Education, Science and Manufacture Integration Models Features in Continuous Professional Education System

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Abstract: The scope of Russian higher education modernization encourage pedagogical science go beyond the purely academic boundaries and develop real practice-oriented education, science and manufacture integration models. In this regard, the purpose of this article is to reveal education, science and manufacture integration models peculiarities in continuous professional education system. The integrative approach, creating conditions for elements constant interaction not only within integrated systems, but also with the external environment is put down in the studied problem basis. Productive integration is not determined by the links density, but integrative wholeness of its component parts. The article reveals the features, advantages and major guiding points of such education, science and manufacture integration models, as colleges - enterprise, University - enterprise, University - research Institute - enterprise, University - enterprise - research Institute, College - University - enterprise, as well as their components productive integration terms are revealed. These models are based on the mutual educational, research and manufacture processes penetration, educational institutions, professional education levels, educational programs content, training and education technologies, organizational and administrative forms, financial and economic resources and manufacture processes integration.
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1. Introduction

The Russian society development modern stage, associated with intensive penetrating and related changes in the political-economic and socio-cultural life which take place under unfavorable economic, political and environmental factors impact, determined the priorities in the education system development (Shaidullina, 2009).

The following targets of the educational system development are established in the Concepts of long-term economic development of the Russian Federation for the period till 2020 (Concepts of long-term economic development of the Russian Federation, 2020): global level scientific-educational centers set forming, which integrate advanced scientific researches and educational curricular and solve personnel and research tasks of the national innovation projects; integrated innovative programs development, which solve personnel and research tasks innovative economy development on the basis of educational, scientific and manufacture activities integration; employers' involvement system forming to establish educational standards and educational programs accreditation; national qualification structure forming taking into account the perspective requirements of innovative economy advanced development and citizens professional mobility, the state educational standards updating and all levels training curricular modernizing on the basis of qualification requirements.

The above mentioned guiding points pointed on the need to solve such problems of professional education, as: in coordination between labor market and educational services market; the shortage of qualified personnel, especially in high-tech and innovative areas; lack of effective partnerships between vocational education system and the business community (Sokhabeev, 2006; Duffy et al., 2009; Seddigi et al., 2009); unreasonably long terms of training; the lack of working professions prestige; the mismatch between training and material base of educational institutions and modern manufacture technologies (Nurutdinova, 2012; Bakar and Hanafi, 2007; Seals et al., 2008); undeveloped legal regulatory support of the relationship between educational institutions and educational services consumers, and others In the above enumerated problems solution an important role the education and industry integration takes place.

2. Materials and Methods

The research methodology of this problem is based on an integrative approach, which create conditions for elements constant interaction within the system and with the external environment. Productivity of integration is not in its links density, but its component parts integrative wholeness. The necessary conditions to develop the integrated system "education - production" are functionally stable connections between professional training educational institutions and industrial production structures.

Integration processes in continuous professional education system, which were caused by modern challenges and directed to education and industry common problems joint solutions, are not mechanistic and artificial in nature, but are the result of historical and economic development of this system.

Functions organic interpenetration of the integrated system "education –manufacture" participants creates additional dynamics and efficiency of integration processes via getting rid of limiting factors on their organizational-structural, content and technological levels, and this gives the structural and functional stability to the integration process. The main structural component of the integrated system internal structure are persons possessing the purpose of their behavior and seeking their own "self-making" via integrative communication with the external environment, where their competitive properties being specific system properties, allow them not only self -make themselves, but also to transfer with the help of their contribution the entire system to a qualitatively new level.

3. Results

Each level employee should have different combination of fundamental and practical knowledge, skills and competences that enable him to implement the results of his work and realize himself on the modern labor market (Khan, 2009; Barth and Timm, 2011). For example, skilled operators need fundamental knowledge less than the acquired skills and abilities. Practical knowledge and skills play more important role for an engineer - designer and basic knowledge have mainly basic educational character. For an engineer who works at the enterprise as a linear master more important qualities are: the ability to manage staff, to organize manufacturing, specific manufacturing skills, etc. For a scientist fundamental knowledge are more important (Shaidullina, 2009). All these things are very difficult to implement in one and the same educational curriculum, even within a particular industry.

