Preparation of Professional Training Teachers for Network Cooperation between Educational Establishments during Labor Preparation

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ABSTRACT

Relevance of the problem being investigated is conditioned by the necessity to arrange network cooperation between educational institutions during labor force preparation in the conditions of informatization of educational and technological processes. The aim of the article is to prove the necessity of including basics of network cooperation between educational establishments to preparation of professional training teachers for computer modeling in the conditions of implementation of Federal State Educational Standards for labor professions. The main method of research is pedagogical modeling of professional training teachers preparation, permitting to identify the structure and content of the preparation process for computer modeling. The necessity to train professional training teachers in organization of network cooperation between educational institutions during preparation for computer modeling has been identified and proved; the approach to development of the structure and component content of the process of preparation for computer modeling has been determined; content of preparation for computer modeling has been reconstructed by introduction of cross-discipline module "Computer modeling"; module and competency-based learning and teaching support of the process of preparation to computer modeling has been developed. The materials of the article can be used by magistrands, post-graduates, teachers in development of content of information preparation of professional training teachers.

Introduction

Development and introduction of professional standard for professional training teacher necessitate improvement of requirements to the quality and efficiency of the professional pedagogical educational system, which is reflected in Federal State Educational Standards (FSES) and assumes the necessity of changes in arrangement, content, technology and scale of professional training

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teachers preparation, whose professional and pedagogical activities include preparation of qualified labour forces and middle-ranking specialists for economic sectors of the Russian Federation.

Within the context of the strategy of the personnel resource development of professional education for workers (employees) and middle-ranking specialists, constructs stabilizing processes of providing economy with qualified and highly-qualified specialists are required. The main constructs are:

− new educational systems of preparation professional training teachers for personnel support of training specialists for highly-productive and high technology work places;

− preparation of professional training teachers and masters performing targeted formation of high qualification for workers in specialized educational centers;

− systems of standardization and assessment of professional pedagogical qualification (Bugrova, 2009).

One of the conditions for efficient preparation of labor force and middle-ranking specialists being in demand on the labor market is the formation of open educational system allowing to lead educational and training process out of the boundaries of the educational establishment by means of cooperation with the whole chain of national and foreign educational institutions, employing companies, educational administrative agencies, public organizations, etc. (National educational initiative, 2010). Reorganization of the educational process to present-day objectives is required for the purpose of formation of a new attitude in accordance with the interests of sustainable development both of a separate educational establishment and the whole system of professional education (Can, 2016).

The major part in this process is given to the professional training teachers who require continuous improvement of professional competencies, including informational ones, by means of inclusion to innovation activities (Dorozhkin & Zeer, 2014; Shukshina et al., 2016; Ualiyeva & Murzalinova, 2016; Leontyev et al., 2016; Stukalenko et al., 2016). The basis of such activities is the idea of designing educational system as an open system of network cooperation between the participants of the educational process for the purpose of formation a personality of a professional able to self-development and social self-realization, responsible for its professional future and the future of its country's economy.

At present the term "network cooperation" is determined by the authors with different emphasis. The closest for us is the following definition: "network cooperation as a form of specially structured connections between separate teachers, educational establishments, processes, activities and events, based on voluntary combination of resources, mutual responsibility and obligations, idea of openness for the achievement of the common goal of teachers professional competence development in the system of advanced training in the conditions of information society" (Bugrova, 2009).

Network cooperation especially within the educational establishments and interested employers is becoming a modern highly effective innovation technology which allows educational establishments to develop quickly (Davydova & Dorozhkin, 2016; Davydova et al., 2016). It's important to mention that during network cooperation not only distribution of innovative developments takes place, but there is also a process of dialogue between educational establishments and a

process of reflection of their experience, technological processing happening in the educational system as a whole (Mokretsova & Shvets, 2011; Davydova, 2013; Fedorov & Davydova, 2014).

In the most common understanding a network is a combination of participants having their certain positions and connections between them. The main components describing a network are structure-related and resource-related components (Adamskiy, 2006). Structure-related component reflects spatial location (configuration) of the participants and connection between them conditioned by such configuration. Resource-related component characterizes the type of inter-changed resources and differentiation of the positions based on such exchange (Medvedev & Denisova, 2009).

