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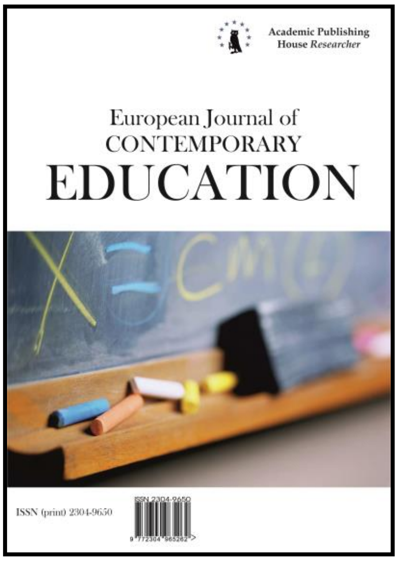

The History of Education

Pedagogical Model of Integrative-Modular Training in Professional Preparation of Students

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Abstract

The present article is aimed to prove that integrative-modular training is one of the conditions for the formation of students' unified vision of the professional world, and to offer a solution to the problem: what is the pedagogical model of integrative-modular training in professional preparation of students. The aim of the article is to describe the features of the pedagogical model of integrative-modular training in professional preparation of students. The review of foreign and russian literature on the subject of the study is done. Research methods include analysis of scientific literature and analysis of learning outcomes. The theoretical, methodological and empirical basis of the study is described. The conceptual apparatus of the pedagogical model of integrative-modular training is specified. The analysis of experimental work of professional preparation of students in the conditions of integrative-modular training is given. Results: the ascertaining, forming and control stages of the experiment within the professional training of students are described. The content of each component of the pedagogical model of integrative-modular training of students is revealed. Finally, it is concluded that the developed pedagogical model of integrative-modular training has a positive impact on the professional training of students, in accordance with the indicators of their professional skills formation.

Keywords: model of training, integrative-modular training, professional preparation of students, higher education.

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1. Introduction

The topicality of the presented research is caused by the fact that the pedagogical model of teaching students is considered as a means of professional preparation of students, indicators of which are general cultural, general professional and specific professional types of competence. On the other hand, the modern education system should correspond to the modern pace of development of scientific, technical and technological components of the society, the rate of increase in the amount of information that a modern person analyzes in professional activities, trends in the integration of the world professional community. Under these conditions, the pedagogical model of integrative-modular training is designed to prepare students to solve problems of this kind. The social order of the society to the modern system of higher education is the order to provide students with progressive professional knowledge and the formation of the future specialist's systematic and complete worldview, the system of professional competencies, including knowledge and skills in a particular professional activity. One of the means of implementation of this order is integrative-modular training.

2. Literature Review

The theory and methodology of professional education involves the use of not only traditional teaching technologies (reduced to illustrative and explanatory way of teaching), but also the active use of innovative technologies. One of these technologies is integrative-modular training, which is one of the ways to build a model of the educational process, the basis of which are completed independent units of information, students' self – preparation for the lesson, parity subject-subject relations between the teacher and the student.

Questions of construction and application of the model of training are studied by many Russian scientists. For example, V.V. Guzeev (2001) develops the theory and practice of integrated educational technologies. I.A. Akulenko (2013) and A.N. Dahin (2002) works on the issues of the essence and effectiveness of pedagogical modeling. The result of their research is the consideration of the modeling process as a general scientific method. In pedagogy, the model is understood as a graphical representation of the process of formation or/and development, for example, professional competencies, and is a system that reflects the process of pedagogical research. One of the main requirements to the model of education is its accordance with the real pedagogical process on the properties and parameters that are studied, as well as the possibility of obtaining new knowledge about the pedagogical process. The problem of constructing pedagogical models is studied by such scholars as A.N. Dakhin (2001), V.D. Lobashev (2006), E.F. Nasyrova (2010) and others. Analysis of their works leads to the conclusion that the concept of "teaching model" is considered in two ways in the scientific and pedagogical literature. Some researchers, for example, An. Dakhin (2001) define this concept somewhat narrowly as a specific example of a multifactorial pedagogical process, created in a special symbolic form, the direct analysis of which gives new knowledge about the studied pedagogical process. Other scientists (Nasyrova, 2010 and others) define the concept of the model more broadly, and present it as a reflection of the parameters of the studied pedagogical process in a purposely created model, which is called the pedagogical model. In this case there are three levels of pedagogical modeling: methodological, theoretical and pedagogical. In accordance with this, there are three groups of pedagogical models: conceptual, didactic and methodical.

The research work by M. Navarro et al. (2016) presents a pedagogical model, describes an integrative training module which helps teachers of the engineering faculty to overcome the problems in the development and implementation of interdisciplinary training programs. Interdisciplinary (integrative) courses in engineering education allow students to critically evaluate knowledge (Orillion, 2009), analyze the correlation of technical, social and human sciences. The work of K. Green and P. Hutchings (2018) is devoted to the development of more effective integrative tasks that contribute to the continuous improvement of learning outcomes of university students. The article by Z.V. Shilova and T.V. Sibgatullina (2017) provides a pedagogical model of teaching University biology students taking into account the professional and applied orientation of training. Ana-Elena Guerrero-Roldán and Ingrid Noguera (2018) proposed a pedagogical model, corresponding with professional competencies and learning activities of students.