In this regard, within the framework of this research the existing models of education and industry integration in the system of continuous professional education should be taken into consideration aimed at competitive specialists in the system of continuous professional education training.

Model "College – enterprise". The most important part of professional education is the system of vocational education. Specialists who are prepared in this system, are predominantly do intellectual work, solve algorithmic type tasks requiring assessment, selection and implementation of the most efficient and quality of all possible solutions of the problem in the framework of the established number of options (Ursul, 2008).

For example, specialists with secondary technical education (technicians, technologists, and others)are heads of the primary labor collectives (foremen, masters and others)do technical, technological and other information processing with the purpose of materials for making engineering decisions preparation, ensure the functioning of complex technical and technological systems. Vocational education is different from other areas of training in that it is focused on technicians training, providing together with engineers engineering work performing.

In comparison with the engineer, whose functions are determined, first, as a strategic one, able to set and solve large-scale tasks on the implementation of science, technique and manufacture achievements; secondly, as tactical one that can predict and evaluate the nature and character of various external disturbances affecting the manufacture system, and taking into account the program and its development prospects develop organizational and technical measures to prevent or eliminate undesirable disturbing phenomena, the technician is the executor of private tasks of common engineering problems (Zhurakovsky and Sazonova, 2010).

At the enterprise a technician serves as an engineer assistant who performs work for which there are generally accepted standard methods of execution (technical documentation writing, sketching, regulation, simple devices making technology development and others).

The employment functions of engineers and technicians are an integral part of engineering work. Engineering activity, in any aspects of its consideration, always refers mainly to the sphere of mental labor. Being a part of the total worker, technical and engineering employees directly are engaged in productive work, which is also required as the job of a worker.

Modern enterprises need specialists who are ready to work effectively from the first day after the colleges graduating. Such specialists training needs the customers' taking part in their knowledge, skills

and competences forming.

The purpose of "colleges - the enterprise" model is interests realization of all participants of educational process for highly qualified specialists training who are really in demand on the labor market.

Integration colleges - enterprise allows: to delegate responsibility for needs determination in specialists and operating personnel and their training and retraining planning to the enterprises; to change the approaches to vocational guidance (through pre-profile training and specialized education); to strengthen the links between educational institutions and the labor market via employers and other social partners involvement in qualified requirements, knowledge testing procedures and professional skills development; to enhance the role of enterprises in competencies training which meet the specific requirements of manufacture; to promote the educational institutions on self-government principle work transition, to stimulate their greater autonomy, to contribute to their transition to economic methods of management, results evaluation methods implementation, graduates employment (Masalimova and Shaidullina, 2006; Sokhabeev, 2006).

"Colleges – enterprises" productive interaction terms are: the agreement on social partnership; students professional training schedule at the enterprise, with timelines, stages, departments, workplaces; coordinated and approved a detailed curriculum of students professional training at the enterprise; resource (material training, educational-methodical, personnel, financial and others) providing of the students training at the enterprise; the graduates employment.

Model "high school – enterprise". There are a number of objective and subjective factors that aggravate further adaptation of future specialists to work in tough market conditions. They include: the abolition of the centralized distribution, the preference of skilled professionals by employers, difficulties with graduates employment according to their specializations and others, as well, such as inadequate level of graduates self-esteem, lack of information about the real labor market needs and employers requirements, incompetence in the field of labor law, employment, career planning, lack of adaptation skills on a workplace, consolidation in the workplace and other. As the alternative solutions to problems of this nature the students' involvement in the maximum close to real conditions of the industrial relations system can be suggested.

The main forms of high school and industry integration are: the promotion in employment, i.e. the interaction between high schools and enterprises via the labor market, as employment is the most obvious criterion of interaction efficiency between high schools and enterprises, the obvious result of the high school activity as the "producer" of qualified specialists; the industry requirements in curricula development and continuous specialists knowledge and skills updating due to their obsolescence; reduction of professions within the multidisciplinary training; periodic study of the graduates professional career and the obtained results using to estimate and correct curricula; training at the enterprise (internships); joint curricula development of specialists training by high schools and companies (enterprises); forecasting the company's needs in the specialists on the basis of their activity indicators (Sazonova, Sidyakina and Ishchenko, 2010).

