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Training of workers and specialists relevant to the requirements of high-tech industries in the context of networking cooperation of regional educational institutions and enterprises

Formación de trabajadores y especialistas en las necesidades de las industrias de alta tecnología en el contexto de la cooperación en red de instituciones educativas y empresas regionales

Aleksey Viktorovich SAVCHENKOV 1

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ABSTRACT:

The author mainstreams the need for training of a newgeneration specialists that meet the requirements of high-tech industries. The article presents sociopsychological and organizational conditions of the process management of the networking cooperation between educational institutions and enterprises when training specialists for the regional high-tech industries based on the dual education system. The article discusses the features of German dual vocational system and analyzes the main positive aspects that could be beneficial for enterprises, professional educational institutions, and the mainstream schools. Sharp focus is made to the organization of networking cooperation of enterprises, professional educational

RESUMEN:

El autor incorpora la necesidad de formación de una nueva generación de especialistas que cumplan los requisitos de las industrias de alta tecnología. El artículo presenta las condiciones socio-psicológicas y organizacionales de la gestión de procesos de la cooperación en red entre instituciones educativas y empresas cuando se capacita a especialistas para las industrias regionales de alta tecnología basadas en el sistema de educación dual. El artículo discute las características del sistema vocacional dual alemán y analiza los aspectos positivos principales que podrían ser beneficiosos para las empresas, las instituciones educativas profesionales, y las escuelas principales. Se hace hincapié en la organización de la cooperación en

institutions, and secondary schools. The author considers the basic domestic and foreign approaches to the implementation of networking cooperation, presents the methodological, methodical and procedural aspects of studying the problem, as well as draws conclusions and suggests the ways of its resolution.

Key words: dual vocational training, innovation, innovative technologies, pedagogical technologies, vocational educational institution, vocational training, network, networking cooperation, subjects of partnership relations.

red de las empresas, las instituciones educativas profesionales y las escuelas secundarias. El autor considera los enfoques nacionales y extranjeros básicos para la implementación de la cooperación en red, presenta los aspectos metodológicos, metódicos y procedimentales de estudiar el problema, así como saca conclusiones y sugiere los caminos de su resolución.

Palabras clave: formación profesional dual, innovación, tecnologías innovadoras, tecnologías pedagógicas, institución educativa vocacional, formación profesional, redes, cooperación en red, temas de relaciones de asociación.

1. Introduction

Today the Russian vocational education is under the influence of the imperatives generated by the world community in terms of development both the global economy and the economies of individual countries, focused on innovative, highly productive technologies. Despite the relatively high level of education in Russia, and the availability of extremely good professionals in particular sectors of economy, culture, law, management, etc., a significant part of Russian workers and mid-level professionals have no practical skills necessary to ensure competitive advantage of domestic enterprises in the world market. At that, the quality of secondary vocational education continues deteriorating. Effective models of vocational education are used rather rarely. Often scientific-methodical and technical provision does not meet up-to-date standards. Entrenched pedagogical training technologies in most educational institutions remain unchanged (Abdykarimova, 2016). The necessity of transition to innovative, alternative technologies causes rejection, if not to say resistance in many executive heads and engineering pedagogical staff of secondary vocational education institutions. These circumstances reduce the quality level of trained specialists and, accordingly, the competitiveness of enterprises, which employ these specialists. Therefore, domestic and foreign investors are not ready to come to the regions, which lack specialists with the necessary training and qualification level.

However, both worldwide and Russia have gained considerable experience in vocational training that meet up-to-date requirements and able to develop not only the economy, but also technologies aimed at rapid development.

German dual vocational system, widely spread in many countries, including Russia, has gained high reputation worldwide. The dual vocational education is a type of vocational education, where the practical part of the training of mid-level specialists and workers is carried out at the workplace, while theoretical training is conducted at educational institutions. Dual education technology of future workers and specialists implies joint financing of training programs, focused for specific workplace, by commercial and publicly-owned enterprises, interested in qualified personnel, as well as regional authorities, interested in the development of the economy and rising living standards in the region. Trainees, when acquiring knowledge and skills at enterprises, at the same time are engaged in a real production process, so after graduation they do not need onboarding the job and can easily join the personnel. The purpose of implementation of dual education consists in improvement of the qualified personnel training model with due account for the real needs of the economy, and increasing investment attractiveness of regions.

