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FORMING THE MODEL OF SCIENTIFIC COMPETENCE AMONG THE STUDENTS OF RESEARCH UNIVERSITIES

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The main objectives are the research of special effective integration features of educational and scientific activities at the national research universities; the identification of forming the factors of unique scientific research and practice competence development among university students and staff; the development of scientific competence model among the students of research universities. We have chosen the following methods: the retrospective content-analysis for structuring the categorical research apparatus and the factor analysis for identification the factors of integration the science and education at research universities. We have modeled the formation of scientific competence among the students (bachelors, masters and PhD students) of research universities. The integration of theoretical and empirical researches, based upon the systemic, systematic, interdisciplinary approaches, the methods of induction and deduction, classification and personalization, structural-functional and categorical analyses are at the core of this model. The creation of a unique atmosphere of scientific competence among the students of research universities is an important factor in the formation of this model. The use of the developed model will ensure the formation of qualitatively new scientific competencies among students and will form the basis for improving their competitiveness in the global educational space.

Keywords: Scientific competence, professional competence, Research University, education and science integration, the model of forming the scientific competence among the students of research universities.

INTRODUCTION

Introduce the Problem

Current higher education priorities include strengthening the role of scientific activities at universities, fundamental and applied researches in the training of highly qualified competitive staff. The process of training bachelors, masters and graduate students should be carried out in oneness with research, project and practical actions. It is necessary to provide students involvement to the scientific research process from the beginning of university study.

Solving the main task of the modern education, that meets international standards and requirements of the modern world economy, providing training of highly qualified specialists, is only possible on the base of advanced scientific and technological developments (Vdovin, Okunev & Golovushkin, 2011).

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The main mission of the university, which has the status of National Research (NRU) is the effective implementation of both the educational and research activities based on the unity of science and education principles (Zhurakovsky & Vorov, 2015).

The science and education integration determines the general structure of the educational process and training modules.

Therefore, the construction of methodical system of training, determination of its structure, content, methods, forms and tools of learning should be based on scientific principles, unity of fundamental and professional orientation training (Maslennikova *et al.*, 2014a). Thus, the problem of determining the mechanism of those principles usage in each component of methodical system of training at the research universities becomes very urgent.

The proposed concept of the integration of science and education in research universities is not contrary to the concept of holistic education, which has an integrative quality, or irreducibility to the sum of its components.

The theoretical significance of the model is based on the development and implementation of the evidence-based approach to the forming of scientific competence through the integration of theoretical and empirical research.

The practical significance of the research is determined by the application versatility of the developed formation the scientific competence model within the learning process in different areas of training in research universities.

Exploring the Importance of the Problem

Research universities in today's global knowledge economy are among the main subjects of the Higher Education Development (Okunev, Maykova & Maslennikova, 2015). The new learning technologies show the advantages of the universities, which staff consist of highly qualified specialists in various scientific fields.

The integration of science and education that meets the requirements of high activity and intensity of training is possible only in this case. The work of bachelors, masters, graduate students and teachers in the modern scientific and research laboratories, that satisfy the most demanding customer, is possible at such universities. The distinctive feature of such universities is the ability to generate new scientific knowledge on the basis of a wide range of fundamental and applied researches (Maykova & Golovushkin, 2012). The system of professional training and improvement of qualification, that allows transferring the scientific developments and achievements to the practical work of enterprises and organizations of high-tech economic sectors, acquires the special significance too. The creation of academic departments at the leading enterprises for the preparation of highly qualified specialists, implementation of new information technologies, engaging teachers - practitioners will enable NIU students to participate effectively

in the research work of scientific laboratories, workshops, scientific courses and competitions.

In this regard, the main task of the modern educational system at the research universities should be to develop the concept of learning, which should form not only the general cultural and professional competence, but will provide the development of scientific competence. From this perspective, the current research is highly relevant and timely.

The selected issue requires an additional research that will be focused on forming the model of scientific competence among the students of research universities on the basis of the influence factors that provide unique conditions of its formation.

The proposed model should be based on the integration of theoretical and practical research, as well as the principles of interdisciplinary, systemacity, integrity and of systematicity.