High school strategic partners system forming, the achievement of advanced forms of vertical integration of the High school requires the establishment of direct contacts with the main "profile" enterprises on questions of joint educational curricula and internal corporate training system creating, their participation in the educational process and students' knowledge quality control organization. The main impetus for the partnership relations forming is the mutual interest in specialists training quality increasing.

The cooperation of the High school with industrial enterprises can be carried out in the framework of: experts, managers and scientists target preparation curricula development on the enterprises orders; scientific and research developments organization and carrying out for the enterprises benefit; creation of joint centers, expert councils and laboratories for scientific support of relevant industries development programs; organization of scientific activities designed to unite the efforts of scientists and practitioners in the most important problems solving of region economic development.

Such cooperation of High schools with enterprises allows solve the following tasks: to provide an opportunity to influence the content of high education curricula and to prepare for the enterprises specialists of a definite quality, which are not only installed by state educational standards, but also by additional requirements to preparation level on the part of the enterprise, reducing young specialists adaptation period to their professional activities via educational process part integrating in current activities of the enterprise-customer.

The period of adaptation in this case is combined (partially or fully) with curriculum special subjects and specialization disciplines study, course projects training and work on diploma project. High schools flexible response provision to the enterprises needs in the part of specializations spectrum forming for the preparation and organization of continuous professional education guarantees young specialists

employment after graduation on mutual term benefits of professional activity (Naboichenko, Sobolev and Bogatova, 2007).

In this connection participants of the integration system "High school – enterprise", should clearly define their responsibilities. For coordinated relations optimization with the enterprise the High school should: develop end-to-end education curricula on related specialties of primary, secondary and higher professional education; give opportunity to the graduates of vocational colleges to get higher professional education in shortened curriculum; provide conditions which allow at the same time the vocational College senior students master the High school first courses curriculum; ensure the availability of higher professional education on a budgetary basis for gifted high school students and College graduates (vocational schools), who was enrolled on the cross-curricular of primary, secondary and high professional education; develop techniques, organize the selection (contests, competitions, working in the student teams on innovation projects implementation and others); create the rating data Bank of gifted youth with students of specialized schools, students of vocational and high school; contribute to gifted young people professional and carrier development; ensure the higher professional education availability for orphans and children from poor families; send the High school teachers staff to work in base vocational school; enact the enterprises representatives into the institute Supervisory Council; organize masters industrial training and special disciplines teachers with higher education for institutions of professional education; under contracts with the basic enterprises organize scientific-research and experimental work aimed at innovative commercial products development and introduction in manufacture.

Model "High school - enterprise – scientific and research Institute". The basic strategic development direction of modern institutions of professional education is specialists and scientific personnel of higher qualification training, meeting modern requirements of economy and able to work effectively in conditions of competition and the free labor market (Alekseev, 1997; Mukhametzyanova and Shaidullina, 2011). In modern conditions the most important feature of higher education institutions along with their being focused on providing high quality professional training, integration of education and science is the direction on innovation.

Modern engineers integration model in the system "higher education - science – manufacture" is the result of the system organization of education, science and manufacture, which represents the integration of education with science and manufacture as isomorphic process with at least two relation channels: information channels within the education system and external one for information links' forming with science, manufacture or other spheres of social reproduction.

Education, science and manufacture productive integration conditions are: each participant being interested in optimal ways, methods, forms of educational process organization and scientific-research activity search; constructive cooperation in order to overcome the most significant problems; democracy, which allows each side to take the initiative, to substantiate its position; parties representatives keeping of laws and other normative-legal acts, which can be a guarantee of legality in social partnership relations; parties voluntary acceptance of their obligations which express the essence of social partnership; the community of values which are in the basis of the integrative mechanisms of social interaction of education, science and manufacture and which are hierarchical in accordance with the importance for the participants of social partnership; informational communication, which is focused on links and relations organization.

