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Creation of Permanent Institutional Monitoring Mechanism of Modern Educational Technology Market Significant for Nanoindustry

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ABSTRACT

The article briefly represents the results of the monitoring of nanoindustry market. In particular, there is an urgent need for highly qualified personnel today. Accordingly, new educational programs for all levels of professional training are needed. The questionnaire survey of employers from different regions, revealed problems of educational programs. It was found that a system secured in legislation is needed, which would include occupational standards and related "system of obligatory public and professional assessment" of educational programs. During development of the Federal State Education Standards (FSES), in particular when forming professional competencies, it is necessary to take into account the wishes and requirements of employers. The scope of this study is the analysis of employers' satisfaction in quality of professional training in specialized secondary and higher educational establishments, further vocational education (FVE) and evaluation of the industry needs in the nanoindustry personnel in the future.

KEYWORDS
Educational programs; provider of educational services; overall system of monitoring; nanoindustry needs; result-oriented interpretation.

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Introduction

Competence today is in high demand as result of education. Competence is considered as specialist's ability to react quickly and render his or her own decisions in difficult situations (Schutte, Barkhuizen & van der Sluis, 2016).

This approach makes it possible to obtain the results, which are proposed for practical use in changeover educational system. In other words, the shift in emphasis on educational outcomes that are associated with success in training of particular student occurs, and it greatly differs from targets (Boud & Molloy, 2013). Therefore, today, it is often an attribute of the educational program developing process. Thus, the student becomes a front-line player of the educational process. Student interests and needs in education, become the basis for the development of competence-education program (Puchkova, 2016).

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Vocational education institutions should consecutively go over to the third and third-plus generation of FSES, ensuring the formation of common cultural and professional competencies of graduates. Competence, both professional and common cultural, should provide a demand for the graduate, which means employment and mobility in the labor market of nanoindustry (Bhushan, 2016; Jackman et al., 2016). Vocational education institutions have to develop new standards for teaching materials and certificates. In accordance, the policy and procedure of quality assurance will change dramatically (Foster, 2016). Their designated purpose is to improve the quality of everyday teaching. In turn, interim attestation of masters, undergraduates and graduates, should be carried out with the help of the developed and conventional regulations, criteria and procedures.

Under the conditions of actively developing market, the concept of education focuses on results (Shaidullina et al., 2014). Consequently, the purpose of professional institutions in the field of education should be formulated to meet professional requirements of labor markets, taking into account the needs of the region. In this situation, educational institution is not only a provider of educational services, but also an adapter between the users of these services and employers (Gercij & Grivina, 2001). The main task in the field of educational process management is to teach employees of educational institutions to record and satisfy the labor market requirements as to the level of competence of experts, taking into account the prediction for the next few years (Kunter et al., 2013). It is necessary to take into account the needs, capabilities and requirements of the service consumer in order to content educational programs thoroughly. This would provide mobility and competitive ability at the market of educational services. Although it would be necessary to create (or modify existing), provide and implement a corresponding set of educational and professional technologies (Yu et al., 2013). Capable system of monitoring the educational and professional results is also required.

Today, one of the important aspects of the development of the nanoindustry is the problem of involvement of highly qualified personnel, and this problem is very serious in the Russian Federation (Connolly, 2013). At the same time, it should be noted that the market economy has changed the operating environment for educational institutions. In turn, this requires improvement of the quality of educational services, differentiation and diversification of offered educational programs (Becker, 2013), which would allow to solve the problem of the preparation of highly qualified specialists in the sphere of nanotechnologies. In addition, it is well known that the specialists of required level are actively involved in researches, both in Russia and abroad, take part in the implementation of research projects.

Currently, the demand exceeds the supply (Connolly, 2013; Becker, 2013). There is a disproportion at labor market between the demand for skilled workers by the employer in the sphere of nanoindustry, as well as sectoral science, academic and university. Thus, in order to eliminate disparities, a system of training of specialists for the production of nanotechnologies should be continuous at all educational levels.