The analysis of scientific and methodical works of such scientists as S.N. Goricheva (2016), E.I. Ismagilova (2009) and P.A. Yucyavichene (1989) reveals that integrative and modular training can be considered as a means of integrating knowledge in the process of obtaining new knowledge, cognitive activity, allowing the professional to adapt to the changed conditions, to think critically and generate new ideas. E.F. Nasyrova (2010) in her works shows that integrative-modular training provides individualization of the following components of training: content, pace of learning, independence, types of control and self-control. In addition, these scientists defined the purpose of interactive-modular training: the creation of conditions for the formation of students' independence through the implementation of the main components: the integrated curriculum, the modular program and the training module.

3. Materials and Methods

The following methods were used in the research: theoretical (analysis of literature on the problem under study, systemic analysis, classification, modelling); empirical (pedagogical observation, survey); statistical (statistical observation, methods of statistical analysis). Research methods are based on the study and analysis of the results of pedagogical and scientific and methodical research results of foreign and Russian authors on the problem of improving the quality of teaching methods with the help of integrative-modular training in professional preparation of students.

The theoretical and methodological basis of this study are: the principles of the theory of systematic understanding of pedagogical processes (Kraevsky, Khutorskoy, 2007 and others); the principles of the competence approach in professional education (Abramova, 2016, 2017; Polat, Bukharkina, 2009; Shilova, 2011 and others); the principles of the technologization theory of the pedagogical process (Bespalko, 2009 and others).

General theoretical and special theoretical methods of research allow us to clarify the conceptual apparatus of the pedagogical model of integrative-modular training. In the present study, the term "pedagogical model" is understood as a graphical representation of the formation process of students' professional efficiency in accordance with the professional society's order. The concept of interactive-modular training" includes an integrated curriculum, modular programs of professional disciplines and subject modules. The process of professional preparation of students in this study is understood as the formation process of general cultural, general professional and specific professional competences of students.

We present the content of the pedagogical model of integrative-modular training in professional preparation of students, which is focused on the implementation of the society's social order for initiative and educated professionals. In the generalized form the pedagogical model of integrative-modular training of students is given in Figure 1.