Model "High School –Science and Research Institute - Enterprise. For Russia entry into the number of world economic leaders we need our own original innovative integrated system of education, science and manufacture, which will be a sort of frame building for: intellectual capital accumulation, progressive manufacture rates achieving and super-breakthrough technologies creating, that are very actual nowadays.

Very important organization - substantive and ideological role in national innovation system creation and development belongs to a public policy in which a special place is occupied by the education system and, above all, higher education in an interconnected chain "science-education-manufacture" (Manushin and Dobryakov, 2007).

Education interaction with scientific and industrial spheres is determined by two major vectors: competitive innovation products industrial production; staff training in the spheres of innovation activities organization and management.

To solve these tasks it is necessary: to create conditions for personnel potential development of Russian science and continuity providing in scientific and technological spheres; to provide for integration processes acceleration of scientific, academic and manufacture activities to enhance Russian economy competitiveness; to provide state support for scientific, educational and manufacture integrated structures forming, which are oriented to serial production and marketing of innovative products in cooperation with small high-technological enterprises; to improve the efficiency of state-private partnership when

implementing the most important innovation projects of state importance (Novikov, 2005).

Selection and potential opportunities identifying criteria development for competitive innovative products production involves special priority to higher education, which should be focused on: higher professional education system development in the macrostructure "education-science-manufacture"; several universities functions diversification in accordance with the specialists chosen model; higher qualification personnel training concentration in base high schools of innovative and research direction; intensive development of continuous education; postgraduate training various forms improvement; organizational support of scientific research in the field of higher education; the intensification of the educational process; development and introduction of new educational technologies on the basis of modern information and computer training tools.

This challenge today can be accepted by the following three main models (types) of higher educational institutions of Russia: research universities (Moscow universities, institutions of higher education, which are integrated with major research institutions, huge regions leading universities); teaching and research universities (the majority of regional classic universities and academies); educational complex of higher professional education, which is oriented on interdisciplinary training (colleges that implement the model of continuous education, undertaking the vocational education curricula development and drawing largely resources of other high schools).

But it was noted that the full implementation of innovative projects require greater integration of science, education and industry, which involves personnel training problems solving in a particular educational level, therefore the integration of the "science-education-manufacture" should be differentiated in such trajectories, as "High school – Scientific and Research Institute - manufacture" and "High school - industry – Scientific and Research Institute". The first trajectory will work on intellectual potential forming for breakthrough technologies creation, and the other will be focused on the engineering personnel of high qualification forming, i.e. modern engineering personnel who will be able to work with these technologies.

At present more and more not only highly qualified specialists, but also comprehensively educated and creative personalities are appreciated on the market of educational services, who can "obtain" the necessary knowledge and basing on them can generate new ones. Such professionals bring to their firms greatest profit, and therefore they are in demand on the labor market. These graduates in law are called elite personalities, which can be brought up in the same conditions similar - elite training – in a special system of scientific training and educational process (Golyshev, 2011). Such training may be, and probably should be implemented not only in the elite, but also any High school that can accumulate the necessary resources in one or several directions of professional education for elite training of some part of the trainees. The important incentive for the intensification of scientific and educational process is participation in grants and projects. Many universities actively participate in competitions of innovative projects and grants, such as, for example, "50 best innovative ideas of Tatarstan Republic ", "Idea-1000", "Innovations for sustainable development of Tatarstan Republic " and other

It is not enough to give these students a chance to express themselves only from competition to competition, moreover, such personalities are interested not only on the result but on the process of self-study, while the traditional high school training is some kind of "brake" for them on many disciplines in their development. In this regard, one of the basic principles of the system in elite training is the principle of increased individualization of the training contents and of their "trajectory" in educational process, and consequently research and educational curricula which are relevant to this process (Manushin and Dobryakov, 2007).

Model "College – High School - enterprise." Forced growth rates of scientific and technical progress, multiple complication of the applied techniques and technologies lead to the fact that technical systems become more complex and their complexity increases in "geometric progression", new projects are being developed by more and more growing groups that require both researchers and engineers, manufacturing engineers, technicians.