Types of educational resources which can be used as network-based are presented by five generalized groups: social resources, human resources, information resources, material and technical resources, learning and teaching resources (Antonova, 2014). Despite of the significant differences these groups have one common feature of the data base, accumulating information about latest technologies, trends and developments in educational, production sectors, sector of goods and services, about specialists labour markets and trends in their development, changes in requirements of employers to the quality of professional training in this sector of labour market; electronic libraries; depositories of multimedia products, etc. (Medvedev & Denisova, 2009).

Development, introduction and work with network resources currently is the main component of professional pedagogical competence of a graduate, prepared for work in educational establishments of professional training (Knjazev & Drantusova, 2010). At the same time one should pay attention to the necessity of formation of information constituent of such preparation, which cannot be expressed only by computer knowledge (Ivanenkova, 2011), but assumes preparation to the activity called computer modeling. Computer modeling is an activity combining both designing of the educational system and modeling of production processes with the use of information technologies (Fedulova, 2014).

Preparation of a professional training teacher to computer modeling shall include organization of educational process using information technologies (interactive and multimedia technologies, case-method, training systems) and computer modeling systems for technological processes support.

Unlike information training preparation to computer modeling assumes deeper studies and mastering of information technologies, which is connected with the processes of modeling studied technological processes and objects in virtual information-computer didactive medium, as well as designing and modeling of education process using information technologies, development of information resources for organization of network cooperation between educational establishments (Fedulova, 2014).

In view of this preparation of future professional training teachers for computer modeling is a targeted process of formation of dynamic integrative system of personal education based on studying the experience of information technologies application of professional pedagogical activities and ensuring efficient goals achievement (Fedulova, 2014).

Materials and Methods

Research methods

During research the following methods were used: theoretical (analysis and conceptional synthesis of ideas stated in scientific sources for psychological and pedagogical problems of preparation professional training teachers, problems of development, introduction and application of information technologies connected with the process and results of professional education in general and with informatization of the education in particular), diagnostic (observation, monitoring of students activities); empiric (questioning, conversation, interview, observation, testing); experimental (pedagogical experiment); methods of mathematical statistics and graphic interpretation of the results.

Research facilities

Russian State Vocational Pedagogical University, its affiliates and representative offices in Omsk, Pervouralsk, Berezovsky, Berezniki cities were the base for research.

Stages of research

The research was conducted in three stages:

the first stage involved studying of regulatory documents, philosophic, psychological and pedagogical, information and methodical literature concerning the problem of research, its theoretical understanding, specific features of professional pedagogical activities; the level of knowledge on the problem was identified; tasks of the research were stated; methods of research were identified; development of the program was performed;

during the second stage analysis and generalization of the experience in professional training teachers preparation in higher education institutions permitted to identify the content and structure of preparation of future professional training teachers for computer modeling. Development and verification of the model of future professional training teachers preparation for computer modeling were performed; didactive conditions for preparation to computer modeling were described; criteria for assessment of the level of information competencies of professional pedagogical institution were analyzed;

the third stage included processing, analysis and adjustment of the results of the experimental research work on introduction of the developed model of future professional training teachers preparation for computer modeling to educational process; conclusions and recommendations were formulated.

Results

Designing of the process of future professional training teachers preparation for computer modeling

Module and competency-based approach, providing organizational complexity and efficiency of preparation for computer modeling, and logical and information-based approach, enhancing and supplementing the efficiency of the first approach, were chosen as a conceptual basis determining the designing of the process of future professional training teachers preparation for computer modeling (Tereschenko, 2011).

Module and competency-based approach S.A. Efimova (2006), V.P. Medvedev & L.N. Denisova (2009) allows performing integration of the theoretical and practical training content with emphasis on value-targeted orientation of professional pedagogical preparation which includes assistance in development of future indicators of personal professional development called competencies.