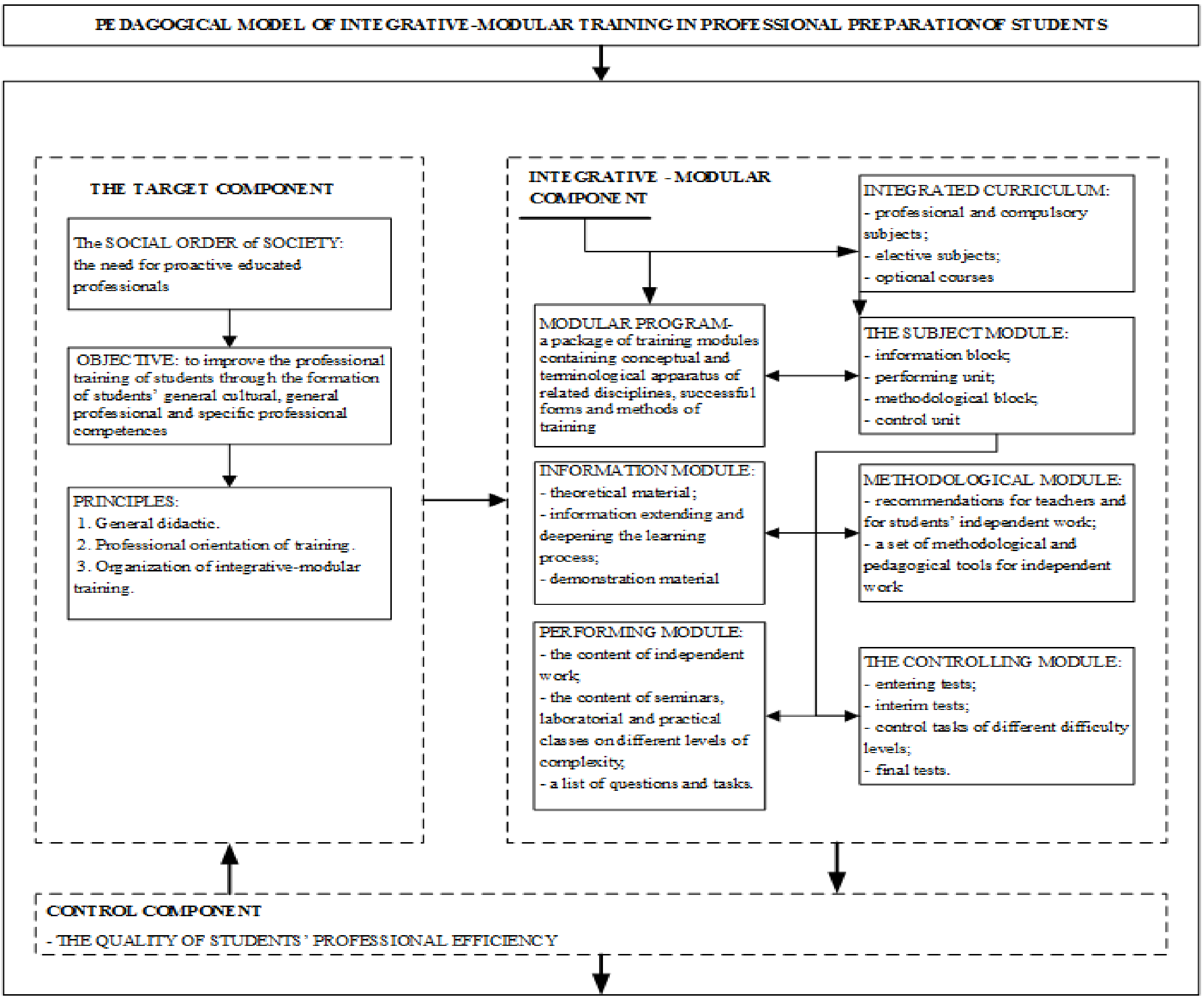

Fig. 1. Model of integrative-modular teaching in professional training of students

Pedagogical features of the model of integrative-modular training in professional preparation of students consist in adaptation of the integrative-modular training model content to professional training for a specific field. In this study, the content corresponds to the professional training in the field of Applied mathematics and Computer Studies.

Social order of the society determines the target component of the model (social order, purpose, principles). The purpose is formulated in accordance with the content of indicators of students' professional training formation, namely: improvement of students' professional competence level. The content of indicators of students' professional training formation is as follows:

I. General cultural – the ability to apply the foundations of philosophical knowledge to the formation of ideological positions, legal and economic knowledge in professional life; communication in oral and written forms for the organization of interpersonal and intercultural interaction and teamwork;

II. General professional – the ability to use basic knowledge of mathematical and natural sciences, to acquire new scientific and professional knowledge, to develop algorithmic and software solutions in the field of system and applied programming, to solve standard problems of professional activity;

III. Specific professional competencies are divided according to the types of activities: research one, design one, production and technological one, organizational and management one.

The theoretical material of the information block is organized in the form of lectures revising the theory of the above mentioned sections of disciplines. In the same block the information deepening the educational process and demonstration materials are provided. The methodical block is presented in the form of methodical recommendations in accordance with the content described above. The performing unit is organized in the form of laboratory and practical training on the content mentioned above. The control unit is in-between and final tests, in accordance with the score-rating system of the University. The principles of professional efficiency formation are selected in accordance with the purpose and characteristics of competencies, namely: general didactic (scientific, systematic, etc.) one, professional orientation of training principle, integrative-modular training principle.

These three parts of the objective component of the model determine the content of the integrative-modular component, which consists of three main modules:

- integrative curriculum, including professional and compulsory subjects (26 subjects of the basic part and 15 subjects of the variable part); elective subjects include 13 pairs of subjects; three optionals;

- modular program, including a package of training modules containing conceptual and terminological thesaurus of related disciplines and successive forms and means of training. As an example of a modular program it is possible to take the module "Theoretical Foundations of Computer Modeling", the purpose of which is to systematize knowledge in the field of computer modeling, to adapt previously acquired knowledge in computer modeling, to implement succession between the disciplines of the basic and variable parts. The module includes information from the disciplines: "Introduction to Applied Mathematics", "Ordinary Differential Equations", "Mathematical Models in Economics", "Modeling of Computer Systems", "Mathematical Logic and Theory of Algorithms", "Modeling Systems and Computer Simulation", "Theory of Experiment Planning", "Computer Probabilistic Statistical Modeling»;

