


Article

# Transformation of the Personnel Training System for Oil and Gas Projects in the Russian Arctic

Ekaterina Samylovskaya <sup>1,\*</sup>, Regina-Elizaveta Kudryavtseva <sup>2</sup> , Dmitriy Medvedev <sup>3</sup>,  
Sergey Grinyaev <sup>3</sup> and Alfred Nordmann <sup>4</sup>

<sup>1</sup> Faculty of humanities and sciences, St.-Petersburg Mining University, 199106 St Petersburg, Russia

<sup>2</sup> Institute of History, St.-Petersburg State University, 199034 St Petersburg, Russia; aethel@yandex.ru

<sup>3</sup> Faculty of Integrated Security of the Fuel and Energy Complex, I.M. Gubkin Russian State University of Oil and Gas, 119991 Moscow, Russia; medvedev.d@gubkin.ru (D.M.); gsn@gubkin.pro (S.G.)

<sup>4</sup> Institute of Philosophy, Darmstadt Technical University, 64289 Darmstadt, Germany; nordmann@phil.tu-darmstadt.de

\* Correspondence: samylovskaya\_ea@pers.spmi.ru; Tel.: +7-921-367-37-91

Received: 19 October 2020; Accepted: 19 November 2020; Published: 22 November 2020



**Abstract:** This paper analyses the process of transforming specialist training systems for oil and gas projects in the Arctic, which has been taking place within the structure of education in Russia over the past decade. Using classical methods of analysis, synthesis, and classification, the authors studied the main global trends in training personnel for the Arctic and the manifestations of these trends in the system of training Russian specialists. To identify the qualitative characteristics of the educational system development, the authors applied the survey method and composed a list of leading universities in training personnel for the Russian Arctic, as well as the “Arctic professions of the future”. As a result of the study, the authors came to the conclusion that global trends in training “Arctic personnel” show the need to develop an interdisciplinary approach, to form basic knowledge in Natural Sciences, to study the socio-cultural specifics of the region, to develop new educational standards, to implement the concept of ‘Life Long Learning’, to widely introduce digital technologies and to internationalize education. In general, the Russian personnel training system is adapting to changing conditions, in particular, some progress has been made in the formation of “digital” competencies and skills to work in a developed IT infrastructure. The introduction of “digital fields” has led to an increase in the demand for IT specialists in the Arctic oil and gas sector. With the help of an expert survey, it was revealed that in the future, the most popular professions, along with “drillers” and transport specialists, will be IT specialists who ensure the “digital fields” functioning. The leading Russian universities that train specialists for modern oil and gas projects in the Arctic have been identified. It is noted that not all leading industry universities in Russia are participating in international educational projects and organizations. There is skepticism about the internationalization of education.

**Keywords:** oil and gas education; personnel training; Arctic education system; oil and gas projects; international cooperation

## 1. Introduction

In the vector of development of both the global and Russian economy, the Arctic is the most important region with a huge potential for the Russian oil and gas industry. According to experts, the Arctic zone of the Russian Federation has 7.3 billion tons of oil reserves and 55 trillion cubic meters of natural gas [1], so Russia is developing an extensive program to develop production capacities and realize the potential of the region [2].

Arctic resources are of considerable interest to non-regional powers. Thus, according to American analysts, the most aggressive policy is led by China, which, according to their estimates, is the largest investor in the Arctic countries [3,4]. Other major economies (Japan, Germany, France, Great Britain, etc.) are also actively expanding their participation in developing the region [5]. To a greater extent, they are suppliers of technologies that ensure the extraction of hydrocarbons on the Arctic shelf, as well as of competencies for working with these technologies.

Indeed, along with the intensification of economic activity in the Arctic region, the issue of improving the personnel training system has become more urgent. At present, there is a shortage of highly qualified specialists in the oil and gas industry in several specialties [6], ranging from workers to engineers and managers. This deficit will only increase as large-scale projects are implemented [6,7].

According to experts, at the moment, the most popular in the Arctic are highly qualified specialists in the sphere of extractive industry, in particular, specialists developing offshore oil and gas fields, ice-class marine shipbuilding, port, and shipping infrastructure, and others [4]. At the same time, successful implementation of oil and gas projects in the Arctic requires qualified specialists not only with higher, but also with professional education, as well as service and support personnel. In turn, until recently, the number of graduates with higher education was estimated at dozens of graduates per year. Today, the situation has somewhat changed: We can talk about several hundred graduates of various specialties. However, for example, in the near future, only for the development of the Barents Sea fields, there is a need for 15 thousand specialists with higher education, more than 50% of whom have a marine oil and gas education and a qualification of “mining engineer” [8,9].

Authors set goals to see the process of the transformation of the specialists training system for oil and gas projects in the Arctic occurring in the education structure in Russia over the last decade, for which it seems necessary to examine the major global trends in training for the Arctic; to trace the manifestations of these trends in the system of Russian specialists’ training; to identify the list of universities that are leaders in training for the Russian Arctic, preparing “Arctic jobs of the future”.

## 2. Materials and Methods

Despite a fairly large number of studies in the sphere of education for Arctic training [10–18], there is no consolidated international or Russian statistics on training specialists for the oil and gas industry in the Arctic at the moment. In this regard, this study focuses on studying the directions of transformation of the personnel training system.

Based on the analysis of modern foreign and Russian scientific literature on the problem of training personnel for work in the Arctic region, the main current global trends in the training of Arctic specialists were identified.