Implementation of the above objectives will require fulfillment of the following tasks:

- developing occupational standards for relevant professions in economy and business;
- developing and modernizing educational programs in accordance with the requirements of professional standards;
- improving the mandatory requirements to the organization and the content of educational programs;
- developing a mechanism for independent evaluation of the workforce skills;
- optimizing taxation in order to attract business and potential investors to funding the personnel

training, etc.

The effectiveness of the dual vocational education system for the subjects included in this system consists in the following.

- For enterprises, the dual education system is preferable due to the fact that the customized training provides personnel qualifications, which are exactly needed by the enterprise. Taking an active part in the educational process, enterprises can adjust content of educational programs as the learning unfolds, as well as change the curriculum in accordance with the progress of their technological modernization. An important feature of the dual approach is that in this case the enterprise, even more than an educational institution, is interested in the quality training. Therefore, the production workers fully share responsibility for the learning process, exercise control over the activities of educational institutions, ensure the continuity in the theoretical and practical training of students, who are seen as enterprise's future employees (Vorobyova, 2015);
- For professional educational institution, the dual system bridges the gap between what is taught in college and the practical experiences of graduates coming to the enterprise. The discourse on harmonization of educational and vocational standards in the Russian science and practice is being on the agenda over the last decade, though this issue still remains relevant (Lupanov, 2009);
- For mainstream schools dual training will allow solving practical issues related to occupational orientation of pupils. The issue of propedeutics in vocational education i.e. the issue on developing in school children the elementary working skills, their interest in the worker occupations, enhancing motivations for mastering these occupations at professional educational institutions, as well as intentions to continue the labor dynasty still remains debating point in science and practice (Tereshchenkova, 2014).

In this respect, the dual education can be realized through the creation and implementation of integrated educational programs, whose theoretical part would be implemented partly at school and partly in the college, while the in-service training would be carried out on the basis of a occupational organization (secondary technical school or college) (Uvarina, 2016; Falyakhov, 2014). In this case, dual approach in training of pupils will be aimed at forming their working and technological culture, technological knowledge and skills, inoculation of labor, civil and patriotic qualities of the personality, their professional self-determination in the labor market as well as forming tolerance and humanistic worldview. Dual education is an essential component of general education of pupils because it provides opportunity to apply the acquired knowledge in basic sciences.

Based on the foregoing, we should note the fact that dual education, which was implemented in Germany and other countries, has proved its worth. This involves the involvement of several social actors in the course of advanced training of workers and middle ranking specialists. Such social actors should be schools, secondary professional education institutions (organizations, management structures, etc.) interested in developing of regional and state economies as well as in improving the welfare of the community.

Brief characteristics of dual vocational education and its benefits allow raising question concerning the mechanism of its implementation. Since a complete cycle of vocational education (vocational training of workers and middle ranking specialists that meet the requirements of high-tech enterprises) is understood as the sum of several components, namely, propedeutics, direct training, on-the-job training, and scientific support of the educational process, the most appropriate mechanism, in our viewpoint, may be a networking cooperation of at least four actors: school – vocational educational institution –enterprise – university.

The institutionalization of networking cooperation in the Russian education is reflected and normatively fixed by the law "On education in the Russian Federation" (Federal law of the Russian Federation of December 29, 2012 No. 273-FZ). Article 15 of this law brings under

regulation the activities of educational institutions, determines their structural composition, their interaction procedure, conditions and arrangements for training and education activities in the framework of networking cooperation, determines the issued certificates of study, the duration of contracts, etc.

As pointed out by researcher G.A. Gertzog, one of the further development vectors of education in Russia is a comprehensive modernization of regional professional education systems, which aim at uniting the potential of occupational education institutions regardless of their level and departmental subordination, and optimizing the institutions' network structure. This will open a new page in the networking cooperation practice of institutions and organizations in the field of vocational education, networking cooperation of universities and colleges, as well as schools with strategic partners. The author believes that exactly networking cooperation will give Russia a chance to bring vocational education to the condition agreeable to standards of the Russian economy and global competition challenges (Gertzog, 2015).

Comparing approaches that are used in Russian and foreign vocational education when organizing networking cooperation of educational institutions, Gertzog takes note that "...there are obvious differences in the extent and variety of interaction forms. These differences are complemented by important divergences in the understanding of the essence of this process." (Gertzog, Danilova, Korneev, Savchenkov, and Uvarina, 2017) For example, in the Russian education system the initiative in the organization of interaction mostly comes from the state, while educational institutions often consider such projects only as a source of attracting additional external financing. Practical work training of foreign universities suggests that initiating cooperation with various strategic partners is most often an internal institutional decision, it is strictly pragmatic in nature, and is seen as regular way of pooling resources for moving towards the objectives that cannot be achieved when acting alone (Gertzog, 2015; Sheresheva, 2006).