- subject module consists of four units: information, technical, methodical and controlling. The content of each block is given in accordance with the modular program "Theoretical Foundations of Computer Modeling". The information block contains: theoretical material of the sections "Linear Differential Equations of the n-th Order with Constant Coefficients, the Structure of their General solution", "Matrix Method of Integration of Linear Systems of Differential Equations" of the discipline "Ordinary Differential Equations"; sections "Basic Concepts of the Algorithm Theory", "Description and Examples of Primitive Recursive Functions", "Partially-Recursive Functions" of the discipline" Mathematical Logic and Algorithm Theory»; sections "Mathematical Processing of Experimental Results", "Regression Analysis of Experimental Data", "Factor Plans of Experiments" of the discipline "Experiment Planning Theory"; sections "Computer Modeling Technology and its Stages", "Simulation Modelling" of the discipline" Computer Probabilistic Statistical Modeling", information, deepening the educational process from the sections "Functions in the Economic Processes Modeling", "Linear models of Economics", "Network modeling" of the disciplines "Mathematical Models in Economics»; sections "Fundamentals of Modeling Information Systems", "Approaches to modeling information systems" of the discipline "Modeling information systems". The demonstration material is taken from the sections "Problems of Applied Mathematics and Computer Studies", "Problems of Mathematical Support of Computer Systems", "Problems of Probability Theory and Mathematical Statistics" of the discipline "Introduction to Applied Mathematics" and from the sections "Mathematical modeling of Objects and Systems", "Modeling of Random Variables, Processes and Event Flows" of the discipline "Modeling Systems and Machine Simulation". The methodical module contains methodical recommendations for students and teachers on individual and independent work on the highlighted sections of disciplines. The performing block of the module "Theoretical foundations of computer modeling" involves students' independent work on the material of the module on the issues compiled in accordance with the sections of the disciplines that make up the modular program. The content of laboratorial and practical classes has different levels of complexity, in accordance with the rating system of the University. The low level involves the development of basic knowledge of this module, corresponding to the educational standard. The intermediate level contains the tasks that involve the use of the ability to transform basic knowledge into practical professional activity. High level means the solution of non-standard tasks from the professional field, defence of the student's grounds, proof of efficiency of their knowledge application and their practical professional skills. The list of questions and tasks create conditions for the successful passage of the control unit of the subject module of the integral-modular component. On the basis of the problems of the relevant sections of disciplines the entering test is created. Basing on the list of questions and tasks of the module, in-between and final tests are compiled. It should be noted that the University rating system creates favorable conditions for students to perform control tasks of different levels of complexity. Students are interested in obtaining the maximum number of points for control activities, so they strive to show their erudition, creativity, professional efficiency of knowledge application.

After the implementation of the integral-modular component, it is necessary to carry out the control component of the pedagogical model of integral-modular training in the professional preparation of students. The realization of this component is based on determining the degree of quality of students' professional efficiency. This is revealed not only in classroom knowledge, possession of professional skills, but also in their application in professional activities during probations: obtaining primary professional skills, traineeships, obtaining real professional skills and experience of professional activity. If the quality of formation of students' professional efficiency satisfies the professional community, which is reflected in the students' characteristics after their probations, the conclusion is made about the effectiveness of the pedagogical model of integrative-modular training of students. If there are any shortcomings in the professional efficiency of students, it is necessary to return to the objective component of the model, adjust it and integrative-modular component, and again check the quality of the formation of professional efficiency of students.

Empirical research methods have allowed to implement, analyze and make a conclusion about the effectiveness of the pedagogical model of integrative-modular training in professional training of students. Experimental work was organized and carried out for two years with students doing Applied mathematics and Computer Technologies.

The following methods of statistical analysis were used in the study: sampling method, comparison method (nonparametric criterion for independent samples: Chi-square). The study sample consisted of the third- and fourth-year students of the study field 01.03.02 Applied mathematics and Computer Studies, with a total of 48 people from the Federal State Budget Educational Institution of Higher Education (FSBEI HE)" Vyatka state University» (of these, 28 people were in the control group, a group of 20 people were in the 1st experimental group) and 20 people from Federal State Budget Educational Institution of Higher Education (FSBEI HE) "Perm State National Research University" (this group of 20 people was part of the 2nd experimental group). The use of statistical analysis methods allows to determine the students' professional efficiency formation level and in accordance with it to conclude about the effectiveness of the presented model of integrative modular training.

4. Results

4.1. Ascertaining stage of the experiment

The experimental work was carried out in FSBEI HE "Vyatka state University" and FSBEI HE "Perm State National Research University" (68 students in total). The study ran from September 2016 to June 2018. The aim of the experimental work was: to increase the level of indicators the students' professional efficiency formation level: general cultural, general professional, specific professional competencies, the content of which is described above.

The experimental work had three stages: ascertaining, forming and control ones.

The ascertaining stage of the experiment took place in September 2016, which included projecting of the integrative-modular training model at the University in the framework of students' professional training, the search for opportunities to implement individual components of the model and the questionnaire. The purpose of the ascertaining stage of the experiment was: to identify the initial level of formation of indicators of professional training of students. The forms of the ascertaining stage of the experiment were: testing and analysis of the students' testimonials basing on the results of their probations. On the basis of questions and tasks sections of those subjects that are included in the modular program "Theoretical foundations of computer modeling" a modified set of tasks to identify the initial level of formation of indicators of students' professional efficiency are created (3 tasks for each indicator). The tasks for diagnostic testing are grouped in accordance with the indicators of students' professional training. Upon completion of the test, the initial level of formation of students' professional efficiency in accordance with the indicators and levels of their formation (described above) is revealed. The results evaluation is the same for all methods:

3 points – the student does a non-standard task from the field of professional activity, justifies his position on the effective application of knowledge and skills in practical professional activity;

2 points – the student does a task that involves the use of the ability to transform basic knowledge into practical professional activity;

1 point – the student does the basic task of the module corresponding to the educational standard.