To identify qualitative characteristics for developing the educational system, in August 2020, an expert survey was conducted among the heads of educational and scientific organizations engaged in training Arctic personnel, as well as among representatives of mining enterprises and businesses in the oil and gas industry of the Russian Federation. The expert survey was sent to 42 respondents from 23 institutions. As a result, 30 experts participated in the survey: Unfortunately, 12 respondents could not participate (Table 1).

Using the methods of systematization and classification, we analyzed the scientific and educational programs for training personnel for the Arctic suggested by those universities that were named by experts to be the leading centers for training Arctic specialists. Based on the method of comparative analysis, the authors analyzed the level of compliance of scientific and educational programs at these universities with the selected global trends.

**Table 1.** Expert group description <sup>1</sup>.

The Institution Activity Specifics	Name of the Institution	Number of Participating Respondents	Number of those Who Refused
Scientific (directors of institutes/centers, heads of departments)	Kola Science Centre RAS	3	1
	E.M. Primakov National Research Institute of World Economy and International Relations RAS	1	-
	European Institute RAS	1	-
	Arctic and Antarctic Research Institute	1	-
	Institute of oil and gas RAS	1	-
	Karelia Science Centre RAS	-	1
	Komi Scientific Centre at the Ural branch of the Russian Academy of Sciences	-	1
	“Arctic” Research Centre of the Far Eastern branch RAS	-	1
Universities (deans and heads of departments of specialties)	Murmansk State Technical University	2	-
	Northern (Arctic) Federal University	2	-
	Gubkin Russian State University of oil and gas (2 respondents)	2	-
	Saint Petersburg Mining University	2	-
	Murmansk Arctic State University	2	1
	Petrozavodsk State University	-	1
	North-Eastern Federal University named after M. K. Ammosov	-	1
	Far-Eastern Federal University	-	1
Companies that specialize in oil and gas production (department heads and shift managers)	‘Gazprom Neft’ PJSC	3	-
	‘Gazprom Neft shelf’ LLC	2	-
	‘Rosneft NK’ PJSC	2	-
	‘NOVATEK’ PJSC	-	2
Institutions involved in the development and implementation of oil and gas projects (heads of departments)	‘SPG’ group of companies	3	-
	‘Iceberg’ Central Design Bureau	-	2
Expert center (head of the expert center and experts)	Expert center of the Arctic development project office	3	-

<sup>1</sup> Compiled by the authors.

### 3. Results of the Expert Survey

According to the results of the survey, the experts identified themselves as specialists working in the following areas of professional activity:

- Oil and gas complex—27%;
- Science—27%;
- Education—19%;
- Business (Economics and consulting)—27%.

It is noteworthy that 100% of the respondents who took part in the survey agree with the statement that there is currently a shortage of qualified personnel for implementing Russian oil and gas projects in the Arctic.

The respondents were asked to assess the qualitative characteristics of the development of the educational system for training personnel for oil and gas projects in the Arctic.

The absolute majority of respondents note that today, in the process of training “Arctic personnel”, the importance of using digital technologies to solve professional problems is growing. They all emphasize the need to develop international cooperation in the sphere of training “Arctic personnel” and a practice-oriented approach to training specialists for Arctic projects. 13% of respondents in the sphere of economics/consulting (7% of respondents) and science (6% of respondents) question the statement that in the process of training modern specialists, the importance of mastering basic knowledge in meteorology, physics, biology, and ecology is growing, regardless of the direction of training. 28% of respondents also related to economics/consulting (20%) and education (8%) questioned the statement that the participation of universities from non-Arctic countries in training specialists for the Arctic contributes to increasing the effectiveness of Arctic projects (Table 2).

Thus, all the surveyed representatives of the oil and gas industry and business, as well as the vast majority of representatives of science and education, note that all the above quality characteristics are necessary for training qualified modern specialists for oil and gas projects in the Arctic, thus confirming the need to implement an interdisciplinary, integrated and international approach in the educational process. In turn, it is noteworthy that representatives of business (economics and consulting) underestimate the role of interdisciplinary knowledge (knowledge of meteorology, physics, biology, ecology) and an international approach in training specialists. We dare to assume that this is due to the professional specifics of respondents who are focused on developing narrowly focused competencies and specific skills.

**Table 2.** Qualitative characteristics of the development of the educational system for training personnel for oil and gas projects in the Arctic (30 experts interviewed) <sup>1</sup>.

Qualitative Characteristics	Respondents' Answers
The importance of using digital technologies to solve professional tasks is growing	<b>Fully agree—73%:</b> oil and gas complex—27% science—9% education—10% business—27%
	<b>Quite agree—27%:</b> oil and gas complex—0% science—18% education—9% business—0%
There is a growing need to develop international cooperation in the sphere of training “Arctic personnel”	<b>Fully agree—47%:</b> oil and gas complex—12% science—11% education—12% business—12%
	<b>Quite agree—53%:</b> oil and gas complex—15% science—16% education—7% business—15%
The importance of a practice-oriented approach to training specialists for Arctic projects is growing	<b>Fully agree—60%:</b> oil and gas complex—18% science—12% education—14% business—16%
	<b>Quite agree—40%:</b> oil and gas complex—9% science—15% education—5% business—11%

Table 2. Cont.

Qualitative Characteristics	Respondents' Answers
There is a growing importance of mastering basic knowledge in meteorology, physics, biology, and ecology, regardless of the sphere of study	<b>Fully agree—60%:</b> oil and gas complex—24% science—24% education—12% business—0%
	<b>Quite agree—27%:</b> oil and gas complex—3% science—3% education—4% business—17%
	<b>Rather disagree—13%:</b> oil and gas complex—0% science—0% education—3% business—10%
Participation of universities from non-Arctic countries in training specialists for the Arctic contributes to increasing the effectiveness of Arctic projects	<b>Quite agree—73%:</b> oil and gas complex—27% science—27% education—16% business—3%
	<b>Rather disagree—27%:</b> oil and gas complex—0% science—0% education—3% business—24%

<sup>1</sup> Composed by the authors basing on the experts' interview analyses.