Background / Literature review

One of the major modern tendencies in the world of educational practice is a competence-based approach to learning. It had been founded by the scientists of the European Union (Bader, 1990; Mertens, 1974; Oscarsson, 2001; Schelten, 1991; Shaw, 1998 and others). They had implemented the notions "the competence" and "the competency" into the professional terminological turnover.

In the Russian Pedagogy and Psychology, the approaches for researching a given problem field are widely presented by works of N.V. Kuzmina (2001), I.A. Zimnaya (2012), L.A. Petrovskaya (2007), A.K. Markova (2003), L.M. Mitina (2010) and others.

The new stage of scientific research competencies is connected to the modeling of the interaction of science and education. The main result of such investigations was the universal model of gradual and consistent formation of scientific competencies. The authors of monographs N.P. Anisimova, V.A. Mazilov and O.V. Rakitina (2012) identify a number of regularities in the formation of scientific competencies. Particularly, the authors point out that the formation of research competencies is carried out both on the basis of the principle of invariance of educational content at all stages of education, and through the creation of new, specialized competencies, which are shown at each next stage of education. Such competencies are in continual unity and integration. The given literature review demonstrates the sufficient deep degree of studying both didactic and methodological sides, considering the formation of scientific competency in the field of educational, scientific, research and innovation activities of the university. Literature review proved the investigated problem of formation the scientific competency had been considered in private fields (the following enlarged groups of training: technical, natural sciences, humanities) (Brylina & Kuzmina, 2014;

Maslennikov *et al.,* 2014; Salmi, 2009; Natyrova, 2013; Chechulina & Likhachev, 2014; Skibitskiy, 2007).

The holistic system of realization the formation of a scientific competence among students of research universities is absent. The study of existing models of professional competence, teaching theories and their practical application is difficult. The reason for that is their discreteness, the lack of methodological soundness and the absence of a unified methodical system of the formation the scientific competency among students of research universities.

State Hypotheses and Their Correspondence to Research Design

Taking into account the discrete nature of the basis in the researched study area, it is necessary not only to identify the factors of unique professional, scientific and research competencies of students and university staff, but also to offer methodical bases of formation the scientific competence among the students of research universities.

The research addresses the following issues:

- The systematization of the categorical apparatus, applied in the formation of the scientific research competence among the students of research institutions;
- The identification of factors that form the unique scientific, practical competence of students and staff of at research universities;
- The construction of a model that forms the scientific competence among students at research universities.

The formation of the scientific competence among students through the integration of science and education in research universities will allow preparing highly qualified specialists, capable to solve the complex professional problems independently.

METHODS

The use of content - analysis of pedagogical, scientific, scientific-technical and psychological literature caused by a significant stratification of scientific approaches to the definition of competence and the scientific expertise. There had been applied the following methodological basis, such as: generalization techniques, the unity of analysis and synthesis, an integrative idea of systemic and structural analysis of the conceptual apparatus, extrapolating the results of previously obtained research and teaching experience. The main result of forming the scientific competence among the students of research universities is a developed model of formation, based on the principles of integration the theoretical and practical research, an interdisciplinary, a systemacity, a scientific approach, a sequence and methods of structural and functional, systematic, and categorical analysis, classification and individuality.

RESULTS AND DISCUSSION

The essential content of the following concepts "the competency" and "the competence"

The "competence" concept has become widespread in the late 1960s and early 1970s of the XX century with the advent of a special area of research - The Competence Approach in Education - J. Raven (2002), V.I. Baydenko (2009), I.A. Zimnaya, (2012), A.M. Novikov, (2006), V.V. Kraevsky (2009), V.V. Serikov (2006).

The categories of "the competence" and "the competency" are frequently used in the modern theoretical and practical studies of the learning process and their effectiveness. The competence of a trained specialist is realized in his professional activities and reflects abilities, knowledge and skills obtained during the training. J. Raven (2002) defines competence as specific ability necessary for effective implementation of specific actions in a particular subject area. In his opinion it includes highly specialized knowledge, a special kind of substantive skills and ways of thinking. At the same time, it should be mentioned that nowadays there exists not only the confusion of the concepts "the competence" and "the competency", but also their identification.

