Educational potential of the Murmansk region as a factor in the development of the Arctic territory in the context of Industry 4.0

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Abstract. The paper studies the features of the educational system development in the regions of the Arctic zone of the Russian Federation in the context of the fourth industrial revolution. The authors analyze the areas of education system development in the Arctic zones of the Russian Federation and the Murmansk region. The authors have carried out the analysis of the flagship university educational programs in the Murmansk region and proposed a system of indicators of educational potential, taking into account the peculiarities of training personnel for the Arctic territories.

Key words: education system, educational potential, Murmansk region, fourth industrial revolution, arctic space

1. Introduction
The development of the Arctic territory in the context of Industry 4.0 is difficult to imagine without the use of relevant scientific knowledge and the application of digital technologies. It is important to develop the educational potential and professional training taking into account the development areas of the Arctic economy in the context of the fourth industrial revolution.

In these conditions, the role of educational potential as a factor necessary for the development of the territory increases significantly [1-4].

A huge number of social, economic and demographic factors influence the development of educational potential. It should be noted that the development of the Arctic regions of Russia is hindered by the shortage of labor resources, deterioration of demographic indicators, and the lack of compliance of the existing education system with the needs of the economy in the context of the fourth industrial revolution [5-7].

The purpose of the article is to develop a concept for combining the educational potential of the Murmansk region, the capabilities of Industry 4.0 and the development of the support zones of the Russian Arctic.

2. The theoretical basis of the research
The theoretical and methodological basis of the research is the graph theory toolkit. The problem of choosing development options in the Arctic zone of the Russian Federation involves the presentation of a complex project in the form of an alternative network.

The design options rely on the dynamic programming and use a system of recurrent equalities for the case of uncertainty.
To substantiate the concept of combining educational potential and the capabilities of Industry 4.0, a decision tree and predictive alternative graphs are used [8, 9]. A decision tree and a predictive alternative graph allow us to consider many possible options for the development of the support zone. The analysis of alternatives ultimately leads to the selection of a set of effective options, i.e. a combination of material costs, time costs, and the feasibility study.

3. The main research areas

3.1. Features of the development of the Arctic zone of the Russian Federation in the Murmansk region

The development of the Arctic zone of the Russian Federation implies the development of support zones, with one of them, the Kola support zone, located in the Murmansk region. The development of the support zones of the Russian Arctic relies on the territorial principle rather than on the sectoral one, which predetermines the complex nature of their development and requires the interrelated growth of the production, infrastructural, environmental, socio-economic and educational spheres [10-12].

The main functions of the Kola support zone include: 1) service function, which provides the projects for the development of offshore oil and gas fields in the Russian sector of the Arctic and ensures navigation along the routes of the Northern Sea Route; 2) recycling of aquatic biological resources and extraction of minerals; 3) transport services [13]. Hence, the professional training should take into account the requirements for the implementation of these functions.

However, as noted in the works [14-17], there are practically no projects for the development of the scientific and educational complex among those implemented in the support zones of the Russian Arctic.

3.2. The main areas of the education system development in the Arctic zones of the Russian Federation

Currently, the development of the Arctic territories is an important federal task to fulfill in various fields, including education.

At the Russian Federation governmental level, the areas to improve the demographic policy, especially in the social and educational field, have been determined in 2020. The program is aimed at increasing state-funded places in regional universities where there is a shortage of doctors, teachers, engineers (which is very typical for the Arctic regions). The implementation of these measures will increase the accessibility of high quality education, also in the Arctic zone of the Russian Federation, and will ensure a more flexible response to the needs of the labor market.

The development of the education system in the Arctic zone is strongly influenced by the following factors:
- population outflow: more than 300 thousand people in 15 years;
- underdeveloped social and educational infrastructure;
- high proportion of dilapidated housing - up to 40-50 percent;
- ineffective system for forecasting the needs for specialists with higher and secondary vocational education;
- low interaction of educational institutions with territorial enterprises;
- lack of methods for assessing the quality of Arctic programs and determining the professions required in the Arctic regions.

Currently, there is the monitoring research «Professionals for the Arctic» [18], developed by the Russian Ministry for the Development of the Russian Far East in cooperation with the Agency for the Development of Human Capital in the Far East and the Arctic, dedicated to identifying the needs of regions, enterprises, institutions located in the Arctic zone.