As a result of the survey, the top five Russian universities that train qualified specialists in the oil and gas sector that meet modern requirements for developing the oil and gas industry include: I. M. Gubkin Russian State University of oil and gas (28.2% of the total number of responses), Saint Petersburg Mining University (25.6%), Saint Petersburg Polytechnic University (12.8%), Northern (Arctic) Federal University (10.2%), Murmansk State Technical University and Ufa State Oil Technical University (5.1% each) (Table 3).

**Table 3.** Russian universities that train qualified specialists in the oil and gas sector that meet modern requirements for developing the oil and gas industry in the Arctic (30 experts interviewed) <sup>1</sup>.

Higher Educational Institution	Number of Responses (%)
I. M. Gubkin Russian State University of oil and gas	28.2
Saint Petersburg Mining University	25.6
Saint Petersburg Polytechnic University	12.8
Northern (Arctic) Federal University named after M. V. Lomonosov	10.2
Murmansk State Technical University	5.1
Ufa State Oil Technical University	5.1
Ukhta State Technical University	2.6
Northeast Federal University named after M. K. Ammosov	2.6
National Research Institute of Technology "MISiS"	2.6
Tomsk Polytechnic University	2.6
Saint Petersburg State University of Economics	2.6

<sup>1</sup> Composed by the authors basing on the experts' interview analyses.

It is worth noting that representatives of extractive enterprises and businesses in the oil and gas industry (i.e., representatives of potential employers interested in university graduates), in addition to the obvious leading universities, also mentioned the following universities: Northern (Arctic) Federal University, Ufa State Oil Technical University, Murmansk State Technical University, Ukhta State Technical University, Tomsk Polytechnic University and North-Eastern Federal University named after M. K. Ammosov.

To analyze the objectivity of the university assessment, respondents were asked to answer the question: “Which university did you graduate from?”. The survey showed that four respondents (13%) indicated their “Alma mater” among the leading universities that provide training for Arctic oil and gas projects. Therefore, the psychological moment of commitment to “their own” university could play a role in the assessment, and this percentage can be considered a probable error. The high percentage of probable error can be explained by several reasons: First, the specifics of the expert survey, when a small number of professional participants take part in it; second, the specifics of the sphere the survey is aimed at.

The survey identified the most popular professions for Arctic oil and gas projects in the next 5–10 years. The experts named 21 professions, among which the most frequently mentioned were:

- drilling engineers, including specialists in offshore drilling (14.3% of the total number of responses);
- specialists in the sphere of marine transport—pilots, captains, security specialists in marine transport (14.3%);
- database specialists—programmers (11.9%);
- mining engineers (9.5%);
- geologists (7.1%);
- environmentalists (7.1%);
- construction workers (7.1%).

The data obtained on the professions that will be in demand in the Arctic in the future are quite correlated with the list of universities that, according to experts, train qualified specialists in the oil and gas sector that meet modern requirements for developing the oil and gas industry in the region: The leading universities mentioned above train personnel in these specialties.

Given the complexity of living and working conditions in the Arctic, the absolute majority of experts surveyed (87%) consider it necessary to conduct special psychophysical training for future Arctic specialists.

#### 4. Discussion: New Trends in Training Specialists for the Arctic

Modern foreign and Russian experts in the field of education, analyzing the main global trends in the training of “Arctic” personnel, note that the transformation of the training system is influenced by the following global factors:

- increased inter-state competition that covers not only traditional markets for goods and capital, but also human potential, and consequently, the increasing role of human capital as the main factor of socio-economic development [6,19];
- digitalization and technological complexity of projects in the Arctic, the intellectualization of activities, resulting in the formation of qualitatively new qualification requirements and educational standards [6,7,19];
- internationalization of the educational process, increasing the importance of international network forms of education [6,19].

It is noteworthy that the presented trends overlap with the qualitative characteristics identified in the expert survey that are necessary for developing the educational system for training personnel for oil and gas projects in the Russian Arctic. Moreover, the characteristics allow us to more accurately reveal the manifestations of these trends in the Russian educational system.

#### 4.1. Increased Competition, Development of New Standards

Analysis of the survey results and modern pedagogical and professional literature [6,19] showed that “Arctic cadres” should have interdisciplinary knowledge. So, regardless of the chosen direction of future professional activity, students should get a basic knowledge of meteorology, geography, geo-ecology, physics, chemistry, and biology to form a more complete understanding of the region’s features. This is important because when solving professional tasks in Northern latitudes, it is necessary to understand the nature of natural and climatic factors and the associated risks and dangers to human life and the security of industrial facilities [20]. Environmental and socio-economic spheres of life are the most important areas of human activity in the Arctic [21], so it is no accident that the method of modeling environmental and economic risks in the region is increasingly used in the implementation of Arctic projects [22], in particular in the oil and gas industry [23,24].

In addition, extreme weather conditions, lack of convenient logistics, and a complex communication situation lead to the need to solve non-standard tasks in the course of performing professional activities. A modern specialist in the oil and gas industry should start implementing projects in a comprehensive manner, taking into account the level of scientific and technological progress in the industry, the specifics of the socio-economic life of the Arctic region, and should be psychologically ready to live and work in extreme Arctic conditions [25–27].

Accordingly, the specialist should be able to flexibly and creatively approach the solution of complex situations that do not fit into the “standard templates”.