Different types of competence are listed in the scientific and educational literature. The essential content of all types of competence is shown in the personal significance of the subject activity, and in this context the value aspect is crucial (Raven, 2002). The structural analysis of the application terms "the competency" and "the competence" in scientific research, led to the conclusion, that along with the well-known concepts as "knowledge", "ability", "skills" the terms "the competency" and "the competence" include in its essential content the properties and characteristics of a particular individual, his intellectual qualities, features of character and ability to perform mental operations (analysis, classification, generalization, extrapolation, forecasting)

In modern studies devoted to pedagogy, "the professional competence", as a rule, is defined as the specific set of knowledge, abilities and gained skills applied for solving the problem. Frequently this concept is characterized as a complex of knowledge and qualities inherent in the professional field of activity as a vector of professionalization, as well as the unity of theoretical and practical training of the ability to act in a professional field with high productivity (Maslennikov et al., 2014b). In different research works we could meet the abstract models of the discussed concepts, including the hierarchy of competencies, their structural and functional representation, a structured set of elements defined using the diagnostic abilities of the individual, etc. A point feature of all above mentioned is the presence of an ordered structure and links of elements and the internal organization of the models components. The delineation of the didactic system of competence model features in statics and dynamics is important for the purpose of this research. In the

static state model allows us to identify the elemental composition of the complex concept at a particular time, taking into account the inherent characteristics of each element. The dynamic model allows to analyze the process of transformational changes competence through time. The peculiarity of the dynamic model reflects the variability of the purpose, content, structure, individual components that determine the diversity of conditions in the specified time interval.

Representations of differentiated system links with "the competence" term in scientific research had been implanted into the concept of "professional competence" in the sence of terminology. It is enriched with the objectives, content, teaching and learning technologies. The professional training vector is directed not only to the development of key competences of a specialist, which is a fundamental task of the educational activity, but rather on promoting growth of creative potential, capacity of private personal and professional competences which together constitute the professionalism. Development of professional competence based on the fundamental and professional orientation of the learning process, integrative approach complex disciplines used for sustained accumulation of necessary knowledge on the examples directly related to future professional activity, realizing the principle formulated by Leonardo da Vinci (1955): "When you set out the science, do not forget to bring provisions for each of its practical application in order to your science was not useless". An active participation in research activities is an important direction of professional competence formation for university students. It allows forming a scientific competence as a key element of the overall professional competence of the future expert. Therefore, scientific competence is a set of personal qualities, allowing the subject of professional activity constitute a reliable expert evaluation of fundamental and applied research in a specific subject area. Currently, more promising direction of the competency approach is the competence-activity approach, which is under development. It is based on the formation of the complex competencies in the educational and research activities, instead of a simple set of knowledge and skills. Fundamentals of the approach are described in the works of L.S. Vygotskiy (1983), A.N. Leontiev (2014), B.G. Ananiev (2008), I.A. Zimnaya (2006), L.V. Maslennikova, A.P. Fomina & E.V. Maykov (2000). Based on the competence and activity approach, it must be concluded that the formation of the scientific competence of the trainees must be based on the organic combination of educational, research and scientific-research activity of the educational process. The most efficient synthesis of these activity types is possible on the basis of a research university.

Identification of the factors in the formation of unique scientific, research and practical competencies among students and staff of research universities

NRU should provide the educational process based on the integration of advanced educational technologies and scientific results. For the effective decision of such

task, the research universities require the integration of three interrelated sets of factors: 1) concentration of experience, knowledge, talents (Deem, Mok, and Lucas, 2007); 2) financial resources to create high-tech laboratory facilities to carry out research work in conjunction with the implementation of the educational function; 3) effective management, ensuring the implementation of educational, research and creative potential of the university community; 4) infrastructure for research and development institution that provides the process of practical application of results of intellectual activity in practice (see Fig. 1).

The main results of the effective integration of listed factors will be the formation of the unique scientific, practical competencies of bachelors, masters, students and university employees, allowing to carry out the fundamental and applied world-class scientific researches, generate new knowledge, to carry out their transfer to technology and competitive high-tech products, to expand the range of educational services, to develop and implement new educational programs, to ensure the effective integration into the world educational and scientific space.