It is the module that takes the leading role in the content of professional education, as the requirements to the results of education are formulated as a list of professional competencies related to kinds of professional activities. In the course of training a graduate shall, first of all, gain real-life experience which is based on knowledge and abilities mastered in an integrated manner. Each module can be mastered independently, and their composite allows to achieve final competency in profession (Fominykh et al., 2016).

Module structure of the process of preparation for computer modeling consists of interrelated elements, has "entrances-exits" to super-systems and sub-systems. Basic features of the module are relative completeness, standardization, independence, succession, ability to variative combination with other modules.

Application of logic and information-based approach (Fedorov, 2004) will provide complexity of training content during preparation for computer modeling taking into account regularities in organization, search and presentation of the information, which are based on logical principles and operations used in this area.

Logic and information-based approach has become a new important basis in developing the process module of preparation for computer modeling. Logic and information-based educational technologies shall be considered as a natural addition to educational means improving the quality and efficiency of the education.

The aim of the preparation of a professional training teacher for computer modeling is the creation of the conditions for formation of the personality of the competent professional training teacher ready to perform professional pedagogical activities in modern conditions assuming application of modern information technologies, multi-media technologies, training systems, control and evaluation of knowledge using intellectual computer assessment systems, designing and modeling of technological processes using CAD, CAM-systems, perform network cooperation within the educational institutions (Fedulova, 2014).

Passing all the stages of the process of preparation for computer modeling is not possible within one subject; therefore, it's reasonable to implement the process in connection between several subjects, whose content is combined in cross-disciplinary module "Computer modeling". This module is understood as a goal-oriented functional unit, supposing integrative content of the educational material and technology of its mastering (Neupokoeva & Chapaev, 2016).

Development of the process of preparation for computer modeling assumes designing the content of the cross-disciplinary module "Computer modeling", which includes stage-by-stage interrelated learning of disciplines from information package "Informatics", "Computer technologies in engineering design", "Modeling of processes and technological systems" with the disciplines of psychology-pedagogical and engineering-manufacturing preparation.

Practical aspect of the preparation for computer modeling is based on task performance which requires application of information and communication technologies in professional activities; solution of pedagogical problem of educational resources informatization; study and search for solutions for various tasks of

information-communication component connected with designing learning and teaching support for educational process, when it's necessary to be able to search for information, carry on a dialogue by means of global and local networks, arrange information and professional cooperation and forecast scientific and social consequences of professional decisions.