In view of unavailability of Russian industry for the production of advanced technology products, despite today's recurrent fluctuations of the economy and its decline, more than half of the considered products preparedness of industry to

production can be assessed at high level, as there are almost ready production chains, or expansion of production is required (Onishhenko et al., 2013).

The aim of the study is to identify the need of the employer in nanoindustry specialists, to define requirements for the level and quality of specialists, as well as to identify the readiness of educational institutions in terms of orientation, quality, availability of interactive educational services and programs, and to determine the readiness of teaching staff to provide such a specialist.

In addition, we tried to determine the level of readiness for close cooperation of the employer and educational institutions in the direction of training, retraining and advanced training of specialists for nanoindustry, which would increase the effectiveness of executive decision-making for the development of the nanoindustry.

Methods

During the process of monitoring of the important for nanoindustry educational technologies market enterprises, the following methods were used:

- information updating method. In the context of the tasks and activities of the project, the updating of information was carried out to provide an assessment of the progress of the project implementation;
- monitoring method. Monitoring is a continuous process of collecting, processing, evaluation and preparation of decisions aimed at achieving the aims and objectives of the organization;
- systems analysis method. Application of systems analysis during the development of models allowed to build optimally the relationship between the elements of these models and to improve the quality of these models. Application of system analysis in document development allowed to structure, qualitatively analyze form the presumptive composition of the documents;
- comparative analysis method. This method is one of the key methods of the project. The analysis and comparison of subjects (phenomena) on the analyzed indicators were carried out, which allowed us to identify the most important (objective, reliable) parameters. Application of this method improved the quality of the analysis and research.

Data, Analysis, and Results

Within the framework of the Federal Target Programs 180 organizations were involved in the FTP "Infrastructure development of nanoindustry in 2008-2011" and 852 organizations were involved in the FTP "Research and Development for 2007-2012". In the course of the project "Monitoring system implementation for research and development in the field of nanotechnologies and nanomaterials" (Granberg, 2004), Russian Scientific Centre "Kurchatov Institute" have conducted primary research of nanotechnology market towards the development of nanoindustry. Later the "Dubna" International University joined to the study, and proposed monitoring algorithm, shown in Figure 1. In the process of monitoring of educational programs implemented and developed in educational institutions, the accordance of programs to requirements of employers was found. Figure 1 shows the monitoring process of educational programs by educational institutions.

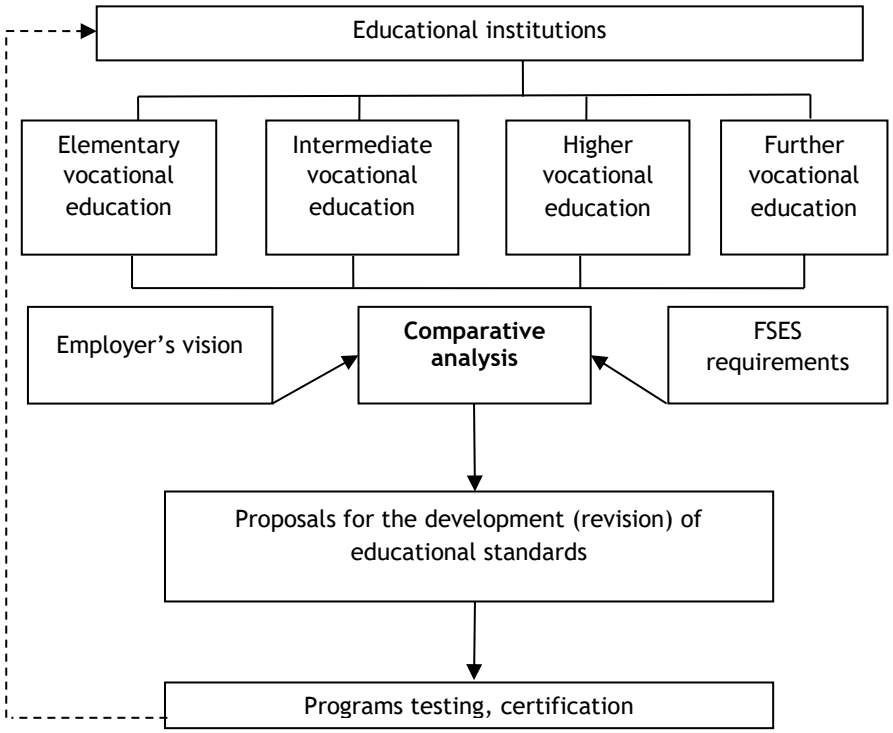

Figure 1. The monitoring process of educational programs by educational institutions.

