Advanced training of personnel for the coal mining industry in the educational ecosystem of the region

Natalia Kasatkina1, Olga Krasnoshlykova1, Elena Rudneva1, and Albina Levanova2,*

1Kemerovo State University, Interuniversity Department of General and University Pedagogy, 650000 6 Ulitsa Krasnaya, Kemerovo, Russian Federation
2Kemerovo State University, Department of Foreign Languages in Professional Communication, 650000 6 Ulitsa Krasnaya, Kemerovo, Russian Federation

Abstract. Changes in the social and economic life of society, an understanding of the forces currently at play require changes in the fields of education philosophy, education technology education curriculum and design for education at all levels. There is a need in transformation and redefining curriculum agendas for educational institutions related to the training of qualified, competitive, professionally mobile staff, who are ready to design and implement the activities of coal mining enterprises. Kemerovo region is one of the most important regions of the country for coal mining and metallurgy development, which almost completely supplies the entire country with coal. Training of personnel for the coal mining industry assumes increasing importance and orientation necessary for the future of the country. Our research has shown that the structure of young people’s self-awareness, their personal life and professional intentions are changing. It is necessary that young people should be ready for making independent decisions in choosing a profession required in the region. The socio-economic development of the region is characterized by the emergence of various innovations in the system of vocational, occupational and human resources management training for the coal mining industry. Based on the results of our research we consider it necessary to create clusters aimed at integrating and concentrating the activities of educational organizations, scientific institutions, supplementary education organizations, industrial enterprises that are located on the same territory, in the same region, in order to prepare qualified personnel for the coal mining industry of the region.

1 Introduction

The domestic regional system of the economy has undergone significant structural and substantive reforms in recent years, for which purpose it proposes to improve the quality of training of the coal-mining personnel needed for the new socio-economic conditions and, requires innovative decision-making.

* Correspondent author: levanova@bk.ru
Education and technology clusters of the coal mining industry have a special role to play in the modernization of the vocational education system, because it is in the context of the clusters that the system of interaction of all the actors of coal mining industry and its social partners is implemented under the real conditions of the region. This interaction makes it possible to deal effectively with the issues of personnel training for the coal industry and, as our study has shown, this process should begin not with vocational and higher education institutions, but with the organizations of general secondary education. This is why it is necessary to develop and change the content of vocational guidance work, which, in turn, contributes to the realization of the concept of advanced professional training for the coal industry.

A special role in the system of advanced professional training for industrial coal mining enterprises is played by institutions of general secondary education (hereinafter referred to as GSEI), professional educational organizations (hereinafter VTEI), higher education (hereinafter HE) which currently do not fully meet the challenges of dynamically changing labor market requirements for a number of reasons, among which we have highlighted the following:
- the lack of understanding by industrial enterprises of coal mining organizations the major ways in which the built environment of education is transforming in response to various globalized policy drivers, computerization, and new education delivery technologies which require a fundamental rethinking of the mission, tasks and responsibility of educational organizations to young people and to the state;
- the lack of a clear understanding among the GSEI, VTEI and HE teams the mechanisms of interaction between educational organizations and social partners in solving the problems of training and retraining personnel for coal mining, in particular, in organizing joint work on mutually beneficial concepts of modernizing career guidance with a focus on the requirements of modern economy and taking into account the prospects for the development of society; the organization of effective practice in the conditions of real production and further training for work at the enterprises of the coal industry;
- the absence of this type of activity increases the issue of vocational guidance for graduates of GSEI, VTEI and HE, which inevitably arises in the context of objective changes in the structure of training specialists for the region, etc.;
- socio-economic situation in the region, when professional organizations of general secondary, professional and higher education, opened in the XX century to meet the needs of certain economic institutions and industrial enterprises, have lost their relevance, either due to the closure or re-profiling of these institutions, or due to material and technical discrepancy with the new requirements of the economy and production, etc..

The main objective of educational organizations (as we consider it) is to develop and implement advanced vocational training of qualified personnel in cooperation of VTEI with educational institutions of general secondary, and higher education, continuing education and retraining institutes, employers, government and business structures.