The content structure for cross-disciplinary module "Computer Modeling" is shown on Figure 1.
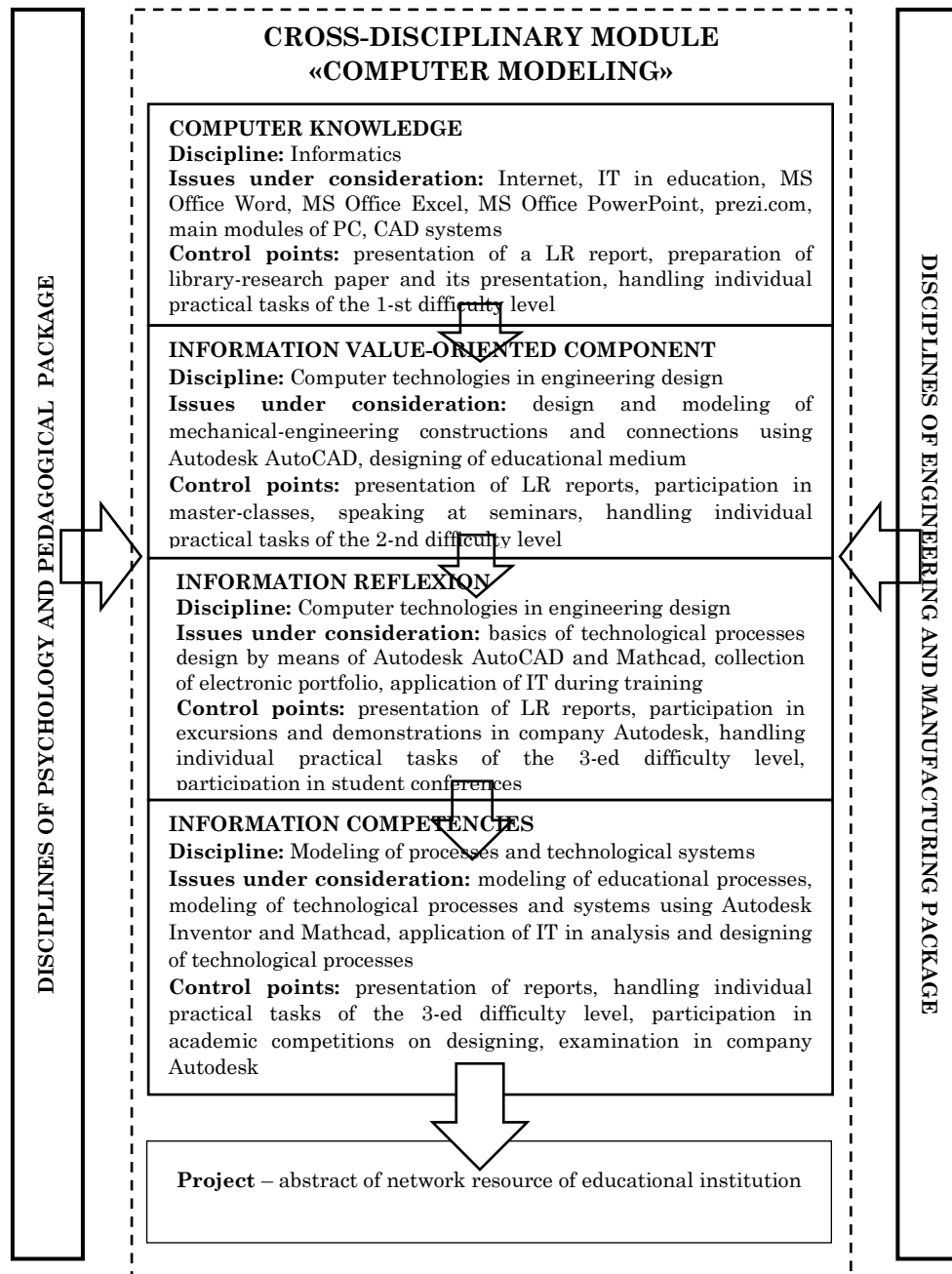
CROSS-DISCIPLINARY MODULE «COMPUTER MODELING»

COMPUTER KNOWLEDGE
Discipline: Informatics
Issues under consideration: Internet, IT in education, MS Office Word, MS Office Excel, MS Office PowerPoint, prezi.com, main modules of PC, CAD systems
Control points: presentation of a LR report, preparation of library-research paper and its presentation, handling individual practical tasks of the 1-st difficulty level

INFORMATION VALUE-ORIENTED COMPONENT
Discipline: Computer technologies in engineering design
Issues under consideration: design and modeling of mechanical-engineering constructions and connections using Autodesk AutoCAD, designing of educational medium
Control points: presentation of LR reports, participation in master-classes, speaking at seminars, handling individual practical tasks of the 2-nd difficulty level

INFORMATION REFLEXION
Discipline: Computer technologies in engineering design
Issues under consideration: basics of technological processes design by means of Autodesk AutoCAD and Mathcad, collection of electronic portfolio, application of IT during training
Control points: presentation of LR reports, participation in excursions and demonstrations in company Autodesk, handling individual practical tasks of the 3-ed difficulty level, participation in student conferences

INFORMATION COMPETENCIES
Discipline: Modeling of processes and technological systems
Issues under consideration: modeling of educational processes, modeling of technological processes and systems using Autodesk Inventor and Mathcad, application of IT in analysis and designing of technological processes
Control points: presentation of reports, handling individual practical tasks of the 3-ed difficulty level, participation in academic competitions on designing, examination in company Autodesk

Project – abstract of network resource of educational institution

DISCIPLINES OF PSYCHOLOGY AND PEDAGOGICAL PACKAGE

DISCIPLINES OF ENGINEERING AND MANUFACTURING PACKAGE

Figure 1. Content structure of cross-discipline module "Computer modeling"