The purpose of this study is to collect information on the required human capital in the Arctic zone of Russia, and to work out recommendations for the development of regional systems of vocational
education. The research methodology is based on the macroeconomic approach and surveys of employers in the main sectors of the economy and the social sphere.

The study is carried out at the following levels: municipalities in the Arctic regions; professional employment; areas of training. The survey involves the main large and medium-sized enterprises in the Arctic territories, as well as some small enterprises.

The preliminary analysis of this study has shown that the regional systems of vocational education provide specialists only for a half of the staffing needs. The figures vary in different sectors of the economy and social sphere. Proper indicators of demand for personnel will allow the authorities of the Arctic regions to choose an appropriate employment strategy: either to develop regional education systems, or a system of targeted training, or a system of rotational work [19].

According to the forecast data of the study [18], the demand for professionals is high in the following regions: the Yamalo-Nenets Autonomous Okrug (418,200 vacancies in 2021, 418,400 vacancies in 2024, 422,802 vacancies in 2035), Murmansk Oblast (353,000 vacancies in 2021, 345,498 vacancies in 2024, 346,397 vacancies in 2035) and Arkhangelsk region (301,793 vacancies in 2021, 292,627 vacancies in 2024, 289,314 vacancies in 2035). This situation is due to the need to implement important projects in both the industrial and social spheres.

Based on the target program for the development of the Arctic zone, regional projects are launched, such as the project «Workers for the Arctic», which is being implemented in the Yamal-Nenets Autonomous Okrug.

The project «Workers for the Arctic» involves workers’ retraining according to the requirements of the region. Key objectives of this project are the following:
- development of the educational and professional environment in conjunction with partner enterprises;
- training and retraining of personnel in conditions as close as possible to production facilities;
- development of professional competencies of students and staff in accordance with professional standards;
- targeted training through the employment of college graduates who have been trained in accordance with professional needs.

Despite the high demand for specialists with the secondary technical education, there is also the need for university graduates. To meet these needs, a program for the development of flagship universities was launched in Russia in 2016, which was aimed to change the trend towards the concentration of intellectual and financial resources in the capitals.

A flagship university in Russia unites several regional universities and supports the regional development of a constituent entity of the Russian Federation through the following measures:
1) assistance in solving urgent problems of the regional economy;
2) ensuring more highly qualified specialists to the local labor market;
3) implementation of various innovative and educational projects in cooperation with regional enterprises.

3.3. Specifics of the education system development in the Murmansk region

As already noted, the main function of the Murmansk region as a territorial entity is the transportation along the Northern Sea Route. This means that the main purpose of education system is training the specialists in this field. The Murmansk region also needs specialists in construction, extraction of minerals, ship maintenance, health care and trade. Among workers, the most demanded are concrete workers, bricklayers, assemblers, locksmiths of various specializations, electric and gas welders, specialists in electrical equipment.

An important factor in the development of the territory of the Arctic region is the compliance of the existing personnel reserve with the needs of the region. To implement the mechanism of targeted training in the vocational schools of the Murmansk region, it is necessary to establish communication with regional enterprises, identify their need for personnel in various fields and offer educational programs to applicants.
Taking into account the specifics of specialist training for the Arctic zones, the development of specialized departments oriented to practical disciplines in the flagship university should become effective. In addition to engineering fields such as construction, geology, electricity, other sectors of the economy, such as health care and education, should develop as well. The lack of doctors and teachers in the region is also a big problem, which suggests the need to organize targeted programs in these areas as well [20].

Thus, the flagship universities of the region should train specialists not only in the field of engineering but also in the field of humanities.

The main problem of the Murmansk region is the outflow of university students and graduates to other regions. The increase in state-funded university places in the region made it possible to attract more applicants. However, it did not keep them in their home region. The solution to this problem is an increase in target training in major educational programs. The number of target training university places in the areas strategically important for the regional economy should increase up to 80-100%; for other educational programs, it should comply with the needs of the region. Targeted training will allow talented students to undergo practical training at the enterprises where they will work in the future. University graduates will not only acquire theoretical knowledge, but also develop practical competences at the enterprises during their internship. This system is very beneficial for the graduates as they can get a job with a decent salary immediately after graduation, and the employer has a guarantee to get the specialist for the next 10 years, after having paid for their education and training.