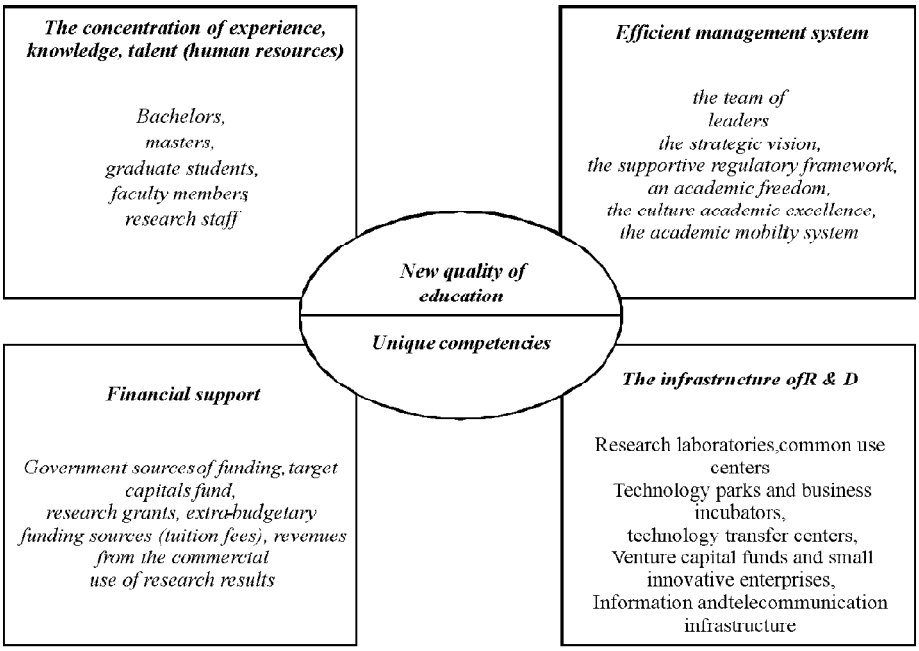

Figure 1: Factors of formation the unique scientific, practical competencies of students and staff of research universities

Forming of scientific competence among students of research universities

In research universities the students conduct the great volume of research work, which is very closely integrated into the educational process. Therefore, the main

mission of modern education at research universities should consider developing the concept of learning, which allows, along with the formation of common cultural and professional competences, to establish a framework for the scientific competence formation (see Fig. 2).

Creating the conditions for the formation of the scientific competence of students is realized through the consistent interaction between the structure and content of educational and practical activities contributing to the creation of a conscious scientific world and the formation of a new quality of thinking. National Research Universities (NRU) are able to ensure the synergy of scientific knowledge and educational activities in the educational space, the most effectively.

A new quality of scientific research, their scale and complexity, which became possible as a result of re-equipment of the material base necessary to make a significant modernization of the structure and content of training courses. We create and implement educational programs in a network form with the participation of leading research centers and enterprises of the real economy, interdisciplinary and practice-oriented content programs that ensure the formation of unique research competence of students. Additional opportunities are based on the use of electronic educational resources, including distance education, that helps to neutralize geographical barriers in the educational process.

Synthesis of new opportunities and the conditions of education created in modern research universities will ensure the formation of a unique complex of competencies for educators and ensure their competitiveness increase.