A student can get a maximum of 27 points, the minimum-0 points. According to the levels of formation of students' professional efficiency, the points can be grouped as follows:

Low level – from 0 to 9 points;

Intermediate level – from 10 to 18 points;

High level – from 19 to 27 points.

The results were processed by interpreting the Chi-square indicator, for which all the necessary restrictions were met. EG1 is the first experimental group, consisting of students from FSBEI HE "Vyatka State University". EG2 is the second experimental group, including the students from FSBEI HE "Perm State National Research University" (Table 1).

Table 1. The level of formation of students' professional efficiency of experimental groups before the experiment

Groups	The level of formation of students' professional efficiency						Total
	High		Intermediate		Low		
	total	%	total	%	total	%	
EG1	$Q_{11} = 2$	10	$Q_{12} = 14$	70	$Q_{13} = 4$	20	$n_1 = 20$
EG2	$Q_{21} = 3$	15	$Q_{22} = 12$	60	$Q_{23} = 5$	25	$n_2 = 20$
total	5		26		9		

$$\chi^2_{эмп} = \frac{1}{n_1 \cdot n_2} \cdot \left(\frac{(n_1 \cdot Q_{21} - n_2 \cdot Q_{11})^2}{Q_{11} + Q_{21}} + \frac{(n_1 \cdot Q_{22} - n_2 \cdot Q_{12})^2}{Q_{12} + Q_{22}} + \frac{(n_1 \cdot Q_{23} - n_2 \cdot Q_{13})^2}{Q_{13} + Q_{23}} \right) =$$

$$= \frac{1}{20 \cdot 20} \cdot \left(\frac{(20 \cdot 2 - 20 \cdot 3)^2}{5} + \frac{(20 \cdot 14 - 20 \cdot 12)^2}{26} + \frac{(20 \cdot 4 - 20 \cdot 5)^2}{9} \right) =$$

$$= \frac{20^2}{20^2} \cdot \left(\frac{(-1)^2}{5} + \frac{2^2}{26} + \frac{(-1)^2}{9} \right) = 0,46$$

According to the statistical table of critical values of the criterion $\chi 2$ we have $\chi^2_{crit} = 5{,}99$ for the significance level 0.05 and the degree of freedom $k = 3 - 1 = 2$ (Glass, Stanley, 1976). So, $\chi^2_{emp} < \chi^2_{crit}$, because 0,46 < 5,99, and at the significance level of 0.05 (with a reliability of 95 %), we assume that before the experiment, the students of groups EG1 and EG2 on average had initially the same level of professional efficiency. Therefore, we can combine both groups and further consider them as a single experimental group (EG).

The results of the ascertaining stage of experimental work are presented in table 2 (CG – control group, EG – experimental group) and Figure 2.

Table 2. The initial level of students' professional efficiency formation

Groups	The level of formation of students' professional efficiency						Total
	High		Intermediate		Low		
	total	%	total	total	%	total	
CG	$Q_{11} = 1$	8	$Q_{12} = 12$	44	$Q_{13} = 15$	48	$n_1 =$ 28
EG	$Q_{21} = 2$	4	$Q_{22} = 19$	48	$Q_{23} = 19$	48	$n_2 =$ 40
total	3		31		34		

$$\chi^2_{эмп} = \frac{1}{n_1 \cdot n_2} \cdot \left(\frac{(n_1 \cdot Q_{21} - n_2 \cdot Q_{11})^2}{Q_{11} + Q_{21}} + \frac{(n_1 \cdot Q_{22} - n_2 \cdot Q_{12})^2}{Q_{12} + Q_{22}} + \frac{(n_1 \cdot Q_{23} - n_2 \cdot Q_{13})^2}{Q_{13} + Q_{23}} \right) =$$

$$= \frac{1}{28 \cdot 40} \cdot \left(\frac{(28 \cdot 2 - 40 \cdot 1)^2}{3} + \frac{(28 \cdot 19 - 40 \cdot 12)^2}{31} + \frac{(28 \cdot 19 - 40 \cdot 15)^2}{34} \right) =$$

$$= \frac{1}{1120} \cdot \left(\frac{16^2}{3} + \frac{52^2}{31} + \frac{(-68)^2}{34} \right) = 0,28$$

According to the statistical table of critical values of the Chi-square criterion, we find χ^2_{crit} = 5,99 for the significance level 0.05 and the degree of freedom k = 3 – l = 2 (Glass, Stanley, 1976). So, $\chi^2_{emp} < \chi^2_{crit}$, because 0,28 < 5,99, and at the level of significance 0.05 (with reliability of 95 %) we can say that the differences in the levels of formation of students' professional efficiency in the control and experimental groups (CG and EG) at the ascertaining stage of the experiment are not statistically significant, that is, students of KG and EG on average have the same level of formation of professional efficiency.