The essential features of networking cooperation are its underlying principles. Gnatyshina E.A. in her study substantiates the choice of fundamental principles and offers some of them having fundamental importance for building a network. According to the author, these include principles such as effectiveness, projectivity, synergistic effect, consistency, etc. (Dorozhkin, and Gnatyshina, 2015).

Based on the foregoing, we can assume that the implementation of *networking cooperation* of potential partners for the implementation of the dual education will allow:

- consolidating and optimizing the use of educational and occupational resources of all networking cooperation participants;
- reducing the imbalance between the needs of the modern labor market and the actual outcome of the educational services;
- strengthening the resource of any innovative organization at the expense of resources of other organizations;
- expanding the range of educational services for trainees, including that through the implementation of curricula in networking form;
- improving the professional competence of teachers through the use of up-to-date practiceoriented technologies.

Thus, there is an evident need to create such a model of networking cooperation of professional educational institutions with enterprises, educational institutions, and universities, where the resources of all cooperating parties will be maximally used to promote blue-collar occupations and training highly skilled workforce.

2. Methods

The innovation studies carried out by A.I. Adamsky, V.I. Zagvizinsky, M.V. Klarin, V.I. Slobodchikov, M.I. Fischer, A.B. Khutorsky, P.G. Shchedrovitsky, and others served theoretical

and methodological basis of proposed networking cooperation system modeling for secondary occupational education institutions with other social entities involved in the training process of workers and middle ranking specialists for regional high-tech enterprises. Works of A.I. Adamsky, V.A. Bianki, N.S. Bugrova, G.A. Budnikov, G.A. Gertzog, E.A. Gnatishina, P. Ziber, M. Castells, N.V. Uvarina, et al. served for us an important sources to study the issues related to the networking cooperation concept. Terminological, regulatory, and managerial aspects of the dual vocational education system as a socio-educational phenomenon were borrowed from works of A.T. Abdykarimova, I.M. Vorobyeva, T.K. Klimenko, M.T. Rakhimzhanova, E.V. Tereshchenkova, I.I. Falyakhov, et al.

A study of the scientific literature on this issue have shown that this topic is rather new and there are no relevant empirical studies, although the literature has formed certain thesaurus, where we can find some of the interpretations of the particular concepts.

Thus, the **relevance** of the present problem study is stipulated by the following factors:

- condition of the problem which concerns current education theory and practice;
- social mandate, as well as particular federal and regional requirements;
- need for studies on organization of networking cooperation of professional educational institutions with enterprises and mainstream education institutions;
- need to solve a problem concerned training of specialists completely prepared to fulfill specific job functions, and to increase professional mobility and competitiveness of graduates in the labor market;
- opportunity to bridge the gap between the knowledge that students gain at occupational and mainstream educational institutions, and requirements of production.

In addition, in the course of analysis of theoretical sources and the acute problems facing particular educational institution (such as Ust-Katav Industrial and Technological College in Chelyabinsk Region), when training personnel for high-tech enterprises in the region, we have identified number of contradictions, which actualize concerned problem and need to be addressed. These are the following *contradictions*:

- the contradiction between the need for designing propaedeutic programs to form initial labor and professional skills in pupils at schools, instilling a sense of pride and respect for the blue-collar occupation as well as the motivation to master a profession, and the actual practice at mainstream schools, which formally carry out the work on occupational orientation of pupils;
- the contradiction between the need for dual education programs in terms of networking cooperation and the need to create and implement them, as well as the lack of scientifically grounded regulatory framework for the creation of such programs and difficulties arising between the enterprise and vocational educational institution, when agreeing on the content of training program and decreasing the amount of time for on-the-job training;
- the contradiction between the need for scientific and methodological support of educational process using the dual education model, and lack thereof in educational institution intending to implement this model.

In accordance with the aforesaid, the problem consists in searching the answer to the question, what are the *organizational*, *managerial*, *regulatory* and *socio-psychological* conditions for the design and implementation of the networking cooperation model between universities, occupational educational institutions, enterprises, and mainstream schools which serve as the organizational framework of the dual education. The present work aims at identifying and justifying organizational, managerial, regulatory, and socio-psychological conditions for the design and implementation of the networking cooperation model between professional organizations, enterprises, and mainstream education institutions as the organizational framework of the dual education.