1) The monitoring of programs used by all vocational educational institutions (for the analysis of nanoindustry HVE and FVE were taken directly) was carried out using a variety of sources, requests for educational institutions (Federal web-portal "Russian Education", "National Accreditation Agency in Educational Sphere", websites of the Ministry and Regional Departments of Education), survey. The list of all professions and specialties of HVE and FVE in the nanoindustry was drawn up. The analysis of these programs showed the most common areas of training of specialists for the nanoindustry. Then, with the help of online resources, and on the basis of survey data, employers' interviews, the most popular areas of specialists training in nanoindustry were determined. Consequently, based on data from the survey and interviews of employers, and other monitoring tools, the employers' requirements to the content of training programs for the most popular professions, conditions and technologies of their joint implementation, and educational outcomes - professional competence of specialists were formed.

2) The study was conducted by experts from governmental educational organizations, teachers and marketers. Initially, the experts examined 52 most promising products of nanoindustry. Then, 23 products were selected for conduction of a more detailed examination. The study concluded that most of the examined products are ready for production. It can be confirmed due to the fact that there are almost ready production chains, or diversification of production is required (Analysis of the monitoring results in order to determine the overall need at labor market in the context of professional qualification, 2003). One of the main problems of the development of the nanoindustry in the Russian Federation is the problem of involvement of highly qualified personnel.

3) Besides the universities of National nanotechnology network (NNN), there are scientific and educational centers and laboratories at higher education institution. Each of the elements of the infrastructure solves problems at its level of competence (Figure 2)

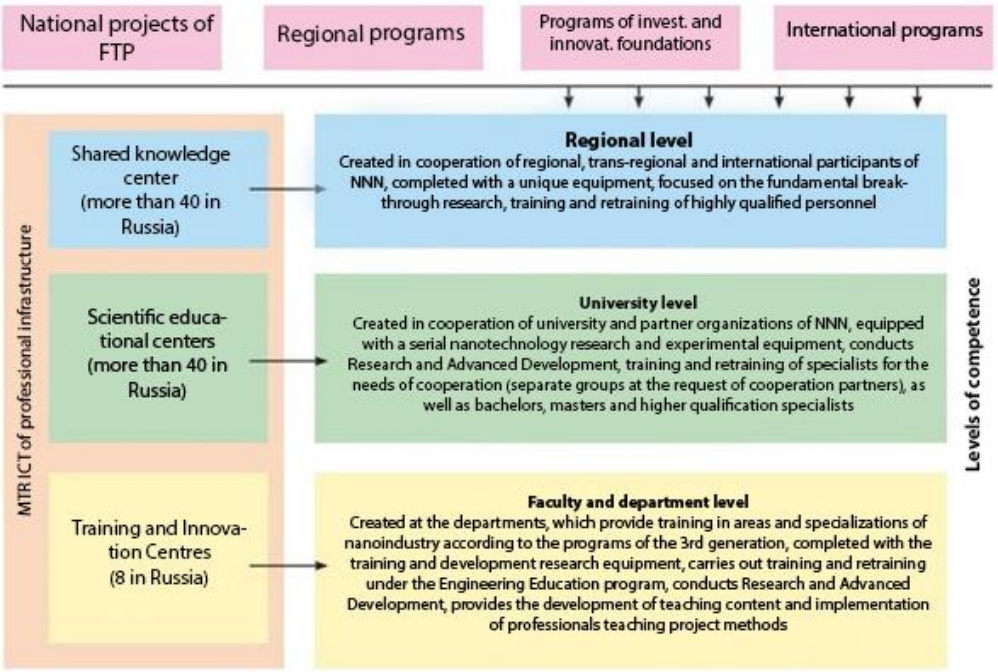

Figure 2. Levels of competence.