In this regard, the competencies of “problem solving skills” are of particular importance, and not just “knowing the classic ways to solve them”. The focus on obtaining skills and abilities is emphasized by researchers who analyze the staff training system for the Arctic [12,20].

It should be emphasized that it is important to increase the adaptability of the national training system to ensure its sustainability in the face of rapid changes in the socio-economic sphere. Education is the most important factor in the sustainable development of the Arctic territories. When considering the features of the education system in the Arctic, several researchers emphasize the implementation of the concept of Arctic sustainable education (ASE) [28,29], which is provided in several domains, such as: Community, cooperation, problem-solving skills, and opportunities for active, local, and cultural training in sustainable development [28,29] through an inclusive approach that takes into account the cultural, linguistic, and other characteristics of the peoples living in the Arctic.

A relevant area of work is the preparation of new educational standards for training specialists for the Arctic. Work in this direction began in 2018–2019, when the “Arctic national scientific-educational consortium” Association conducted preliminary work to explore the possibilities of developing these standards. Now it regularly provides them to the Ministry of education, presents them at the meetings of the Council for the Arctic and Antarctic under the Federation Council of the Russian Federation, at the meetings of the Expert Council under the State Duma for legislative support of the Far North regions development, and so on [20].

So, in Russia today, programs are being implemented to train engineers for technological support of the oil and gas industry in the Arctic, geological exploration in the Northern latitudes. A special standard of educational programs is being developed for doctors who will work in the Arctic.

To date, 42 educational organizations of higher education, 12 of higher professional education, and 72 of secondary professional education operate in the Arctic zone of the Russian Federation [9]. At the same time, specialists with higher education for the Arctic are also trained in “non—Arctic” subjects of the Russian Federation—a total of 17 subjects of the Russian Federation (including six subjects of the Russian Arctic) [20]. In this regard, it becomes necessary to concord the network interaction of universities that train specialists for the Arctic. To this end, in 2016, the Ministry of education and science of the Russian Federation (today the Ministry of higher education and science of the Russian Federation) created “National Arctic scientific and educational consortium” Association.

The consortium is a voluntary association of universities, scientific organizations, and enterprises that implement training programs and scientific research of the region for the sustainable development

of the Russian Arctic territories. In fact, the National Arctic scientific and educational consortium acts as the national counterpart of UArctic. As of September 2020, the Association includes 33 organizations, including 23 higher education institutions, of which only nine are located directly in the Russian Arctic (Table 4) [30]. Thus, it is clear that the Russian scientific and educational environment has clearly formed an opinion that network interaction is necessary for implementing Arctic projects.

**Table 4.** Higher educational institutions, the Association members <sup>1</sup>.

Universities Located in the Arctic Zone of the Russian Federation	Universities out of the Arctic Zone of the Russian Federation
1. Northern (Arctic) Federal University named after M. V. Lomonosov 2. North-Eastern Federal University named after M. K. Ammosov 3. Murmansk Arctic State University 4. Murmansk State Technical University 5. Petrozavodsk State University 6. Northern State Medical University 7. Syktyvkar State University named after Pitirim Sorokin 8. Ukhta State Technical University 9. Ugra State University	1. National Research Tomsk State University 2. Siberian Federal University 3. Far Eastern Federal University 4. Tyumen State University 5. Ural Federal University named after the first President of Russia B. N. Yeltsin 6. Admiral Makarov State University of sea and river fleet 7. Novosibirsk State Technical University 8. Russian State Hydrometeorological University 9. Ryazan State University named after S. A. Yesenin 10. Saint Petersburg State University 11. Siberian Automobile and Road University 12. Tyumen Industrial University 13. Ufa State Aviation Technical University 14. Ufa State Oil Technical University

<sup>1</sup> Composed by the authors basing on National Arctic scientific and educational consortium site data analyses [30].

It is noteworthy that the Association does not include two leading universities that train specialists in the production of hydrocarbons in the Arctic—Gubkin Russian State University of Oil and Gas (Scientific Research Institute) and Saint Petersburg Mining University. In turn, the expert survey showed that these two universities are among the leaders in training qualified specialists in the oil and gas sector that meet modern requirements for developing the oil and gas industry in the Arctic. Along with them, the Association does not include the third leader of the expert survey—Saint Petersburg Polytechnic University.

Therefore, we can say that these universities somewhat ignore the domestic project of scientific and educational collaboration in the sphere of Arctic projects. This position is probably related to the broad scientific and educational ties of these universities directly with oil and gas companies and enterprises operating in the Arctic, as well as to the traditionally broad and direct ties with the leading scientific, educational, and industrial centers of the country. Saint Petersburg Mining University and Saint Petersburg Polytechnic University are the largest technical universities with a rich history: They have been creating technical, scientific-technical, and scientific-educational personnel for the entire country for decades and even centuries, thus creating entire scientific schools. In addition, these universities, despite many years of experience in training specialists for the oil and gas industry (including in the complicated conditions of the Arctic), relatively recently announced “their Arctic specialization”. So, in 2019, the Centre of competence in the field of engineering and technology of field development in the Arctic conditions (CC “Arctic”) was established at Saint Petersburg Mining University, which has already received a patent for invention No. 2704451 “Methods for constructing an offshore drilling platform on the shallow shelf of the Arctic seas” [31]. At the beginning of 2020, Saint Petersburg Mining University decided to start training specialists in the specialty “liquefied natural gas”, in particular for ‘Yamal SPG’ project.