In turn, training under the close collaboration of GSEI with VTEI and HE and social partners becomes more effective if such interaction takes place within a certain institutional framework, namely, the education and technology cluster, which ensures a real convergence of the interests of general educational organizations with the social sphere in the training of personnel needed for the mining industry in the region.
2 Results and discussion

2.1 Goals and objectives of the study

Our analysis has shown that the problem of organizing the education and technology cluster currently requires special attention in pedagogical science.

The goal of the study is to define, scientifically validate and pilot test the main activities of the education and technology cluster, that provides training for coal mining enterprises in the conditions of cooperation of general education and vocational education organizations, operating within the regional labor market system.

Research Objectives:
1. To determine the current trends in the training of personnel for the coal industry in the conditions of the education and technology cluster (joint work of general educational and professional educational organizations with employers using innovative technologies, network interaction, the formation of motivation and value orientations, advanced training of specialists of professional educational organizations, joint activities with employers to train personnel for the coal industry in the region).
2. To reveal the features of interaction of professional educational institutions with employers and social partners in training coal mining personnel using a new legal form of such interaction (social partnership, networking, public-private partnerships, education and technology cluster).
3. To define, transform and implement the content of the curriculum of the education and technology cluster, related to the training of the personnel for the coal mining industry for the students of general and vocational educational institutions and take into account the needs of the social partners; based on various forms of cooperation among actors.
4. To carry out, design and pilot test the main lines of action in the context of the education and technology cluster for the training of personnel for the coal mining industry among students [1].

2.2 History of the creation of the education and technology cluster

The first clusters as objects of economic agglomeration of interconnected organizations on a limited territory have been known since the beginning of the XVIII century. The study of spatial competitiveness in the context of cluster theory is associated with the name of M. Porter (1998), who considered the cluster approach as one of the most efficient mechanisms for the structural development of the economy [2].

The prerequisites for the creation of cluster theory were laid down in the works by S.Marland, 1974; M. D. Miller, 1985; L.Reetz, 1990; A.Shelton, 1991, et al. [3; 4; 5; 6].

Modern research in the field of economics and innovation processes related to clusters is carried out by Nota, L., Ferrari, L., Solberg, 2007; P. Merlevede, 2014;; L. Benade, M. Jackson,2017, et al. [7; 8; 9].

In the context of building an innovative economy in modern Russia, researchers have identified the following types of regional clusters:
1. "University-oriented" clusters. These include innovation clusters that create a large concentration of university intellectual power in the local territory. This ensures an adequate economic environment conducive to innovation.
2. Multilevel clusters, which are vertically integrated structures of the type “VTEI - university - employer”.
3. Pre-university-level clusters, which consist of multi-level general secondary and vocational education institutions established on the basis of VTEI and graduating qualified skilled workers and mid-level specialists who acquire several working professions.
We consider the establishment of education and technology clusters based on professional educational organizations, in integration and cooperation with employers and social partners, a necessary method for achieving the objectives set for the education system [10].

The formation of education and technology clusters is based on three main sub-processes:
- “horizontal integration” of educational organizations of general secondary education and secondary vocational education (i.e., organizations of the same level);
- “vertical integration” of general educational institutions, organizations of secondary vocational education and higher education institutions, as well as educational complexes (i.e., organizations of different levels);
- “complex integration” (“horizontal” and “vertical”) - the creation of multi-level educational institutions and their networks, educational consortia, etc.

The core of the education and technology cluster is an educational organization of vocational training (a technical school, college or an industrial organization), which possesses the innovative potential to position itself as a center, that can strengthen the processes of integration of innovative activity within the territory of Kemerovo region.

2.3 Prerequisites for the creation of the education and technology cluster

In the course of the study, we considered the following as the basis for the formation of an education and technology cluster:
- presence of large industrial production complexes in the region, in some cases belonging to a federal or regional special economic zone;
- existence of active regional employers' associations;
- experience of social partnership with employers in the regional system of professional cooperation;
- the immediate need in training personnel for the coal mining and metallurgical industries of the region.