The main reason why university graduates leave the region is the low level of wages, as well as difficulties in finding the desired job. To reduce graduates’ outflow to other regions, it is reasonable to reduce the number of state-funded places for the university programs where the number of graduates annually exceeds the needs of the region in these specialists and leave only the fee-based training. Thus, the economy of the region will reach the balance between the needs of the region and the required number of specialists.

Today, the Murmansk region has one flagship university - MASU (Murmansk Arctic State University). Using the MASU as an example, let us consider the fields of training vital for the Murmansk region to form its personnel reserve.

As noted on the main page of the MASU website, the university trains specialists in various professional fields: physics and mathematics, nature sciences and humanities, social sciences, education and pedagogy, culture and art, economics and management, and the service sector. The university provides about 50% of graduate training in the Murmansk region and is the main supplier of specialists for the system of general and secondary vocational education in the region.

Located on the territory of the Arctic, MASU is aimed at solving priority problems in the Murmansk region, and in the entire Arctic zone of Russia as well. In 2017, the university received the status of a flagship university [Murmansk Arctic State University - MASU (masu.edu.ru)].

Let us consider the main areas of MASU educational programs. Murmansk Arctic State University (MASU) offers the following areas of training:

1. Institute for Creative Industries and Entrepreneurship:
   - Economics;
   - Management;
   - Civil and Municipal service;
   - Business Informatics;
   - Service;
   - Design;
   - Tourism;
   - Teacher Training.
2. Institute of Psychology and Pedagogy:
   - Psychology;
   - Teacher Training (preschool, primary);
   - Psychological and Pedagogical Education (educational psychology);
Specialist (Correctional) Teacher Training (speech therapy).
3. Institute of Social Science and Humanities.
   Sociology;
   Jurisprudence;
   Journalism;
   Social work;
   Teacher Training;
   Linguistics;
   History.
4. Faculty of Mathematics and Nature Sciences.
   Applied mathematics and Computer science;
   Informatics and Computer technology;
   Biology;
   Pedagogical education (secondary, specialized disciplines in technical field and nature science);
   Physical education
   Ecology and environmental management.
5. Faculty of Physical Education and Life Safety.
   - Pedagogical education (Physical education);
   - General medicine.

Thus, social sphere prevails in the educational programs of MASU in Murmansk. It is important to train personnel for social institutions such as state committees, schools, kindergartens and social services.

However, given the specifics of the Arctic zone development, it is important to train specialists both for social and engineering spheres.

In the development strategy of the Arctic, engineering education is connected with maritime specificity. Therefore, the basis of its further development should be the effective use of the intellectual potential of marine scientific and educational centers.

MSTU (Murmansk State Technical University) implements a large list of programs for training engineering and technical personnel for undergraduate, specialist and graduate programs, as well as postgraduate studies. Taking into account the maritime orientation of the region's economy, as well as the lack of qualified engineering and technical personnel in the region, it seems necessary to create a flagship university on the basis of MSTU.

4. Research results

Based on the research conducted, the following conclusions can be drawn.

1. Training of specialists for the development of the Arctic territories should be targeted to the following fields: offshore oil and gas fields, navigation along the Northern Sea Route, the extraction and processing of aquatic biological resources and various types of strategic mineral raw materials, exportation. It is necessary to take into account the requirements of the modern economy concerning the qualifications and skills of specialists, due to the rapid growth of digital technologies.

2. There are practically no methods for assessing the quality of Arctic programs and methods to determine the specialist fields important for the Arctic regions. The exception is the monitoring program «Professionals for the Arctic» aimed at identifying the needs of regions, enterprises, institutions located in the Arctic zone. The identified indicators determine the strategy for personnel training in the region.

3. The analysis of educational programs implemented at the Murmansk Arctic State University shows that they focus on training specialists mainly in the social sphere, which allows us to conclude that the interests of employers in this area are satisfied to the greater extent than their demand for engineering and technical workers.

5. Areas for further research
In the future, it is necessary to develop a system of indicators for assessing the educational potential of the region in terms of the needs for the economy in the context of Industry 4.0.

The system of indicators should consist of at least two groups: 1) indicators reflecting the demand for specialists in various fields in terms of their education and competences; 2) indicators assessing the existing educational training programs in terms of educational level and qualification of the teaching staff.

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