Russia's lag from developed countries in high technologies development and especially the implementation is in a weak links with educational institutions. Innovative processes development requires highly qualified personnel, not only to create, but also to implement and operate new technologies. Therefore, in the framework of this research problem a model of integration "College - University – enterprise" is taken into consideration, involving the creation of a single integrated educational-industrial complex on the basis of integrity, consistency and complementarity of the integration system elements.

The suggested model consists of the following blocks: functional-target (goals tasks, functions consistency of the integrated educational-industrial complex); organizational-structural (consistency of requirements to quality of experts of

vocational education and high education with manufacture; consistency of legislative and normative-legal bases of vocational and high education with enterprise); substantial (consistency of educational curricula of vocational and high education in related specialties, the consistency of the content of academic disciplines of vocational and high education, the consistency of the training and methodological support content, consistency of practical training in the vocational and high schools with enterprises); technological (consistency of training forms and methods in vocational and high education, common types of educational activities and knowledge control); criterion-estimated (*assessment criteria of process*: integrity, structure, conjugacy, continuity, optimality, productivity; *criteria of result*: relevance, competitiveness).

As for organizational-pedagogical conditions of productive integration "College – High school – manufacture" the following ones are determined:

Conditions for structural integration: the consistency of requirements to the quality specialists training with college and high school with enterprise; consistency of legislative and normative-legal bases of vocational and high education and the enterprise.

Conditions for content integration: coherence of educational curricula of vocational and high education on related specialties; the content consistency of curricula on disciplines of vocational and high education on related specialties; consistency training content and methodological support in vocational and high schools; consistency of practical training on modern equipment basis with the same high level of automation and computerization in vocational and high schools with production.

Conditions for procedural integration: the unity of teaching methods for professional activity training; consistency of education forms with professional work training; the common types of educational activity and types of knowledge control at professional work training.

Integration model "College - high school - enterprise" involves consideration of unite integrated educational-industrial complex as a whole, organically including functions-target, organizational-structural and substantive, procedural and result components which can improve the synergy effect of this integration system in competitive specialists training.

4. Discussions

In the modern scientific-pedagogical literature the necessary combination of knowledge is accumulated, which can be a precondition for problems of research resolution: issues of continuing professional education (Vladislavlev, 1989; Mukhametzyanova, 2005; Novikov, 2005 etc.); the integration of school, high school and industry (Chudov, 2004; Shaidullina, 2009 etc.); integration of education, science and manufacture (Mukhametzyanova, 2005; Sazonova, Sidyakina and Ishchenko, 2010 etc.); integration of education and industry (Smirnov, Tkachenko, 2004 etc.); the concept of inter-subject integration of pedagogical knowledge (Bezrukova, 1994; Zagvyazinsky, 1990 etc.); the concept of integrated management of the secondary and professional education (Berulava, 1990; Ibragimov, 2011; Fedotova, 1995; Oliveira, et al., 2011), and other

However, analysis of scientific and pedagogical literature on the problem of education, science and industry integration and relevant experience of practical activity, allow conclude that its models in continuous professional education system are not enough diversified and justified, and therefore, it is necessary to reveal their nature and particular in the context of education, science and manufacture integration.

5. Conclusion

Thus the presented in the article education, science and manufacture integration models: colleges - enterprise, high school - enterprise, high school – science and research Institute - enterprise, high school - enterprise – science and research Institute, College – high school - enterprise are based on the mutual educational, research and manufacture processes, integration of educational institutions, professional education levels, content of educational curricula, technologies of training and education, organizational and administrative forms, financial and economic resources and manufacture processes. However, it is necessary to differentiate these models. The features of the models "colleges - enterprise" and "high school – enterprise" are evident in accordance with the goals, objectives, functions and terms of their implementation in the educational process of vocational or higher professional educational institutions.

It is also necessary to differentiate model "high school – science and research Institute - enterprise" and "high school - enterprise – science and research Institute", as the first is aimed at intellectual potential forming for the breakthrough technologies creation, and the second one - on the engineering personnel forming of higher qualification, i.e. modern engineering personnel who will be able to operate with these technologies.

However, innovative processes development requires highly qualified personnel not only for the creation and implementation, but also for new technologies operation. Therefore, in this

research integration model of colleges, high schools and manufacture in continuous professional education system is developed.

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