specialists, as well as equipping the participants of this process with tools, techniques and methods of fulfilling educational challenges (Mahmutova & Mahmutov, 2015). Thus, we can define the information-educational environment as an interaction of all interrelated participants of the educational process, which use such information exchange tools as special software (Mahmutova & Ovchinnikova, 2009). From this perspective, we included the 'information' notion in the definition of the IEE, firstly, to focus on its fundamentals – modern information technologies and means of communication, and, secondly, to enhance the information process of the elaborated environment. However, a great emphasis is laid on the educational character of the environment, since knowledge-oriented information flows constitute a basis for interaction of a 'computer-human' system, i.e. serve as tools for acquiring knowledge, skills and abilities. In view of this, by the IEE of IT-specialist professional university training we understand a pedagogical

system, which comprises a system-based complex of information resources, data communications, software and educational tools, protocols of participants' interaction, and focuses on satisfying the learner-oriented, educational and professional needs of future IT-specialists (Mahmutova & Ovchinnikova, 2009). Consequently, the IEE, being oriented at a definite subject area, has a direct impact on the level of the IT-specialist university training.

Thus, after a thorough analysis, we can state that the system approach application enabled us to consider the IEE of future IT-specialist training and its methodology as interrelated and interdependent pedagogical systems, whereas the synergistic approach application – as open systems that are capable of developing and expanding. The constructivist approach enabled us to define a strategy of applying the methodology of IT-specialist training within the IEE. These approaches are feasible, provided that the two corresponding groups of principles are implemented, namely: a building principle, which includes integrity, redundancy, maximum coverage; and an application principle comprising intellectual partnership, reflexive activity, person orientation, feedback and constructive interaction. The aforementioned approaches served as a theoretical and methodological basis for elaboration and scientific assessment of the information subject module (ISM) model within the framework of future IT-specialist professional training in the university IEE, and revealing the pedagogical conditions for the effective functioning of the model. The constructivist approach has been used as a method for designing the ISM of future IT-specialist professional training within the university IEE, whereas such design tools as portal technologies have been used as design tools. The choice was determined by the fact that this approach enables to single out and integrate the components of the designed model, while the technologies define its design principles. We consider the ISM as a field of knowledge, a source of information and a tool for future IT-specialist activities. When designing the ISM, we focused on a definite subject area, which covers specific disciplines of

professional training; its functions, which are implemented regardless of the subject area and organisational principles of future IT-specialist training. Special attention has been paid to the knowledge-oriented information flows (incoming, outgoing and internal), which represent the most dynamic part, integrate all components of the model, and provide communication with environment. To carefully design the ISM, we need to have a clear understanding of its place in the complexity of interactions within the IEE, among which the teacher-learner interaction stands out (Mahmutova & Mahmutov, 2010).

RESULTS

The ISM modelling, implemented within the IEE, was based on the principles of portal technologies, which are aimed at a flexible combination of traditional pedagogical principles and new information technologies of future IT-specialist professional training. We consider this model to be a subsystem of open type, built in the context of the university information-educational environment. The requirements of the state educational standards, potential employers, social procurement and knowledge-oriented information flows have a direct effect on the dynamics and development of the environment.

The elaborated model is represented by four components:

1) organisational component comprises the university structures and subdivisions, which provide the implementation, functioning and development of the ISM model within the IEE during the educational process;

2) pedagogical component comprises educational tools applied in the process of professional training (active teaching methods encourage students for independent scientific researches);

3) information and communication component, built by means of information and programme-methodological resources, containing knowledge and its working methods (search, storage, processing and application of information). These resources, stored on the recording media, ensure

interaction between all participants of the educational process and facilitate access to the ISM within the university IEE, in compliance with the corresponding communication technologies;

4) Material and technical component comprises software and technical equipment needed for proper functioning of the ISM of future IT-specialist professional training within the university IEE (Davletkireeva, 2008).**Figure 1** shows the ISM scheme of the IT-specialist professional training within the university information-educational environment .
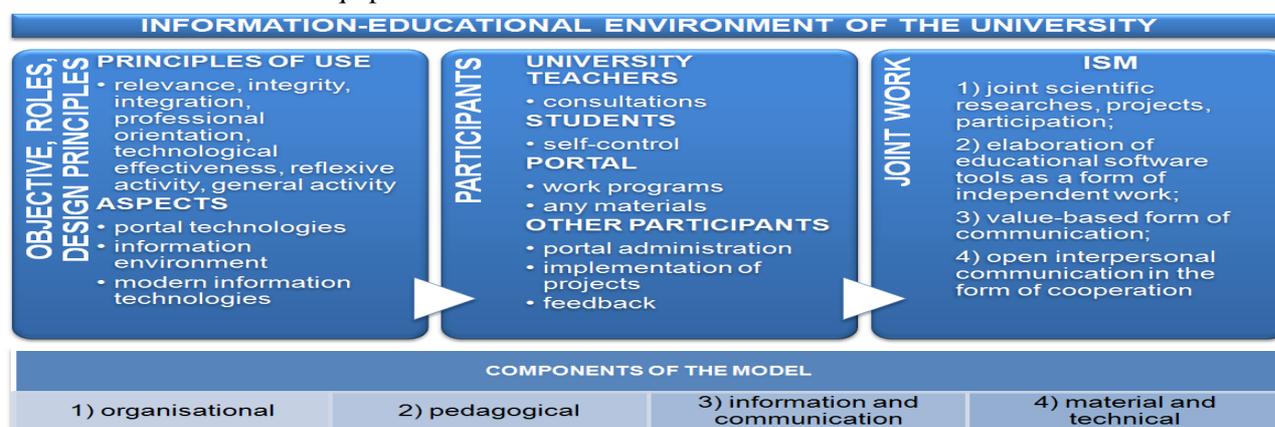

Figure 1. Model of information-educational environment of the University for Professional training of future IT-specialists

Objects, roles, functions, presented in the model (Fig.1):

Objective – to ensure greater efficiency of future IT-specialists professional training;

Roles – educational and self-educational, developmental and self-developmental, compensatory, motivational, controlling, value-oriented.