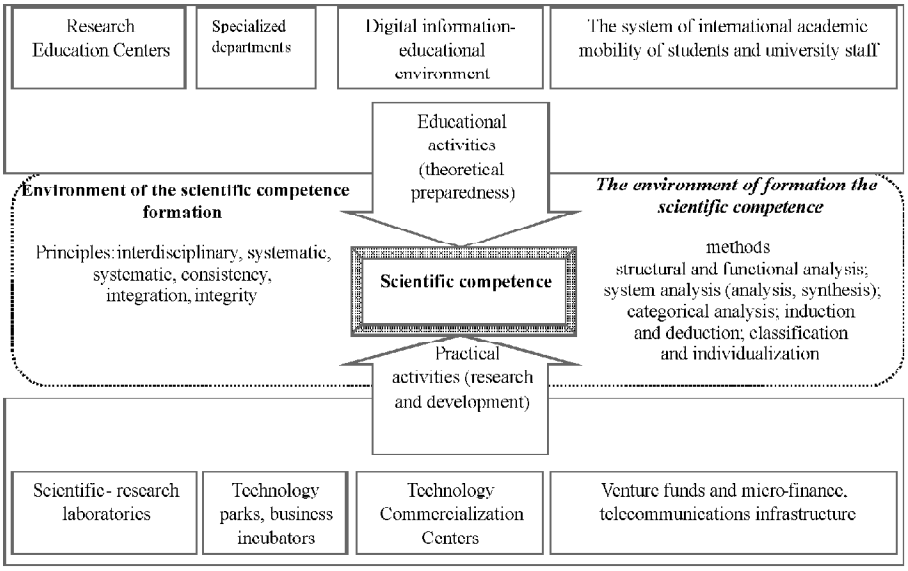

Figure 2: Model of formation the scientific competence among students of research universities

The results of the integration of research activities and the educational process in research universities

During the 2009-2014 period. 48,068 million rubles from the federal budget and 20,696 million rubles of the own funds of universities were sent to the development programs of the Russian Research Institute of the Russian Federation (Zhurakovsky & Vorov, 2015). For carrying out a wide range of fundamental and applied research and creating unique opportunities for the formation of scientific competences, students of the NRU spent 77.0% of the federal budget funds - for upgrading the material and technical base by purchasing modern scientific and educational equipment, 10.3% of funds - for the development of information resources , 4.5% - for curriculum development, 4.3% - for staff development, 3.2% - for improving the management system, 0.6% - for other purposes. In 2014 (compared with 2010), the total amount of research funding has increased in 2 times: from 17 billion 733 million rubles to 36 billion 326 million rubles, and the total share of R & D increased to 6% . The average volume of research and development at one national research university during this period increased from 611 million rubles to 1 billion. 253 million rubles that significantly (8.5 times) higher than the average level of state universities in Russia. In 2014, 40,020 scientific publications in periodicals indexed by foreign and Russian organizations (Web of Science, Scopus, Russian citation index) were published by teachers, researchers, students, post-graduate students and doctoral students of NRUs, and during the period of development programs implementation from 2009 to 2014 - 157,272 publications. It should be noted that during the implementation of the development programs of research institutions in the period 2009-2014 the number of indexed publications on average per university increased in 2.5 times (Zhurakovsky & Vorov, 2015).

The system result of development programs realization at universities is their active participation in the scientific-technological and socio-economic development of territories and sectors of the economy.

20 NRUs were represented as performers of 50% pilot programs for the development of innovative territorial clusters that characterized with a combination of high world competitiveness of basic enterprises and high scientific and technical potential of research organizations.

A significant effect of investments in the development of the research base and the upgrading of the skills of the scientific and pedagogical staff of the NRU is their active participation in innovative development programs for companies with state participation and in the activities of technological platforms.

In order to commercialize the results of intellectual activities in the innovation zone of the NRU, 625 small innovative enterprises were created for 3,570 workplaces, which in 2011 fulfilled the orders in the amount of more than 2 billion 204 million rubles, and in the period 2010-2014 - in more than 12 billion rubles (Gvozdetskaya *et al.,* 2016).

One of the key results of NRU development is a significant increase of the students involvement to the implementation of research projects. For 5 years of the project implementation, their number increased 1.57 times and amounted to 28.5% of the total number. The usage of modern material and technical base for scientific research had provided a significant increasing of students participation in research projects at various levels. Such forms of the scientific competencies development as student scientific societies, design bureaus, youth innovation centers, in the work of which the absolute majority of students of the 2 nd and 3 rd grades of higher education in the Russian Federation were involved, have become spread.

CONCLUSION

The research identifies the factors that provide special conditions for the formation of scientific competence in the NRU, the model for the formation of scientific competence of the students of research universities is based on the principles of integrating theoretical and practical research, interdisciplinarity, systemic, scientific, sequence and methods of structural, functional, systemic, categorical analysis, Classification and individuality.

Summarizing the study, we can state that the model of the formation of scientific competence in modern education determines the new quality of a competitive highly skilled worker in the modern knowledge economy.

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