The indicated processes that emerged in the education and technology clusters evolved at a time when the problems of regional economies were addressed through approaches that were not always sufficiently effective. These methods are still used in emerging clusters and beyond [10].

Kemerovo region is one of the largest coal reserves and coal production regions of Russia. According to official data, 120 coal-mining enterprises are registered in the coal industry, including 43 operating mines and 49 opencast mines. New mines and open pits are currently under construction. In the next 15 years, 15 mines, 7 opencast mines and 16 processing plants will be built in the region. The prospective direction of the coal industry is coal chemistry, as the region is pursuing a course on coal enrichment and processing. In 2019, 79, 6 % of the extracted coal was processed with the prospect of processing all coal at the mining sites of the region in the future.

The emergence of new branches and new areas of production in the coal and coal chemical industries opens up prospects for the creation of new jobs whose specialists should be competitive on the labor market, and therefore, would be able to receive highly qualified professional training in higher education and vocational training institutions, upgrade their qualifications, improve their qualification skills and undergo retraining if necessary [11].

In view of the above mentioned personnel needs there has been established a special regional council on personnel policy in Kemerovo region, which deals with issues of interaction between general secondary and vocational education and the industrial sphere. Its indispensable feature is the mandatory system of direct contracts between general secondary and vocational educational institutions and industrial enterprises in the region. In this case, not only are the common interests of employers, general secondary schools and vocational
secondary schools maintained, but also a joint action is being taken to solve the region’s pressing social and economic needs.

The further development of this challenge is the formation of regional, municipal and sectoral clusters based on long-term strategic planning mechanisms and broad integration of the economic, industrial and educational spheres.

### 2.4 Education and Technology Cluster Model

The productivity of the education and technology cluster for the socio-economic development of the region is assessed by consolidating, within the new innovative infrastructure of technology, the need for specialists for the region, territories, cities; the creation of a normative basis for cluster interaction as a form of social partnership; the formation of a socializing environment that makes maximum use of the potential (resource) of social partners - participants of the education and technology cluster. We have developed a model for training coal industry personnel in the education and technology cluster, which is presented on Fig. 1.

The structure of education and technology clusters is characterized by a reasonably high degree of territorial cohesion and responsibility of its participants (social partners), on the one hand, and sufficient mobility in the organization and in co-ordination, on the other.

The presented model, being multidimensional and structurally functional, comprises five structural components (targeted, methodological, procedural, reflexive and evaluative).

According to the presented model, the target component of the model implementation is focused on the fulfillment of state, educational, social, and personnel orders.

The methodological component relates to the implementation of the following principles: regionality, integration, intensification, differentiation and variability of training, advanced development of professional education, public-private partnership, orientation to self-development and approaches based on the voluntary nature of relations between the parties to the interaction; combining the efforts and resources of two or more equal partners; contractual form of interaction, including the distribution of responsibilities of partners; activity-based nature of interaction [11].

The procedural component is associated with the creation of Centers (the core of the education and technology cluster) in the territory, which provide continuous support for the training of pedagogical personnel on the basis of network interaction with enterprises, educational institutions, local government and businesses, ensuring conditions for integration and concentration of resources in the territory for the development and implementation of innovative programs by the Resource Centers together with employers and educators; carrying out the functions of professional information and guidance, conducting professional tests and competitions, and psychological and pedagogical support for the training of personnel for coal mining and metallurgical industries; including the purpose of adapting graduates of vocational and professional institutions to the regional labor market.

The assessment component (the expected outcome of the study) summarizes the solution to the task of advanced training for the coal mining industry in the context of the education and technology cluster, which ensures the necessary orientation of the vocational self-determination of students on the basis of the criteria and indicators of the quality of training of graduates; the level of formation of professionally significant competences demanded by the region; the level of employment of graduates in areas and activities, as well as the level of personal qualities of trainees: self-esteem, self-organization and self-control [12].