The following conclusions were obtained as a part of the study:

There is an urgent need for highly qualified personnel today, including the sphere of nanoindustry, in particular in nanoengineering, nanotechnologies and microsystem technologies. Accordingly, new appropriate educational programs for all levels of professional training (elementary, intermediate, higher and further vocational education) are needed. To this end, we asked the employers of different regions to identify what specialists are they needed in the first place, what knowledge and skills these professionals should possess. Because being aware in the real problems of the enterprise, educational institutions can provide training, retraining and advanced training.

However, we should not forget that not all the problems associated with staffing of the nanoindustry could be solved by completing studies or retraining of specialists. A major change in the basic level, in the system of vocational education is needed. The change would be possible when the interaction between employers and those who trains the personnel was harmonized.

A system secured in legislation is needed, which would include occupational standards and related "system of obligatory public and professional assessment" of educational programs. During development of FSES, in particular when forming professional competencies, it is necessary to take into account the wishes and requirements of employers.

The scope of this study is the analysis of employers' satisfaction in quality of professional training in specialized secondary and higher educational

establishments, FVE and evaluation of the industry needs in the nanoindustry personnel in the future.

Accordingly, in order to run the monitoring mechanism questionnaires, interviews and test tasks, both for the employer and for educational institutions have been developed.

The monitoring revealed that from 55% to 64% of employers estimate the level of graduates' professional education as intermediate; from 13% to 19% of employers estimate the level of qualification as low. Only from 7% to 12% of employers estimate the level training of graduates as high (Figure 3).

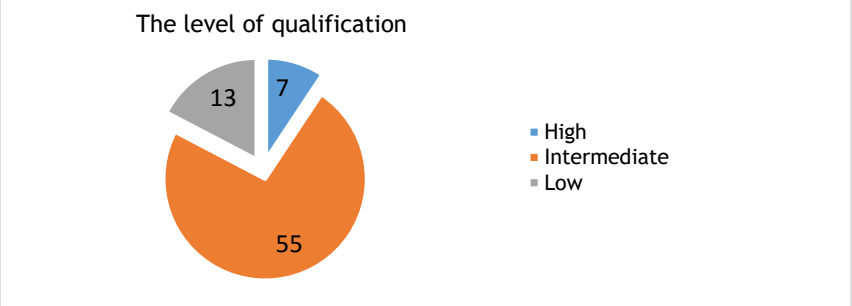

Figure 3. Diagram of employers' estimate of graduates' level of qualification.

During the market research, employers were asked to estimate the level of preparation of graduates of HVE and IVE, by two criteria: the level of theoretical training and the level of practical skills (Figures 4, 5).

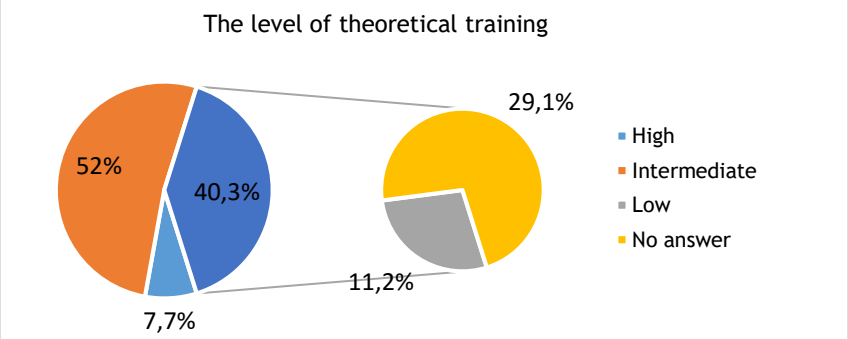

Figure 4. Diagram of employers' estimate of graduates' level of theoretical training.