Within the study of cross-disciplinary module "Computer modeling" the following professional competencies are formed:

− application of information-computer technologies: application software programs (Microsoft Office Word, Microsoft Office Excel, Microsoft PowerPoint), search, processing, storage of information in Internet, "cloud" technologies and services, - this is the level of information (computer) competence;

− application of information-computer technologies in working professions training: development of professional education means using CAD systems, collection of electronic portfolio of achievements, work with information education system; application of CAD systems: basic of designing technological processes and systems, modeling of constructions using Autodesk AutoCAD, creation of mathematic models of technological processes and systems using Mathcad – these are the levels of information value-targeted relation to future activities, information reflexion;

− application of information technologies for modeling and optimization of technological processes: modeling of educational processes by means of application programs, modeling of technological processes and systems by means of Autodesk Inventor and Mathcad – this is the level of information competencies formation.

Peculiarity of the content structure of the cross-discipline module "Computer modeling" is in systemacity and integration of its components, which leads to complex orientation of educational process to formation of competitive, competent and professionally mobile professional training teacher. For the purpose of successful implementation of content aspect of preparation for computer modeling within the preparation for network cooperation it is necessary to develop learning and teaching support for this process.

Module and competence-based learning and teaching support of the process of preparation for computer modeling during studying of cross-discipline module "Computer modeling" includes the following parts:

1. Information part, containing theoretical materials in form of educational elements and methodology guidelines for its mastering and transfer, represented as an electronic work book "Computer modeling", presentation materials for lectures, glossary of main terms, connected with the theoretical material by hyperlinks.

2. Execution part, including electronic laboratory course on module disciplines, system of information-design tasks of different difficulty levels.

3. Control part, containing test base, tasks for control work, topics of research papers, test questions on the topics of electronic work book "Computer modeling".

4. Methodical part with recommendations for studying cross-discipline module, information-design tasks performance, control works, preparation of reports on laboratory research and research papers.

Control part of the module and competence-based learning and teaching support of cross-disciplinary module of preparation for computer modeling contains the system of information-design tasks – these are special ("non-standard") tasks, requiring knowledge on range of integrated disciplines for their solution and designed for development of educational project using information technologies.

The system of information-design tasks was developed with application of case-method, which permits to bring the student closer to the solution of real-life tasks of different levels. Each task assumes a separate mini-project which grows to a

completed computer module after performing all the tasks (project – network resource of an educational institution). During performance of the offered tasks the teacher intentionally creates the situation when the existing knowledge is not enough which leads to the problem situation connected with the selection of the computer model designing technology.

Preparation of professional training teachers for computer modeling pays attention to the formation of information-education media in the educational institution, which is presented by automated education management system, data base, information and electronic resources, including archives of presentations, lectures, video- and audio-materials, scientific articles, electronic libraries, etc.: services and internet-resources for communication, social networks, ICQ, Skype, webinars, sites. This permits to widen the field of application of the learned information resources, make educational process more motivated and modern (Valyavsky & Ivanov).

Introduction of the system of preparation for computer modeling provides formation of information competencies of professional training teachers. Information competencies of a professional training teacher are understood as integrated personal qualities, formed as a result of preparation for computer modeling, permitting to use actively information technologies in different kinds of professional pedagogical activities, including preparation of network resources for cooperation between educational institutions (Fedulova, Tarasjuk & Fedulova, 2011). For estimation of their level we used rating system and fund of evaluation means, representing a set of methodical and monitoring and measuring materials, designed for estimation of knowledge and abilities in the field of information resources creation, such as electronic education resources, multimedia and interactive laboratory works, audio-materials and video clips, as structural components of information competency at different stages of students preparation for computer modeling, as well as for certification examination of graduates for estimation of conformity (or non-conformity) of their level to the requirements of the relative standard on completion of the certain educational program.

Phases of Implementation of the Developed Training System

Conducting experimental work connected with the implementation of the developed model presupposed finding solutions for the following issues:

1. At the initial stage, to determine the level of formation of information competencies with the students from the control group after studying the disciplines from the information block.