In 2019, the Centre for innovative Arctic technologies was established at Saint Petersburg Polytechnic University. At the same time, since 2015, the university has had a scientific and educational center “Gazpromneft-Polytech”, which is engaged in scientific and practical developments and training of specialists in the sphere of developing mathematical models of oil and gas production processes by solving real problems of industry, i.e., directly in digital technologies that are so necessary for modern conditions of the oil and gas industry in the Arctic [32]. Thus, a scientific and educational “block” in the sphere of oil and gas projects in the Arctic is potentially cooperated and created in St. Petersburg between these two universities, which can create strong competition in the industry both in Russia and internationally.

As noted above, the expert survey showed that the leading university that traditionally trains specialists for oil and gas projects in the Arctic is I.M. Gubkin Russian State University of oil and gas. The university is a participant in major oil and gas projects in the Arctic, and also trains specialists for Arctic projects together with major oil and gas companies. So, in 2018, the university and ‘NOVATEK’ launched a master’s degree program in the sphere of ‘Cryogenic technologies and equipment for the gas industry’ to train specialists in the LNG industry. Students enrolled in this program have an internship at the company’s enterprises with the possibility of further employment.

In addition, the university trains masters in the sphere of “development and operation of offshore oil and gas fields”. The research and education center “Underwater mining complexes” was created together with ‘Gazprom’ PJSC. To improve the skills, additional educational programs are being implemented, in particular, “Introduction to subsea hydrocarbon production systems” (initiated by ‘Gazprom’ PJSC).

In addition to Gubkin Russian State University, several universities provide personnel for implementing Arctic oil and gas megaprojects: Lomonosov Northern (Arctic) Federal University, Murmansk Technical State University, Novosibirsk State Technical University, Tyumen Industrial Institute, Siberian State University of Geosystems and Technologies, Marine State University named after Admiral G. I. Nevelsky, Far Eastern Federal University, Ukhta State Technical University, North-Eastern Federal University named after M. K. Ammosov, Tomsk Polytechnic University, Ufa State Oil Technical University, etc.

It is obvious that the title of the center for Arctic research and the main Arctic university, including in oil and gas projects, is claimed by the Northern (Arctic) Federal University, based on which NANOK was formed. The University trains bachelors in the profile “Operation and maintenance of oil and gas facilities of the Arctic shelf (full-time training) and masters in the program “Development of oil and gas fields of the Arctic shelf”. Since 2011, the University has an Innovation and Technology Centre for Arctic oil and gas laboratory research. And in March 2019 it was decided to create an international center for integrated research of the shelf and coastal zone of the Arctic seas of Russia. In addition, since 2012, the university has been implementing the unique for Russia educational program “Arctic Floating University”, which is an annual interdisciplinary scientific and educational marine expedition on board the “Professor Molchanov” research vessel. The program is focused on studying and monitoring the ecology, climate, and bioresources of the Arctic region, as well as studying the humanitarian side (the history of Arctic development, the Arctic in the system of international relations, and the legal space of the Arctic) [33].

Murmansk State University is a leading university that trains specialists in the sphere of Arctic sea transport and shipping, as well as oil and gas projects in the Arctic. The university annually recruits students in the profile of training “Operation and maintenance of oil and gas facilities of the Arctic shelf”, as well as training specialists in the sphere of ice shipbuilding, navigation, construction of port and shipping infrastructure, human-made security [34].

According to experts, Tomsk Polytechnic University trains specialists in the sphere of oil and gas, and is also one of the leaders in comprehensive research of the Arctic shelf. The University has created an international scientific and educational laboratory for the study of carbon in the Arctic seas, which performs research work in the direction of “Siberian Arctic shelf as a source of greenhouse gases of

planetary significance: Quantitative assessment of flows and identification of possible environmental and climate consequences” [35]. In addition, it should be noted that Tomsk State University implements the Master’s program “Study of Siberia and the Arctic”, which is aimed at training specialists in the field of ecology and environmental management in Siberia and the Arctic. Such specialists would know modern methods of environmental research and methodology for conducting scientific research to solve applied problems. In this regard, we can say that Tomsk is forming one of Russia’s leading scientific and educational centers for training personnel for Arctic projects [36].

Based on a comparative analysis of the number of educational programs for training Arctic personnel, the following world leaders in training specialists for oil and gas projects can be identified: UiT The Arctic University of Norway, University of Copenhagen, University of Lapland, The Norwegian Institute of Bioeconomy Research (research Institute), University of Iceland, Luleå University of Technology. At the same time, we can note a significant increase in the number of programs in the Arctic direction, for example, “Arctic engineering”, in all leading universities in Denmark, Iceland, Canada, Norway, the USA, Finland, and Sweden. At the same time, university programs are interdisciplinary in nature, for example: McGill University implements the “Arctic Field Studies Semester” training program [37], the University of Northern British Columbia implements the “Northern Studies” program [38], the University of Alaska-Fairbanks—“Arctic and Northern Studies” [39]; since 2019, Colorado School of Mines has opened several Arctic-themed programs.

It can be noted that the training system in the named countries, as well as in Russia, pays less attention to the Humanities, focusing more on the training of engineers, geologists, biologists, logisticians. At the same time, major Arctic universities, such as the University of Northern British Columbia, enroll students for arts, social sciences, and health sciences [40].

In addition, since years 2013–2014, training programs in near-Arctic countries have been actively developed. In particular, the UK began the first steps in training personnel for the Arctic in 2013 as part of the first British Arctic policy framework, “Adapting to Change” [41]. The UK has also established the UK government’s Science and Innovation Network (SIN), which includes representatives of the Arctic powers and serves as a necessary tool for research collaborations. SIN’s activities are aimed at providing training and student exchanges, as well as creating and building scientific potential [42]. Since 2018, the amount of financial support for the Scientific network from the UK government has increased significantly, which indicates that the country is interested in Arctic research.