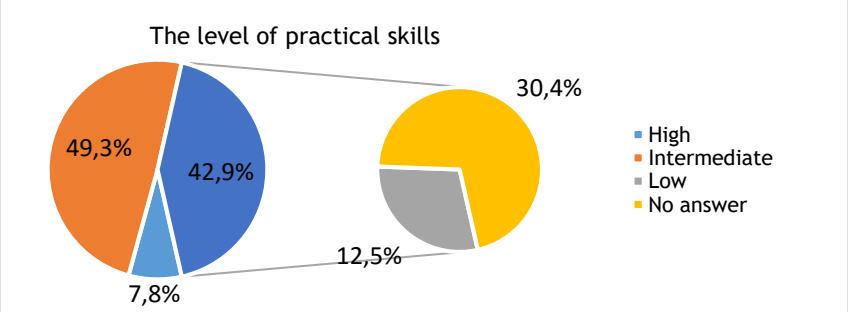

Figure 5. Diagram of employers' estimate of graduates' level of practical skills.

These results shows that the level of theoretical training of graduates is slightly higher than the level of practical skills (Figure 6)

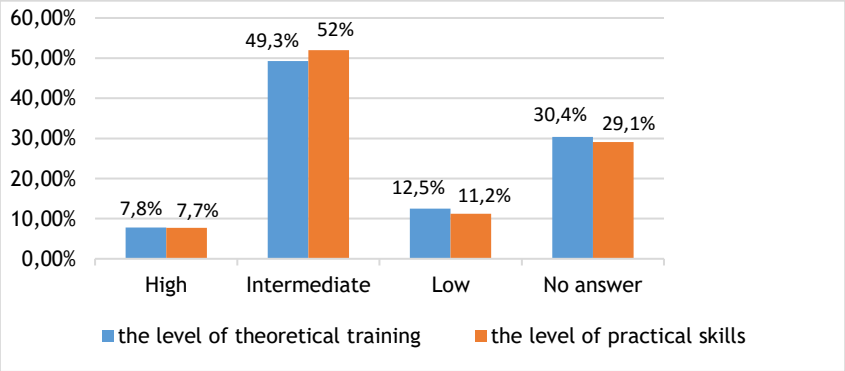

Figure 6. A comparison of the level of theoretical training and practical skills.

Employers arrived at a common view – the greatest attention at the institutions of vocational education should be paid on practical training. Among surveyed, most organizations favored an increase of work placement duration (about by half) in the educational programs and a need for training and retraining of teachers.

In addition, many companies expressed the need to have an intraproductive system of adaptation of young specialists to the workplace.

At the same time, it should be noted that organizations are reluctant to contact the institutions of higher education. This reflects in the limitation of places for practice (work placement and pre-degree), of access to enterprise accounting, participation in common projects, etc. According to empirical observation, enterprises are ready to criticize the system of higher education, but want to get highly qualified personnel.

Thus, it should be concluded that in addition to the basic competencies, a specialist should have special competencies that would ensure the fulfillment of professional functions necessary to perform job duties. As surveys and interviews have demonstrated, employers associate special professional competences with the modern professional technologies and modern organizational and technological working conditions (Figure 7)

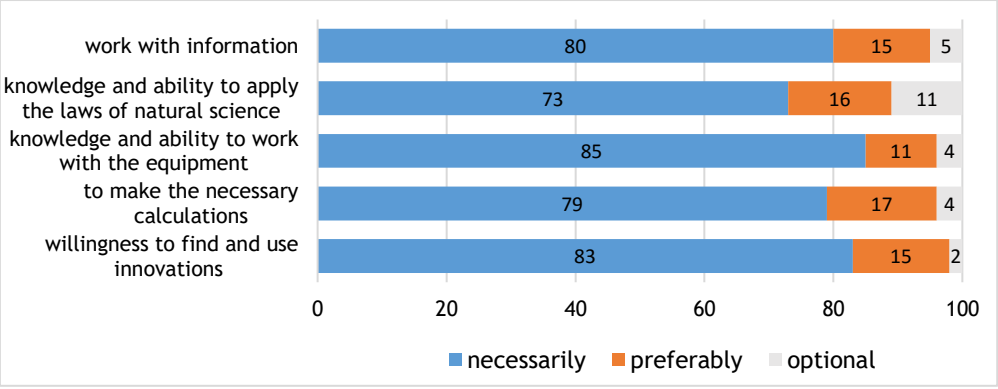

Figure 7. Evaluation of professional competences, the percentage of respondents.