Design principles - completeness, efficiency, object, structured redundancy, purposefulness, personalisation, communicability, compliance with Russian and international standards;

Principles of use – relevance, integrity, integration, professional orientation, technological effectiveness, reflexive activity, general activity.

University teachers – consultations, elaboration of electronic learning and methodical complexes, informative content of the portal, interim and final assessment of students, guidance of students' independent and research work, preparation for theoretical, practical and laboratory classes.

Students – self-control, completion of laboratory and practical works, study of theoretical material, attending video lectures, preparation for classes, information search on the subject, carrying out scientific research work, independent study;

Portal – work programs, reference material, theoretical material, plans for conducting studies, presentation material, report forms with keys, methods for completion the final work, issues for independent study, questions, tests and tasks for self-control, teaching aids for completion of laboratory works, feedback with university teachers, students, groupmates, feedback, connection with a source of information;

Other participants – portal administration, implementation of mutual projects, providing feedback;

Joint work – joint scientific research, projects, participation in conferences, exchange of information and references to the retrieved or created resources, which are of interest to the educational process; support to the environment by means of the organised educational activity in the form of the goal-oriented search, analysis and description of resources, and / or elaboration of educational software tools as a form of independent, course, and diploma work; value-based form of communication, where every participant of the educational process becomes an IT-specialist and is considered to be an equal member of the ISM of the university information-educational environment; open

interpersonal communication in the form of cooperation.

In the context of the study, we thoroughly examined various aspects of application of portal technologies and information environments for special purposes. Furthermore, we analysed the potential of modern information technologies. The obtained results enable us to use them as a basis for the proposed university information-educational environment for training IT-specialists in general, and for modelling the ISM, in particular (Table 1).

Table 1. The potential of the ISM of the information-educational environment for participants of the educational process

For students	For university teachers
- provides up-to-date information about the subject area; - ensures systematic training sessions; - contains necessary educational materials for courses taken; - provides feedback with university teachers by means of e-learning technologies; - ensures communication with unified databases and data banks within the IEE; - exercises systematic, step-by-step control, including both self-control of a student, and external monitoring of a university teacher through a combination of traditional pedagogical and e-learning technologies of education within the university IEE.	- provides a maximum variety of educational methods and forms, which meets needs and expectations of learners with different learning styles and leading representative systems; - ensures an effective organisation of classroom trainings and independent work of students through a combination of traditional pedagogical and e-learning technologies of education within the university IEE; - contains tools for elaboration and implementation of educational materials in the educational process within the university IEE; - contains control tools through a combination of traditional pedagogical and e-learning technologies of education within the university IEE. - provides a learner's personal map for analysis of learning outcomes within the university IEE; - creates an individual learning pathway for every learner (or group of learners) through a combination of traditional pedagogical and e-learning technologies of education within the university IEE.
For joint work and development of the ISM within the IEE	
- educational process is carried out both in the formal and informal ways; - rapid growth of network information resources on the subject studied; - continuous updating of the existing resources; - joint compensatory activity (learners and other participants of the educational process exchange information and references to the retrieved or created resources, which are of interest to the educational process; - support to the environment by means of the organised educational activity in the form of the goal-oriented search, analysis and description of resources, or elaboration of educational software tools as a form of independent, course, and diploma work; - establishing the value-based form of communication, where every participant of the educational process becomes an IT-specialist and is considered to be an equal member of the ISM of the university IEE; - open interpersonal communication in the forms of cooperation, co-creation, cooperation of university teachers and students, which fully corresponds to the paradigm of humanistic–oriented process of education	

The efficiency assessment of the ISM of the university information-educational environment for training IT-specialists is a complex process, where one should take into account both the multidimensional nature of education and dynamics of the environment development.

CONCLUSION

Summarising the results of this study, a conclusion can be made that the key components of the information subject module of future IT-specialist professional training are functions, which are closely related to the subject area, and principles of its design and application in the professional training of IT-specialists. These principles define a shift in the links of all structural components of the model in order to achieve the main goal, and are aimed at a flexible combination of traditional pedagogical and new information technologies. Furthermore, a complex of pedagogical conditions was defined, which ensures the efficiency of future IT-specialist professional training by means of the information subject module. We see this module as an element of the information-educational environment of the university. For the given complex of pedagogical conditions, at

every stage of IT-specialist professional training it is necessary to:

- elaborate elements of the environment on the basis of pedagogical continuity;
- develop professional motivation, interests and values of future IT-specialists with a focus on the information subject module;
- build teachers' competencies for applying the information subject module in the process of future IT-specialist professional training within the university IEE.

The issues on innovative technologies for the IT-specialist professional training have been thoroughly studied in the works of I.D. Belousova (2013), I.Yu. Efimova (2011), Yu. A. Ivkina (2002).

Elaboration of professional educational standards of the new generation, implementation of innovative pedagogical technologies, and a rapid development of info- and telecommunication equipment requires from a system of higher professional education an ample use of the information-educational environment with the aim to build professional competencies of future IT-specialists.

However, not all aspects of the problem have been investigated. Some significant practical problems still need to be solved. Therefore, further work is needed to examine the possibilities for monitoring a qualitative development of the university IEE, setting and modelling its new properties, which address the specific features of a definite educational institution.

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