A comparative analysis of leading Russian universities (according to experts) and world leaders in training personnel for the oil and gas industry according to the QS rating showed that Russian universities are significantly behind Western leaders. Moreover, the failure of specialized universities for the oil and gas industry is revealed (including Gubkin Russian State University of oil and gas and Saint Petersburg Mining University) both in the world ranking and in subject ratings. The situation is somewhat better with three universities (Peter the Great Saint Petersburg Polytechnic University, Tomsk Polytechnic University, “MISiS” National Research Technological University), but their achievements are lost against the background of obvious leaders—the University of Northern British Columbia, McGill University and the University of Copenhagen. The exceptions are several European universities that are not included in any rating at all: The University of Lapland and the University of Iceland. Table 5. [43] There is low competitiveness of Russian universities at the world level, and the nature of their training is catching up.



Table 5. Cont.

Universities	QS WUR	EECA UR	QS WUR by Subject					Environmental Studies
			Engineering— Mineral and Mining	Engineering— Petroleum	Engineering and Technology	Computer Science and Information Systems	Earth and Marine Science	
Universities—world leaders (in order of appearance in the paper text)								
Luleå University of Technology	-	-	-	-	-	-	-	301–350
McGill University	31	-	6	-	47	51–100	27	29
University of Northern British Columbia	45	-	9	-	-	-	-	-
University of Alaska-Fairbanks	-	-	-	-	-	-	151–200	351–400
Colorado School of Mines	-	-	1	18	227	-	36	201–250

<sup>1</sup> The authors consider the subject areas (QS), which development is in demand in the implementation of oil and gas projects in the Arctic. <sup>2</sup> Composed by the authors basing on the QS University Rankings site analyses [43].

#### 4.2. Life Long Learning

One of the ways to ensure “sustainable education” is to implement the concept of ‘Life Long Learning’ [29]. Speaking about the training of specialists for the oil and gas industry in Russia, first of all, we can talk about advanced training and retraining programs implemented in specialized universities, which the authors wrote about above.

To train highly qualified specialists, major Russian oil and gas companies implement continuing education programs in the “school-university-enterprise” system, which form an external personnel reserve. An example is the corporate program of ‘Rosneft’ Corporation. In 26 regions of the country, 117 ‘Rosneft’ classes have been created (for students in grades 10 and 11) in 62 schools. In the process of training personnel with higher education, the company cooperates based on long-term agreements with 60 Russian and foreign universities. The company also works with students of partner universities, organizes the recruitment and selection of the best graduates to work at ‘Rosneft’ enterprises [44].

As an example of implementing this ‘Life Long Learning’ concept in the oil and gas industry through cooperation between the University and an oil company, we note the professional retraining program “Procurement and logistics of offshore projects in the oil and gas industry” of the Murmansk State Technical University and ‘Gazprom Neft’. This program is practice-oriented for training specialists in the sphere of economics and management for the oil and gas industry: It is aimed at studying the specifics of working on offshore and Arctic fields, as well as building an effective supply chain for facilities located there and managing it [45]. A training platform is being organized on the basis of ‘Gazprom Neft’ PJSC, as well as practical training in the ‘Gazprom Neft’ group of companies [46].

Multinational oil and gas corporations are engaged in the process of training their own employees in new technologies and approaches in the industry. So, on the territory of the Arctic zone of the Russian Federation, there are training and multifunctional centers of large corporations, such as ‘Gazprom’, ‘Rosneft’, ‘LUKOIL’ and others (about 56 centers) [8]. In addition, these companies are implementing additional educational programs for university graduates to attract talented young professionals. For example, the practice-oriented additional educational program “Gazprom Neft” “At the start!”, in which university graduates of 2019 or 2020 have the opportunity to implement their own projects in the development of “smart” energy, complete an internship at ‘Gazprom Neft’ enterprises, and then receive an invitation to a permanent job in the company [47].

#### 4.3. Digitalization

In the last decade, the most important factor in changing the training process is the intensive digitalization of all areas of socio-economic development without exception.

Until the second half of the 2010s, the Russian oil and gas sector considerably lagged behind in the sphere of digitalization compared to other industries, as well as from world leaders—the USA, Norway, France, etc. [48] A qualitative leap occurred with the development of difficult hydrocarbons in the Arctic which demands a change in methods of exploration and production resources—using digital technology. So, in 2015, the RAS Institute of oil and gas problems and I. M. Gubkin Russian State University of Oil and Gas initiated the development of a program for digitalization and intellectualization of the Russian oil and gas industry, which was reflected in the departmental project “Digital energy” as part of implementing the national program “Digital economy of the Russian Federation”, adopted in 2017 [49].

Digitalization is designed to reduce the costs associated with hydrocarbon exploration and production in extremely difficult regional conditions (climatic, geological, demographic, and technical), as well as with the development and production of special equipment [50]. It helps to reduce the environmental consequences of human presence in the region—in the future, to minimize as much as possible, and ideally to reduce its presence to zero, thereby ensuring technological and environmental safety by reducing the probability of deviations and transferring competencies to the level of robotic systems [51]. It is worth noting that the extreme conditions of the Arctic are an objective factor in accelerating the introduction of remote-control technologies and intelligent automation of production.