2. To analyze the scientific methodological level of provisions for formation of information competencies with future professional training pedagogues when studying the information block disciplines.

3. To implement the designed process of training of future professional training pedagogues for using computer modeling when studying the 'Computer Modeling' cross-disciplinary module with taking into consideration the training for using network interaction between educational institutions.

4. To accomplish actions for valuating the level of formation of information competencies with the students from experimental groups after studying the 'Computer Modeling' cross-disciplinary module.

The Ascertaining Phase

The process of the experimental work was of educative nature and was carried out in the natural environment of the educational process at the Russian State Vocational Pedagogical University in the course of training for computer modeling. In total, 207 students took part in the experiment.

The results of the Ascertaining Phase of the experimental work showed that in the practice of the educational process, the formation of information competencies was insufficiently provided for, which was confirmed by the indicators of the level of formation thereof with the students from the control group: low level was detected with 11% of students, threshold level with 31%, average with 44%, and high level with 14%, which is represented in Figure 2.
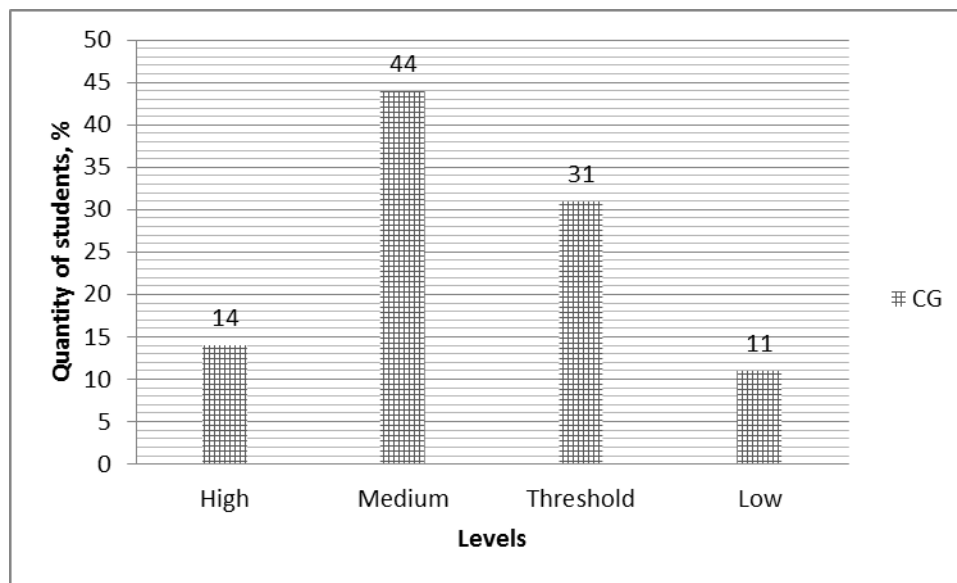
Figure 2. Change of the Levels of Information Competencies' Formation at the Ascertaining Phase of the Experimental Work

The results of the Ascertaining Phase of the experimental work leaded to the following conclusions: 1) at the phase of studying the 'Computer Science' discipline, the students have a low level of computer skills, they do not realize the interconnection between the computer science and other disciplines for training of professional training pedagogues; 2) the students have insufficient level of knowledge and skills in the field of computer modeling (the level of development of information thinking is not high), they do not realize the significance of information as something valuable, they poorly orientate in the implementation of the procedures for information search and analysis using global and local networks, and have a low level of educational and cognitive activity.

The study and the analysis of the Ascertaining Phase of the experimental work showed that the students have a low level of information competencies' formation.

The Formation Phase

At the Formation Phase of the experimental work, solving the following tasks was planned:

− formation with students if a system of knowledge and skills in the field of information technologies, providing for creation of a practice-oriented approach to the use of information technologies in educational scientific activities and future professional pedagogic activities;

− development of professionally important personal qualities with future professional training pedagogues in the course of study of information block disciplines;

− formation of the information component of the professional pedagogic orientation of the personalities of Vocational Pedagogical educational institution's students.