The reflexive component makes it possible to assess the level of theoretical knowledge, acquired by the learners, the level of formation of professional skills and the level of motivation for activity. The education and technology cluster possesses the properties of consistency, flexibility, constructiveness, being a self-developing system. It allows for the
expansion or reduction of the number of modules in the cluster model through the implementation of new educational activities of general secondary, secondary vocational and professional education institutions, the inclusion of new organizations and enterprises in the cluster, etc.

| TARGET COMPONENT |
|------------------|------------------|------------------|
| state order      | educational order| corporate order   |
| state social order| educational social order | business order |
| state personnel order | educational personnel order | private order |
| APPROPRIATIONS: | state target characteristics of trainees | state target characteristics of employers and social partners |
| - mutually beneficial and voluntary nature of the relationship | - contractual level of resources to achieve the results of joint activities, |
| - contractual level of resources to achieve the results of joint activities, | - diversification of risks and costs to ensure mutual accountability |
| - diversification of risks and costs to ensure mutual accountability | - authority of representatives of the parties in the management structures |
| - authority of representatives of the parties in the management structures | - written contractual arrangements with mandatory definition of |
| - written contractual arrangements with mandatory definition of | - control procedures and sanctions for non-compliance |
| - control procedures and sanctions for non-compliance | PRINCIPLES: |
| - control procedures and sanctions for non-compliance | Regionality, integration, intensification of training, differentiation, variability of |
| Regionality, integration, intensification of training, differentiation, variability of training, advanced development of professional education, public-private partnership, orientation to self-development |
| ORGANIZATIONAL AND PEDAGOGICAL CONDITIONS |
| INSTITUTIONAL | creation of Centers (the core of the education and technology cluster) that perform the function of supporting professional self-determination of students |
| SUBSTANTIVE | Establishment of a public-private partnership system, compulsory practice and organization of jobs for apprentices in enterprises, conclusion of contracts for targeted training, internships and further training of specialists |
| ACTION-RELATED | Active inclusion of trainees in the main areas of activity, application of innovative professional technologies, implementation of vocational guidance programs for trainees |
| EFFECTIVE | compliance of the cluster model with the stated principles and approaches, effectiveness of development and implementation of innovative programs and curricula by vocational resource centers, assessment of the level of interaction between educational centers and employers |
| REFLEXIVE COMPONENT | level of theoretical knowledge acquisition (the cognitive component) |
| level of development of professional skills (operational component) |
| degree of motivation for professional activity |
| ASSESSMENT COMPONENT | advanced training for coal mining industry |

Fig. 1. Education and Technology Cluster Model.

### 3 Conclusion

Thus, the Education and Technology Cluster that provides training for the coal mining industry is, in our opinion, a tool of innovative development based on interaction of educational institutions and coal industry enterprises in the training of personnel needed for their own development. In the process of the research, we studied preferences of young people for choosing a future profession based on the data of the questionnaires for youth surveys in the region. They showed that young people, even living on the territory of a coal basin, did not have a complete understanding of the work and its perspectives in the coal industry, let alone new conditions and new modern technologies used in coal mining industry.

That is why we thought it necessary to introduce innovations in the area of educational-building design, education curriculum, education technology, the place and space of learning. To meet the demand for qualified personnel we suggested setting up training mines in the region, where the students of general education organizations and students of vocational
education and higher education institutions (through education and technology clusters) could have their first orientation there. Teachers in collaboration with specialists from coal mining enterprises could create conditions for their trainees to familiarize themselves with the work in coal mining enterprises: from mining coal to managing and owning a mine. Today, due to the joint collaborative work of education authorities and mine managers there have been established training mines within the framework of education and technology clusters in the cities of Mezhdurechensk, Prokopyevsk, Kemerovo, Leninsk-Kuznetsky, and Berezovsky in Kemerovo region. We assume that by 2023 training mines would be created in all the areas with innovative coal-mining enterprises. The main idea and the main advantage of social partnership within the education and technology cluster of the coal mining industry allow for effective partnership among the subjects of the education and technology cluster, which individually might have limited resources.

Thus, we can claim that the scientific development and practical interaction of these organizations determine the solution of the task for preparing modern youth for the real choice of professions necessary for the coal mining industry.

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