The use of digital technologies in the fuel and energy complex, which is the basis for the economic development of the Arctic region, provides intelligent automation of processes at facilities. Major oil and gas companies already use BigData (including BigGeoData), IoT, industrial Internet, blockchain, and artificial intelligence technologies [49,50] to solve applied problems and plan to expand this practice in the Arctic. Thus, 'Gazprom Neft' is ahead of 'Rosneft' in terms of innovation rates in its oil and gas programs, which indicates that 'Gazprom Neft' is more attentive to the digital transformation of implementing the large-scale RF governmental program "Digital economy of the Russian Federation": For example, the programs "Project management center", "Cognitive geologist", "Digital drilling" [52].

The use of digital technologies in the fuel and energy complex, in particular, the development of "digital deposits", provides intelligent automation of processes at facilities. According to experts, "digitalization of wells", "digital drilling", and modeling of technological processes [53,54] can reduce the cost of field operation by approximately 15–20% [51,55]. In the context of lower energy prices for Arctic hydrocarbon deposits, this factor plays a special role.

It is worth noting that digital technologies in the energy sector are used not only within the upstream sector. Static and dynamic analysis of processes allows you to adjust and reorganize related business processes, and make management decisions quickly.

These trends occur against the background of a perceived shortage of professional personnel, which causes the need to algorithmize the competencies of professional knowledge and skills and retrain specialists in new digital specialties [50]. In this regard, a special role in the future 5–10 years will be played by the skills and abilities to remotely control the technological processes, working with databases, and ensuring their security.

As you know, these technologies are end-to-end, which, on the one hand, opens up additional opportunities, and on the other, creates new risks and threats. In this regard, an important condition for effective training of a specialist is inevitably associated with obtaining a basic knowledge of Internet technologies and the complex nature of modern threats. All leading universities that train personnel for the Arctic have conducted training in the digital technologies, and often have separate divisions specializing in this area. For example, the aforementioned scientific-educational center "Gazpromneft-Polytech" (St.-Petersburg Polytechnic University), Teaching and research center of digital technologies (Saint-Petersburg Mining University), Department of integrated security TEK Russian State University of oil and gas (national research institute) named after I. M. Gubkin (which is the basis of the first in Russia laboratory study of detection of computer attacks with the example of virtual enterprises of oil and gas complex), and so on. [56,57].

The high knowledge intensity of Arctic projects underscores the need for in-depth monitoring of the technology market and the development of promising technical solutions and consideration when drawing up professional standards.

#### 4.4. Internationalization of Arctic Education

Although the observed increase in international competition in the development and implementation of technological innovations in the Arctic, international cooperation in the sphere of Arctic education continues to develop steadily.

International exchange of training experience, the convergence of standards, and formation of international educational standards allows us to bridge the gap between educational processes, innovative solutions, and know-how applied in different parts of the Arctic.

A striking example of the internationalization of Arctic education is the international network project UArctic, created in 2001 on the initiative of the Arctic Council to create a unified scientific and educational network of organizations working in the spheres of higher education and research in the Arctic region (organizations located in the Arctic and implementing scientific and educational projects for the Arctic). If at the time of the project creation it included no more than 30 participants, then in 2020, it already had 153 participants from 11 countries. It is noteworthy that the majority of participants are from Russia, 27%—41 participants [58] (Figure 1). However, neither Gubkin Russian State University

of Oil and Gas, nor Saint Petersburg Mining University, nor Saint Petersburg Polytechnic University are members of UArctic.

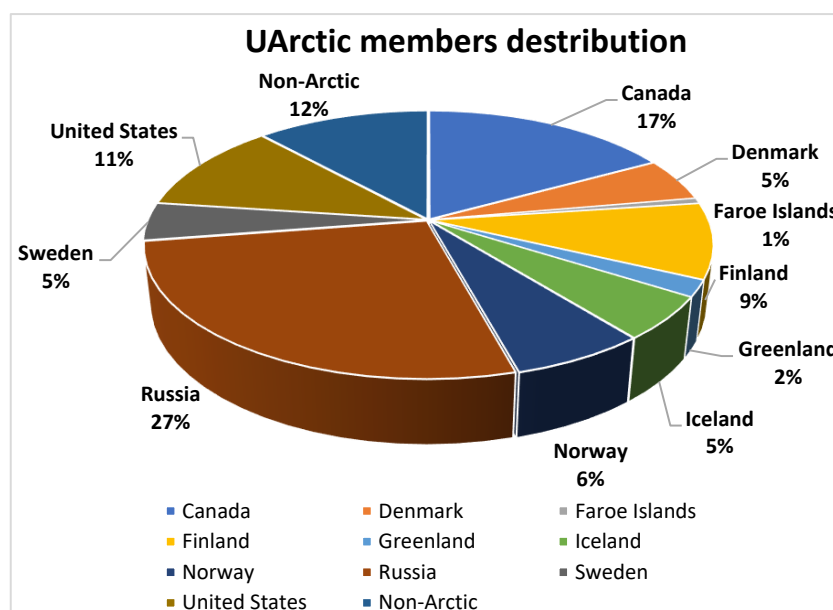


Figure 1. UArctic members distribution [58].

In turn, the analysis of the number of proposed scientific and educational programs showed that, despite their large number, Russian project participants are not inferior to their western counterparts in the number of implemented programs for training specialists.

Thus, within the framework of the project, out of 18 bachelor’s degree programs (43 courses in total), only two programs and six courses are implemented by Russian organizations. While Norway, which has only 6% of the total number of participants in the UArctic Program, implements eleven undergraduate programs and six courses. Out of 81 master’s degree programs, only eight are implemented by participants from Russia. PhD programs are not presented by participants Russian at all, but participants Russian offer seven PhD courses (Table 6) [58].

Table 6. The number of programs and courses implemented under the UArctic project <sup>1</sup>.