From professional qualities, employers have identified the ability to work with new technologies and mobility of specialist to change working conditions, which is very important today, in terms of production reorganization, the use of non-standard forms of employment and the reduction of the total number of employees in the company.

Research of the employers' requirements for personal (Figure 8), and social competence of the employee revealed the following requirements to a specialist as responsibility and readiness to continuous professional growth. Taking the initiative and the ability to make their own decisions is needed to a lesser extent, but some companies-respondents marker out them as a desirable quality.

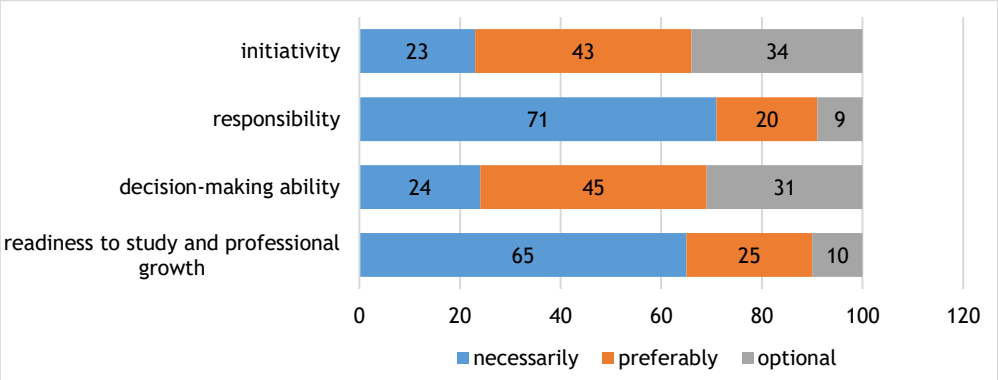

Figure 8. Evaluation of personal competences, the percentage of respondents.

Employers are less demanding for social competence (Figure 9). Most of them said that these qualities are preferable, but not necessary. Such qualities as the ability to share experience and work together to achieve collective goals 10% of employers called optional. These points to the fact that practice of temporary contracts to perform extremely specialized process is extending.

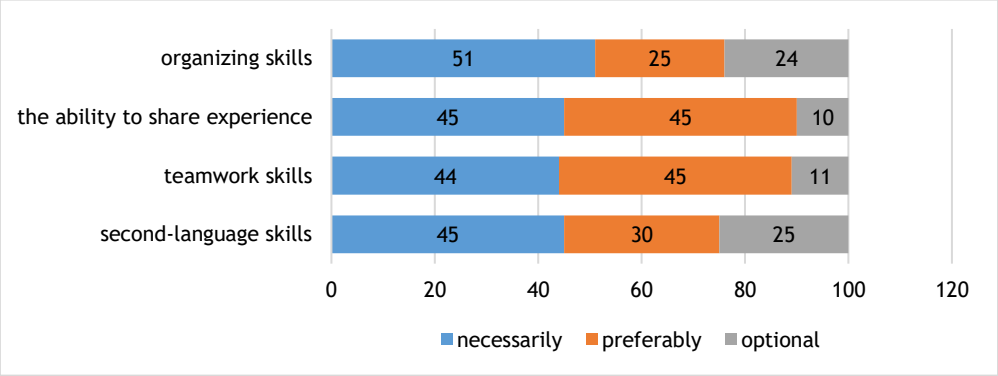

Figure 9. Evaluation of social competences, the percentage of respondents.