Research methods included *theoretical analysis* of scientific literature and practical experience of the German and Russian educational institutions and enterprises in terms of networking cooperation, when implementing the dual system, namely *modeling*; *questionary survey*; *interviewing*, as well as *evaluation and analysis of documents*.

Characteristics of the networking cooperation model. The proposed model represents an integrative unity of social actors (Ust-Katav Industrial-Technological College, two mainstream schools of the Ust-Katav urban district, "S.M. Kirov Railway Car Building Works in Ust-Katav", which is a branch of the Federal State Unitary Enterprise "Khrunichev State Space Scientific-Production Center", and Vocational Pedagogical Institute of the South Ural State Humanitarian Pedagogical University), their resources (intellectual, methodological, material, technical, technological, and regulatory), as well as mutual commitments that allow training of highly qualified personnel for enterprises of the region (Figure 1).

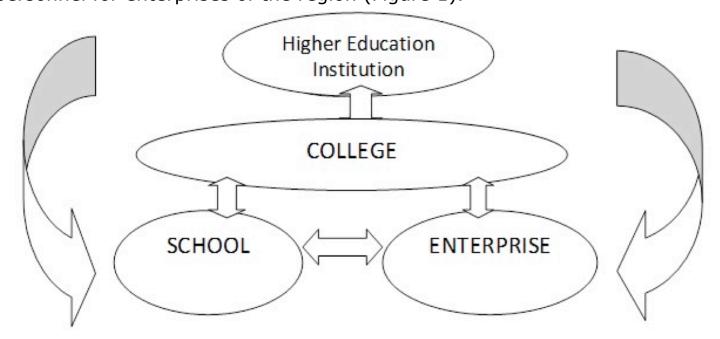


Figure 1. Model of networking cooperation between actors involved in regional human recourses training based on dual education.

The implementation of the proposed model should include:

- scientific and methodical support of the networking cooperation process that is the function of the higher education institution;
- normative, substantive, technical, technological, and methodological provision, as well as provision
 of human resources, implemented through network contract based on the integration of available
 joint resources.

The implementation of the model should ensure:

- motivation of pupils for choosing a specialty and blue-collar occupation, creation of comfortable environment for their onboarding to the conditions of secondary professional education institutions;
- creation of an educational cluster "School-College-Enterprise" that will facilitate continuous occupational education of trainees;
- establishment of mentoring initiative;
- mobilization of mainstream institutions' activities with occupational educational institutions and enterprises to form their networking cooperation model.

Organizational conditions include:

- studying by the staff members of best practices when implementing the dual system of vocational education;
- developing the concept of college students training in the frameworks of the dual vocational education system in the context of "college school enterprise" networking cooperation.
- selecting educational institutions and enterprises to build network-based cooperation system;
- developing network agreements and regulations for the implementation of the dual occupational education system in the context of network-based cooperation.

Regulatory determinants of networking cooperation model of subjects engaged in the personnel training based on the dual vocational education system, include:

- The agreement "On cooperation in implementation of dual vocational education system".
- The provision "On the base enterprise in the dual vocational education system".

- The provision "On voluntary certification of occupational qualification of graduates trained according to the dual vocational education system on the basis of vocational secondary education institution".
- The provision "On dual vocational education system".
- The provision "On contest of the best practice-oriented graduation project".
- The provision "On the master of vocational training as the employee of the base enterprise".
- The provision "On the moral and material incentives for the best graduates, teachers, and masters of vocational training".
- The provision "About students' on-the-job training".
- The provision "On the production-related exam based on dual education".
- The provision "On the employment promotion service to graduates trained according to the dual education system".
- The provision "On public and occupational accreditation of educational programs".
- The provision "On the expert council of the "School-College-Enterprise" education cluster carrying out quality control of the dual education system ".
- The provision "On employment monitoring of graduates trained based on the dual education system".

Socio-psychological conditions influencing the effectiveness of personnel vocational training include:

- employees motivation to work in an innovative mode;
- the readiness of the pedagogical staff to implement updated functions (availability of relevant qualifications, and availability of didactic support of in-service training)

3. Results

As evidenced by scientific sources and practical experience, the human factor is an important component in any innovative activity. In the course of modeling and implementing the dual education system of personnel for high-tech enterprises of the region in the context of networking cooperation, we have empirically investigated socio-psychological factors influencing the effectiveness of vocational training. These factors include motivations of the staff of all network organizations to work in an innovative mode and their willingness to meet updated educational and organizational functions. The research involved 68 people (12 masters of vocational training; 25 teachers of special and technical disciplines; 7 experts accompanying educational activity; 7 school teachers engaged in the dual training system; and 17 enterprise employees). The research sampling was continuous, i.e. corresponded to 100%.