Let us present the results of the ascertaining stage of the experimental work graphically in Figure 2.

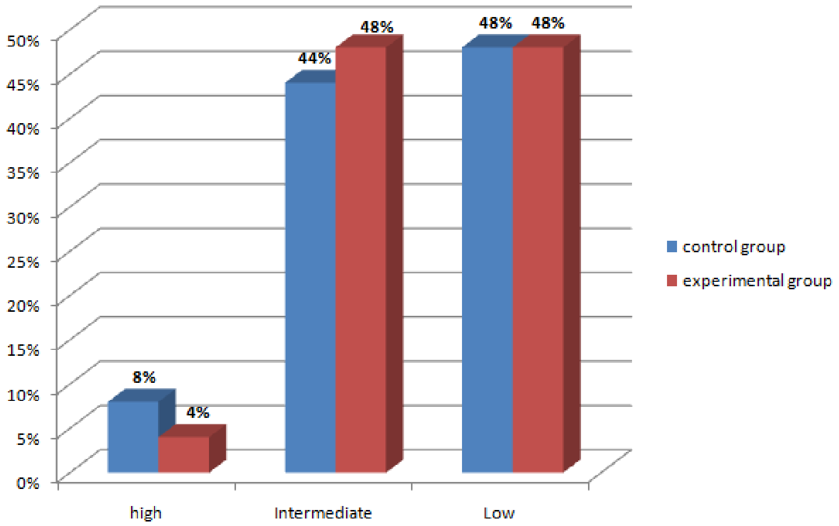

Fig. 2. Initial level of professional efficiency

Analysis of students' testimonials after their probations revealed the employers' wishes to increase the practical orientation of students' professional training.

The result of the ascertaining stage of the experiment was the scientific and pedagogical rationale for the implementation of integrative-modular training in the framework of professional training of University students.

4.2. Forming stage of the experiment

The forming stage of the experiment was performed on the basis of FSBEI HE "Vyatka State University" and FSBEI HE "Perm State National Research University" (68 students in total). The purpose of the forming stage of the experimental work was to identify the effectiveness of the modular program "Theoretical foundations of computer modeling." The subject module of the program was implemented from October 2016 to April 2018.

The information block contains: theoretical material of the sections "Linear Differential Equations of the n-th Order with Constant Coefficients, the Structure of their General solution", "Matrix Method of Integration of Linear Systems of Differential Equations" of the discipline "Ordinary Differential Equations"; sections "Basic Concepts of the Algorithm Theory", "Description and Examples of Primitive Recursive Functions", "Partially-Recursive Functions" of the discipline" Mathematical Logic and Algorithm Theory»; sections "Mathematical Processing of Experimental Results", "Regression Analysis of Experimental Data", "Factor Plans of Experiments" of the discipline "Experiment Planning Theory"; sections "Computer Modeling Technology and its Stages", "Simulation Modelling" of the discipline" Computer Probabilistic Statistical Modeling", information, deepening the educational process from the sections "Functions in the Economic Processes Modeling", "Linear models of Economics", "Network modeling" of the disciplines "Mathematical Models in Economics»; sections "Fundamentals of Modeling Information Systems", "Approaches to modeling information systems" of the discipline "Modeling information systems". The demonstration material is taken from the sections "Problems of Applied Mathematics and Computer Studies", "Problems of Mathematical Support of Computer Systems", "Problems of Probability Theory and Mathematical Statistics" of the discipline "Introduction to Applied Mathematics" and from the sections "Mathematical modeling of Objects and Systems", "Modeling of Random Variables, Processes and Event Flows" of the discipline "Modeling Systems and Machine Simulation". The methodical module contains methodical recommendations for students and teachers on individual and independent work on the highlighted sections of disciplines. The performing block of the module "Theoretical foundations of computer modeling" involves students' independent work on the material of the module on the issues compiled in accordance with the sections of the disciplines that make up the modular program. The content of laboratorial and practical classes has different levels of complexity, in accordance with the rating system of the University. The low level involves the development of basic knowledge of this module, corresponding to the educational standard. The intermediate level contains the tasks that involve the use of the ability to transform basic knowledge into practical professional activity. High level means the solution of non-standard tasks from the professional field, defence of the student's grounds, proof of efficiency of their knowledge application and their practical professional skills. The list of questions and tasks create conditions for the successful passage of the control unit of the subject module of the integral-modular component. On the basis of the problems of the relevant sections of disciplines the entering test is created. Basing on the list of questions and tasks of the module, in-between and final tests are compiled. It should be noted that the University rating system creates favorable conditions for students to perform control tasks of different levels of complexity. Students are interested in obtaining the maximum number of points for control activities, so they strive to show their erudition, creativity, professional efficiency of knowledge application.