Age restrictions can be noted among other requirements of employers; workers under 40-45 years are mostly required.

Teachers and employees of a number of leading educational institutions of higher vocational education have participated in the monitoring of the important for nanoindustry educational technologies market among educational institutions.

The results of the application of modern educational technologies monitoring, the level of equipment of the educational process and compliance of education programs in the educational institutions are shown in the figures.

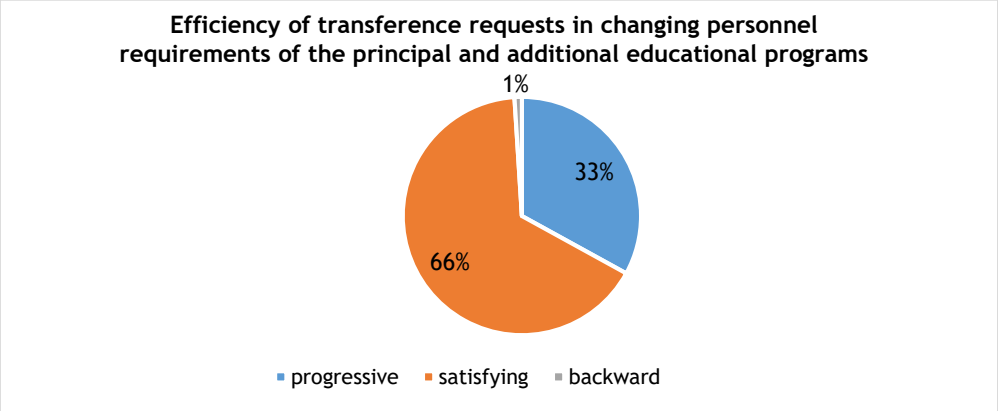

Figure 10. Efficiency of transference requests in changing personnel requirements of the principal and additional educational programs.

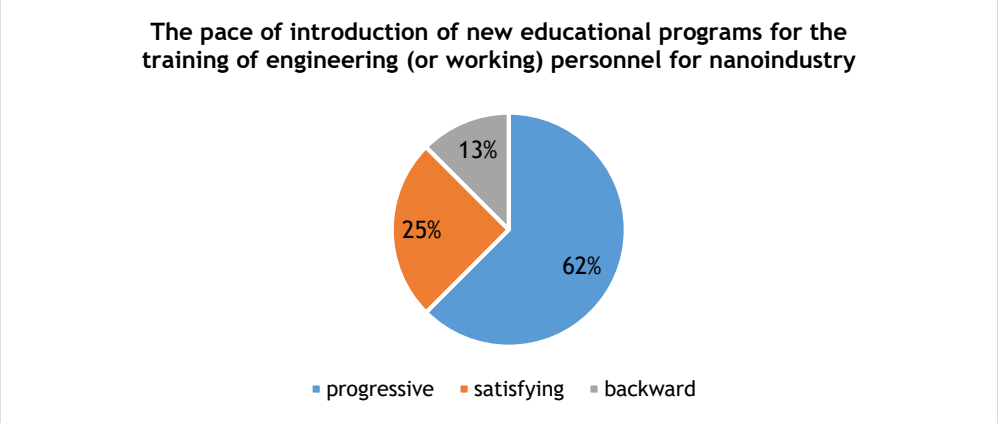

Figure 11. The pace of introduction of new educational programs for the training of engineering (or working) personnel for nanoindustry.

Forecast Monitoring the Most Required Workers and Engineers for the Nanoindustry

Studies have shown that by the middle of 2015 the labor market again experienced its pre-crisis situation in the main economic sectors. Personnel requirements of organizations is comparable with 2008. The number of available vacancies at the end of the year is almost comparable to the pre-crisis period. In 2015, the number of employers' requests for personnel increased by 25% compared with 2010, which represents the effect of pent-up personnel demand after the crisis.

Difficult situation in the global labor market, global unemployment of that period reached 210 million people. This is all the population of Russia, Ukraine and Belarus together. After more than three years from the beginning of the global economic crisis, the situation in the global labor market has not improved yet.