The realization of the process of training of future professional training pedagogues for the use of computer modeling was planned by means of integration of information block disciplines into the 'Computer Modeling' cross-disciplinary module. Within the frames of the cross-disciplinary module, full-fledged and synchronized study of theoretical and practical aspects of the information component of professional activities is carried out, which is connected with both development and operation of educational resources of the open information space, arranging them in order and systematizing them, and ultimately results in improvement of the students' motivation. The implementation of such an approach contributes to the development of not just all of the components of the learning activities (motivation of learning, learning actions, self-control, self-assessment); the development of the components of the intellectual domain (analytical thinking, learning skills, activation of the mechanisms of independent intellectual activities); the development of the of the components of the information domain (information thinking, orientation at studying software products, fields of use of information knowledge); development of relevant self-assessment, self-regulation (control of the results of one's activities), reflexive skills (analysis of educational and cognitive actions, self-control and self-assessment).

The Control, Resulting Phase

The implementation of the Resulting Phase of the experimental work which was of educative nature was carried out in the environment of the educational process at the Russian State Vocational Pedagogical University in the course of training for computer modeling of future professional training pedagogues.

The use of the developed rating system allowed assessing the level of achievement of theoretical knowledge and professional and learning skills of the students after studying the 'Computer Modeling' cross-disciplinary module. That work was carried out on the basis of study and assessment of the educational and cognitive activities of the students (checking the reports on laboratory classes, defending thereof, performance of information and design tasks, preparation of abstracts, reports, passing tests) and tracking the demonstrations of students' personal qualities (independence, sense of responsibility, self-organization).

The comparison of the results of the Ascertaining, the Formation and the Control Phases shows that the arrangement of the process of study of the 'Computer Modeling' cross-disciplinary module, with the use of the model of the process of training for computer modeling and of the educed didactic conditions allowed to assure a persistent improvement in the level of formation of information competencies with students from the experimental groups. The summarized

information about the level of formation of information competencies after the study of the 'Computer Modeling' cross-disciplinary module is represented in Figure 3.
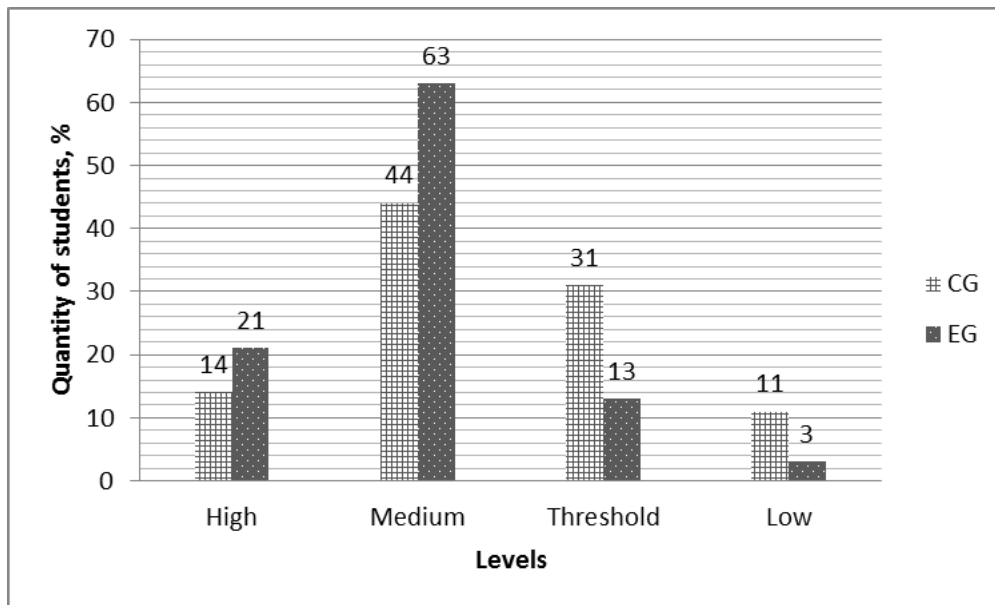
Figure 3. Summarized Data about the Information Competencies' Levels Formation

The development and implementation of the process of training of future professional education pedagogues for the use of computer modeling built on the basis of module-competencies and logic-information approaches and the didactic conditions contributed to the improvement of the level of knowledge and skills, to the formation of significant components of the personalities of students studying at the professional and pedagogical higher education institution.