4.3. The control stage of the experimental work

The control stage of experimental work was held in May-June 2018 with the students of the control and experimental groups. The purpose of the control stage of experimental work was to identify the final level of indicators of students' professional efficiency. Methods of this stage were testing, analysis of the students' testimonials on the basis of their probations. The study was conducted using the same methods as at the ascertaining stage of the experiment. The results of the control stage of the experimental work are presented in Table 3, Figure 3.

Table 3. The final level of students' professional efficiency formation

Groups	The level of students' professional efficiency formation						Total
	High		Intermediate		Low		
	total	%	total	total	%	total	
CG	$Q_{11} = 6$	20	$Q_{12} = 15$	52	$Q_{13} = 7$	28	$n_1 = 28$
EG	$Q_{21} = 16$	40	$Q_{22} = 22$	56	$Q_{23} = 2$	4	$n_2 = 40$
total	22		37		9		

$$\chi^2_{\text{эмп}} = \frac{1}{n_1 \cdot n_2} \cdot \left(\frac{(n_1 \cdot Q_{21} - n_2 \cdot Q_{11})^2}{Q_{11} + Q_{21}} + \frac{(n_1 \cdot Q_{22} - n_2 \cdot Q_{12})^2}{Q_{12} + Q_{22}} + \frac{(n_1 \cdot Q_{23} - n_2 \cdot Q_{13})^2}{Q_{13} + Q_{23}} + \frac{(n_1 \cdot Q_{24} - n_2 \cdot Q_{14})^2}{Q_{14} + Q_{24}} \right) =$$

$$= \frac{1}{28 \cdot 40} \cdot \left(\frac{(28 \cdot 16 - 40 \cdot 6)^2}{22} + \frac{(28 \cdot 22 - 40 \cdot 15)^2}{37} + \frac{(28 \cdot 2 - 40 \cdot 7)^2}{9} \right) =$$

$$= \frac{1}{1120} \cdot \left(\frac{208^2}{22} + \frac{16^2}{37} + \frac{(-224)^2}{9} \right) = 6,74$$

According to the statistical table of critical values of the Chi-square criterion, we find $\chi^2_{crit} = 5{,}99$ for a significance level of 0.05 and degrees of freedom $k = 3 - 1 = 2$ (Glass, Stanley, 1976). Thus, $\chi^2_{emp} > \chi^2_{crit}$, since 6,74 > 5,99, and at the significance level of 0.05 (with a reliability of 95 %) we can say that the differences in the levels of formation of students' professional efficiency in the control and experimental groups (KG and EG) at the ascertaining stage of the experiment are statistically significant, that is, there is an increase in the level of indicators of professional efficiency formation of the students from the experimental group.

The results of the control stage of the experimental work in the control and experimental groups are graphically presented in Figure 3.

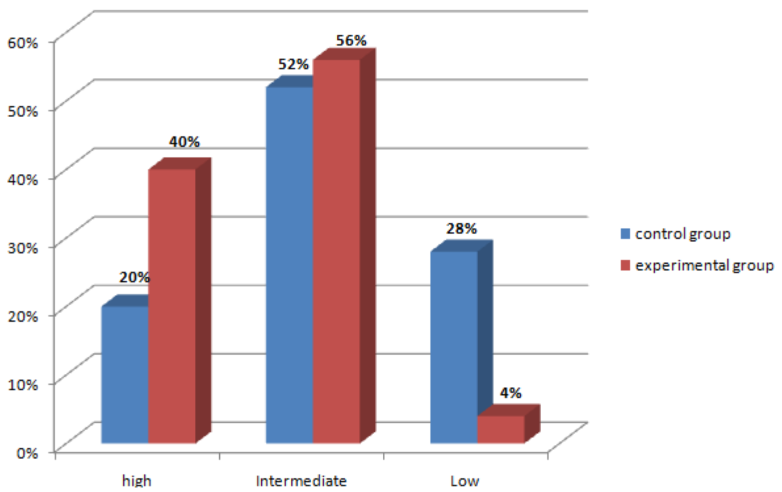

Fig. 3. The final level of formation of students' professional efficiency

Thus, it is possible to talk about the effectiveness of the implementation of the modular program "Theoretical foundations of computer simulation" in the context of integrative and modular training of students, with the aim of raising the level of indicators of formation of their professional efficiency. During the educational process, students form integrative links with other disciplines.

5. Discussion

In accordance with the requirements of higher education standards in Russia, one of the priorities in the educational process is the formation of students' professional efficiency. At the same time, a lot of researchers pay attention to the shortcomings of the traditional method of teaching mathematics to students of higher educational institutions, which does not provide a high quality of mastering mathematical material and the formation of professional competence in students.

To date, the system of vocational education has developed several different approaches to improve the quality of professional training of students. The most promising of them is the integrative-modular approach. It allows on the basis of modular construction of educational process, to integrate educational material, and to come to higher quality level in professional training of students, being guided by the aim to train competitive experts.