Young specialists, recent graduates are mostly subjected to the crisis. Unemployment among this population category has doubled in the world for the last three years. 19% of people from the G20 under the age of 25 years do not have a job.

Our country is in line with global trends. The labor market situation is complicated by the Soviet formation of cities, so-called monotowns. As a result, the whole city becomes unprofitable. There is a marked differentiation of the economy and, as a consequence, unemployment. Wages in Moscow have risen to pre-crisis levels, and in some regions of Dagestan, unemployment reaches 70%. In addition, the situation is exacerbated by the low level of population mobility. Thus, only 2% of the workers in our country are willing to move home for a new job, while in the United States one in five at least once in his/her life moves to another region, receiving an offer from the employer.

Moreover, the standard of living in Central Russia is low, and the average salary is 8000 rubles, thus, redundant workers will not be able to cope with unemployment. They have any resources to change the region, any savings and any possibility to go through retraining and get a new job in the city.

The shortage of highly qualified personnel in Russia is discussed at different levels. Vladimir Putin has more than once outlined the problem of increasing the popularity of blue-collar occupation among young people. In particular, he suggested several solutions to raise the reputation of vocational training and attraction of students. In addition, Putin added, that it is necessary to create impetuses for business, so it would actively invest in the training of specialists and development of vocational education system.

The existing EVE and the IVE systems are not able to provide the labor market with the necessary number of qualified professionals.

We have a deficit of desired experts, because the structure of production does not have time to respond to the decline in the population of working age. The Russian Federation loses about one million people of working age annually. It is caused by retirement, emigration and mortality. According to experts, number of employed will decline steadily by 2025, and this figure could be reduced by 12-15%. Moreover, the number of employed population of the working age could be reduced by 18-21% by 2025.

Discussions

The concept of result-oriented education includes learning objectives, which should be formulated as a projection of the professional requirements of the regional labor markets (Zhuravleva, 2003). In this situation, educational institution is not only a provider of educational services, but also an adapter between the users of these services – students and employers. The main task in the field of educational process management is to teach employees of educational institutions to record and satisfy the labor market requirements as to the level of competence of experts, taking into account the prediction for the next few years. It is necessary to take into account the needs, capabilities and requirements of the service consumer in order to content educational programs thoroughly.

Recruitment agencies and heads of business organizations need a systematic monitoring of personnel market. It provides an overview of the dynamics of the market: supply-and-demand situation, the actual and expected wages, and the

level of employment and remuneration of labor in different regions. It helps to assess the changes and to obtain comparative data simultaneously (Maslov, 2004).

Currently, the Ministry of Labor and Social Affairs conducts the monitoring of the labor market. This monitoring is carried out in each region and is based on official information given by employers about the dismissals of workers as the result of liquidation of organization or reduction of personnel.

Conclusion

According to the results of the monitoring among employers, the characteristic of professional activity, referred in FSES of HVE as third and third-plus generation, in spheres of nanoengineering, nanomaterials, nanotechnologies and microsystem technologies, has determined the common cultural and professional competencies, as relevant to modern process technology and new forms of labor management.

Thus, the main conclusion of the research is the necessity to create a comprehensive monitoring system of nanoindustry labor demand of specialists of all levels of vocational education, especially the specialists of high qualification with a number of skills, abilities and knowledge. It is impossible without regular monitoring of the retraining needs of NNN enterprises and data monitoring of production of specialists for the needs of the nanoindustry. Moreover, it is necessary to place an emphasis on renewal of current system of training, retraining and advanced training of specialists. All of this confirms the relevance and practical significance of the study.

The author concluded that a synchronization of local development programs with federal programs is needed. It will give an additional synergetic effect, accelerate the development of the nanoindustry in Russia and solve the problem of highly qualified personnel.

The implementation of these activities can be conductive in improving the quality and accessibility of educational services in the sphere of nanoindustry.

Disclosure statement

No potential conflict of interest was reported by the authors.

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