In general, the experimental test of the developed system of training for use of computer modeling in training of professional education pedagogues and the educed didactic conditions of implementation thereof confirmed their efficiency.

Discussions

In the scientific literature, much attention is paid to the information training of specialists from various fields of professional activities. The study and the analysis of information training of engineers N.I. Ryzhova (2000), M.V. Shvetskiy (1994) and of pedagogues I.M. Aksyanov (2004), I.A. Bartash (2007), G.Kh. Valeyeva, G.R. Tuysin & Sh.R. Musin (2016), A.L. Mirzagitova & L.G. Akhmetov, (2016), A.M. Kalimullin & S.G. Dobrotvorskaya (2016) allowed to reduce significant differences between the contents of information training of such professionals and training professional education pedagogues for use of computer modeling.

Two main components are outlined in the activities of professional education pedagogues: psychological-pedagogical and production-technological components (Fedulova, 2008). Taking into consideration the development and implementation of contemporary information technologies, the efficiency of professional education pedagogues' activities will depend not only from the level of proficiency in the system of baseline psychological-pedagogical and technological knowledge and skills contributing to the successful solution of a

wide range of educational tasks, but also from the level of information training. In such case, the information training of professional education pedagogues has to be of integrative systematic nature, which presupposes interrelation and convergence into the sphere of psychological-pedagogical and production-technological training of structural components of information and computer activities referred to as computer modeling.

The results of study of the 'Computer Modeling' cross-disciplinary module are the following components of the information competencies: the ability to carry out modeling of the educational environment, including for network interaction, to organize information and professional cooperation and forecasting scientific-technology and social consequences of professional solutions using the information technology facilities; readiness to use information technologies for designing technological processes, objects and systems.

The implementation of the system for training future professional education pedagogues to use computer modeling during the study of the 'Computer Modeling' cross-disciplinary module is carried out on the account of a systematic overall implementation of the components of the developed model. That is assured by a purposeful control over the study process which includes competency and activity goal-setting by both pedagogues and students; adjustment of the contents of the cross-disciplinary module with taking into consideration the educed requirements of employers and the increasing IT penetration into the educational environment; selection of the forms, methods, means of study contributing to the intensification of the students' learning activities aimed at forming his/her professionally important personal qualities and having a professional-pedagogical orientation which is assured by the integration of information, psychological-pedagogical and production-technological knowledge.

In such way, the 'Computer Modeling' cross-disciplinary module is intended for training an information competent professional education pedagogue who is ready to use contemporary information systems and technologies for organization of educational-cognitive and production-technological processes and development of information resources for organization of network interaction between educational institutions.

Conclusion

In the study, module-competent educational-methodological support was developed and tested for training professional education pedagogues for the use of computer modeling within the frame of study of the 'Computer Modeling' cross-disciplinary module, including: disciplines' steering documents; 'Computer Modeling' electronic study guide, electronic laboratory course, tasks and methodological instructions for passing inspection tests; system of information and design tasks; base of test tasks and a shell for writing scenarios for them. This educational and methodological support contributes to organization of the educational process as an integration of all components of the training for use of computer modeling and presupposes an integral system of students' activities built on the basis of intensification of the creative activities and with taking into consideration their future professional pedagogical activities.

In the paper, criteria were determined for measuring the level of formation of information competencies with future professional education pedagogues

during the study of the 'Computer Modeling' cross-disciplinary module, which include the level of acquisition of knowledge and skills; the level of development of professionally important personal qualities (information thinking and education-cognitive activities). The results of the research paper evidence the efficiency of the developed process of training of future professional education pedagogues for the use of computer modeling as the condition for training for network interaction between educational institution at the current stage of development of the professional education system.

Disclosure statement

No potential conflict of interest was reported by the authors.

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