Some research outcomes are presented below.

Staff *motivation* was studied based on a structured interview. The results are shown in the Table 1.

Table 1. Staff motivation reflecting ability to work in an innovative mode (%)

No	Category of employees of the partnering network organizations	Stable motivation to work in an innovative mode	Indifferent attitude towards innovation	Negative attitude towards innovation
1	Masters of in-service training	75.1	16.6	8.3
2	Teachers of special and technical disciplines	96.0	4.0	0.0

3	Experts accompanying educational activity (methodical, socio-psychological services, disciplinary department)	100.0	0.0	0.0
4	School staff	100.0	0.0	0.0
5	Enterprise employees	76.5	17.6	5.9

According to the percentage data presented in Table 1, we can state the fact that a significant number of respondents to the survey have a positive stable motivation to work in the conditions of networking cooperation based on the dual model of staff training. However, among those who have to implement this model there are people with an indifferent and negative attitude towards such innovation. Their number accounts for 10% of the total number of respondents. From a managerial point of view, there arises a need to take immediate action to change their motivation. Otherwise, the implementation of the proposed model will be hindered.

An important condition for implementation of the developed model is the *willingness* of the staff of the organizations included in the networking cooperation to execute the updated functions. Their study was conducted using documentary methods. Table 2 presents the empirical data obtained through document analysis.

Table 2. Readiness of the organizations' staff involved in the networking cooperation to perform updated functions

No	Category of employees of the partnering network organizations	Availability of proper qualification (pedagogical or occupational)	Availability of the updated curricula, plans, and standards	Availability of didactic support, evaluative and diagnostic tools	Availability of the regulatory framework
1	Masters of in-service training	83.4	66.7	66.7	100.0
2	Teachers of special and technical disciplines	100.0	100.0	100.0	100.0
3	Experts accompanying educational activity (methodical, sociopsychological services, disciplinary department)	100.0	100.0	100.0	100.0
4	School staff	100.0 (in pedagogy), 0.0 (in qualification skills)	71.4	71.4	100.0
5	Enterprise employees	100.0 (in specialty and	52.9	52.9	100.0

	qualification), 52.9		
	(in pedagogy)		

The analysis of the empirical data shown in Table 2 indicates that all employees of the organizations have necessary regulatory framework that supports the activities in the innovation mode. This is quite a positive condition for implementing the designed model. No anxiety is caused by the factor such as the compliance of staff qualification to updated functions.

4. Discussion

However, the need of retraining and advanced training of certain categories of employees of educational institutions and enterprises is quite evident. This involves the following aspects:

- school staff requires special courses aimed at propedeutics in the field of mastering of the blue-collar occupations' essence and their place in the occupational structure; in the field of mastering modern technologies for professional orientation and professional diagnostics of pupils; as well as in the field of acquaintance with the terms and requirements of teaching in college and working at high-tech enterprise;
- employees of enterprises require retraining and advanced training in the field of pedagogy and learning technologies.

Most alarming is the fact that a significant number of employees involved in the implementation of networking cooperation model with the use of the dual system training, by the time of the innovation activities lack didactic support of the educational process and evaluation of its results. The elimination of this problem is one of the operational tasks in staff training management.

5. Conclusion

In general, our study has shown that

- dual education as training technology of workers and middle ranking specialists is incontrovertibly productive and competitive.
- the developed model of networking cooperation between educational institutions and high-tech enterprises will provide the region with competitive human resources, as well as facilitate economic and technological development of the region upon condition of implementing of organizational, legal, normative, and socio-psychological factors that serve the conceptual basis of the proposed model.
- empirical study conducted in the beginning of innovative activities has allowed identifying the main problems that need immediate resolution. These problems happen to emerge when designing and coordinating joint education programs, scientific-methodical and didactic support materials, as well as training and retraining of teaching staff involved in the implementation of this model at school, enterprise, and college.
- among the managerial issues the most problematic is the issue of harmonizing the content of in-service training at the enterprise and development of mentoring.

In general, the designed model of networking cooperation of social actors involved in the training of regional human resources for high-tech enterprises is viable and can be extrapolated to other organizations.

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^{1.} South Ural State Humanitarian Pedagogical University, Russian Federation, 454080, Chelyabinsk, Lenin prospect, 69. E-mail: alex2107@mail.ru

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