Theoretical aspects of integrative-modular training are dealt with in the works by Ismagilova (2009), Nasyrova (2010), Sadovskaya (2005), etc. In her study, Ismagilova (2009) gives a didactic model of professional orientation of teaching mathematics to students studying radio-electronics. The model contains an integrative-modular component, which the author defines as a variable part of the content of mathematical training of students, reflecting the intra – and inter-subject connections of the selected modules in the content of mathematical, general and speciphic disciplines. Ismagilova (2009) proposes to strengthen the professional orientation of teaching mathematics through a system of integrative mathematical courses, the purpose of which is to combine the various content components of mathematical and General engineering disciplines, the formation of students' integrative knowledge and skills in mathematics as a holistic block. Meanwhile, this model does not take into account the aspects of the formation of students' general cultural, general professional and specific professional competences. Nasyrova's research (2010) is devoted to professional training of the technology teacher which is defined as functional and personal readiness of the graduate to implement general cultural and professional competences for the solution of professional and pedagogical tasks. The functional readiness of the technology teacher is a state of the teacher's personality, who considers herself prepared and capable of carrying out professional and pedagogical activity, providing Polytechnic and personal readiness of the school graduate. Personal readiness of the technology teacher is her internal psychological mood to perform professional and pedagogical tasks, the formation of professionally important qualities of the individual. Meanwhile, in contrast to the presented model, Nasyrova's methodical model (2010) does not contain aspects of the development of students' personality professionally significant qualities, the formation of their personal professional potential. One of the effective methods of formation of professionally significant qualities, according to the authors, is the use of personality-oriented technologies in the course of practical training , which is understood as an ordered set of actions, operations and procedures aimed at the development of personality, instrumental in achieving a diagnosed and predictable result in professional and pedagogical situations, forming an integration unity of forms and methods of training in the interaction of the student and the teacher in the activity process. The research by Sadovskaya (2005) is devoted to the issues of professional and pedagogical training of a novice University lecturer-researcher, the formation of his personal professional potential. The work in the formation of students' professional orientation does not use a system of professional and applied problems based on the method of modeling. Meanwhile, we share the point of view of Sadovskaya (2005) that the structure of professional training of students is determined by the synthesis of professional knowledge (epistemological component), value relations (axiological component) and professional skills (praxiological component). The epistemological component of students' professional training is determined by the content of theoretical and practical knowledge, which is based on the study of modern technologies and trends of its development and the acquisition of integrative knowledge. The axiological component of professional training is determined by the value relations, orientations, motives of educational and professional activity. The transformation of oneself, the reassessment of values, the creation of a value scale, which leads the person to a value orientation, in the process of which there is an awareness of the future, valuable for the person, the image of the personality of the future specialist is formed. The model of students' professional training proposed by the authors of the article is a pedagogically conditioned sequence of teaching cycles the curriculum disciplines, having a general orientation of training and development of the system of students' professionally significant qualities, using a system of professional and applied tasks based on the modeling method, and takes into account all the above aspects. Such system on the basis of integrative-modular training represents methodically caused, consecutive, systematic order of the modules of the basic educational program providing integration which are in a certain dependence and make the whole in students' professional training according to the requirements of modern Federal state standards of the higher education. Many researchers, including those mentioned above, pay attention to the shortcomings of the traditional method of teaching mathematics to University students, which does not provide high quality of mastering mathematical material. The proposed pedagogical model of the integrative-modular teaching mathematics in the training of students overcomes the shortcomings of traditional teaching methods. Here we consider it necessary to take into account the professional orientation of students, which is possible, for example, using a system of professional and applied tasks based on the modeling method. In turn, the use of professional and applied tasks increases the motivational and educational components of students' personal development. Thus, the analysis of the scientific works published on this issue allows us to conclude that the theoretical, methodological and practical aspects of the implementation of the methodological system to form University students' professional efficiency in the conditions of vocational training remain insufficiently developed.

6. Conclusion

The data obtained allow us to conclude that pedagogical models in general are both the aim and the means of implementation of activities in methodological modeling. They are characterized by integrity and openness, which creates conditions for their adaptation to a specific field of training and revealing additional functional relationships between the elements of the model. According to the results of the study, we can talk about the effectiveness of the pedagogical model of integrative-modular training in the professional preparation of students in the field of "Applied mathematics and Informatics", which is proved by the activation of their cognitive activity, the development of creative attitude to the profession, independence and development of other professionally significant qualities. The indicators of good professional efficiency of students, which determined the effectiveness of the implementation of the pedagogical model of integrative-modular training in the preparation of students, are as follows:

I. General cultural – the ability to apply the foundations of philosophical knowledge to the formation of ideological positions, legal and economic knowledge in professional life; communication in oral and written forms for the organization of interpersonal and intercultural interaction and teamwork;

II. General professional – the ability to use basic knowledge of mathematical and natural sciences, to acquire new scientific and professional knowledge, to develop algorithmic and software solutions in the field of system and applied programming, to solve standard problems of professional activity;

III. Specific professional competencies are divided according to the types of activities: research one, design one, production and technological one, organizational and management one.

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