Country	Number of Bachelor’s Programs/Courses	%	Country	Number of Master’s Programs/Courses	%	Country	Number of PhD Programs/Courses	%
Canada	0/1	-/2.3%	Canada	1/1	1%/1%	Canada	0/1	-/2.9%
Denmark	0		Denmark	17/3	21%/3%	Denmark	0	
Faroe Islands	0		Faroe Islands	0	0	Faroe Islands	0	
Finland	3/7	17%/16%	Finland	17/5	21%/6%	Finland	1/4	50%/12%
Greenland	0		Greenland	0		Greenland	0	
Iceland	0/6	-/13.9%	Iceland	4/37	5%/43%	Iceland	0/3	-/8.8%
Norway	11/6	61%/14%	Norway	27/3	33%/3%	Norway	0/3	-/8.8%
Russia	2/6	11%/14%	Russia	8/6	10%/7%	Russia	0/7	-/21%
Sweden	0/7	-/16%	Sweden	1/20	1%/23%	Sweden	0/1	-/2.9%
United States	2/7	11%/16%	United States	5/8	6%/9%	United States	1/8	50%/24%
Non-Arctic	0/2	-/4.6%	Non-Arctic	1/2	1%/2%	Non-Arctic	0/6	-/18%

<sup>1</sup> Composed by the authors basing on the UArctic site data analyses [58].

Programs and courses are implemented in various forms—international summer and winter schools, training programs. In total, 24 different training programs presented by Russian universities are being implemented. Attention is drawn to the fact that the Summer school of the Saint Petersburg Mining University is marked among the programs, while the university is not an official member of UArctic (Table 7).

**Table 7.** Training programs implemented by Russian universities within the framework of UArctic <sup>1</sup>.

No.	University	Educational Program
1	Far Eastern Federal University	School of Engineering “Ice Mechanics” Annual International Winter Course
2	Northern (Arctic) Federal University	<ul style="list-style-type: none"> <li>• Arctic Floating University</li> <li>• Peoples and Culture of the Circumpolar World</li> <li>• International PhD School “Russia in the Arctic Dialogue: Local and Global Context”</li> <li>• Arctic Winter School 2020</li> <li>• Arctic Summer School 2020</li> <li>• Summer School in Arctic Law</li> <li>• Diverse Arctic: Local Challenges—Global Changes</li> <li>• Russian Studies Programme</li> <li>• Environmental Risks Management in the Arctic (ERMA)</li> <li>• European Studies: Arctic Focus</li> <li>• History and Culture of the Circumpolar World: comparative research</li> <li>• EU and Russia in the Arctic: History of Cultural and Political Interaction</li> <li>• Arctic Law</li> </ul>
3	Saint-Petersburg Mining University	Summer schools at Saint-Petersburg Mining University
4	Arctic State Agrotechnological University	<ul style="list-style-type: none"> <li>• Apiculture and bee-biology</li> <li>• Natural horse husbandry in Arctic and northern regions of Yakutia</li> <li>• Northern reindeer husbandry</li> <li>• Business planning and project management</li> <li>• Pathology of productive animals</li> <li>• Arctic food security: Traditional nutrition and Arctic food</li> </ul>
5	Siberian Federal University	Biological Engineering
6	St. Petersburg University	Geology
7	Industrial University of Tyumen	Logistics and Supply Chain Management

<sup>1</sup> Composed by the authors basing on the UArctic site data analyses [58].

It is noteworthy that among all the training programs and courses offered by UArctic, the summer school of Saint Petersburg State University is the only program focused on developing the oil and gas complex in the Arctic: With a focus on technical and earth sciences. However, the project does not include Gubkin University Summer School “Development of offshore fields”, which is important for training personnel for the Arctic. In turn, the vast majority of programs implemented by UArctic relate to the field of interdisciplinary research that combines social and earth sciences and covers such topics as land, environment, peoples, cultures, and politics in the Arctic and subarctic states—Circumpolar Studies, as well as economic problems of the region. (An exception is ‘FEFU School of Engineering, ‘Ice Mechanics’ Annual International Winter courses, and the ‘Geology’ program implemented by Saint Petersburg University).

Thus, the analysis of UArctic training programs and courses showed that despite a significant number of participating Russian universities (including universities that train personnel for the oil and



gas industry), in the vast majority of cases, their role is limited to providing students with courses, rather than implementing their own training programs. This seems to indicate that Arctic education in Russia is catching up and that the education system is lagging behind the general trends in training Arctic personnel: Russian universities are learning, not teaching. There is an interdisciplinary approach to UArctic programs with an emphasis on earth and environmental sciences, socio-humanitarian and economic courses.

The obvious flagship of this educational movement is the Northern (Arctic) University named after M. V. Lomonosov, which implements the majority of the training program and is the base of the UArctic research office in Russia.

## 5. Conclusions

The changes in the system of training specialists described in this work are aimed at minimizing the existing imbalances in the labor market in the Arctic zone of the Russian Federation.

The focus on high-tech technologies in the Arctic leads to an increase in the importance of human capital as a factor in the efficiency of economic development in the Arctic. It is obvious that as economic activity increases, the personnel deficit will increase. In this regard, based on existing forecasts, the training system should adapt to new challenges and adjust educational programs and directions. The future of the Arctic is in the hands of highly qualified specialists who have the skills to remotely control complex technological processes in oil and gas fields and marine transport.

In the twenty-first century, young specialists in the oil and gas industry who are being trained to work in the Arctic should acquire fluency in information technology and competence in working with complex robotics. Artificial Intelligence (AI) in the harsh natural conditions of the Arctic is already helping people, and in the near future, may even replace them.

At the same time, we can conclude that education is an important factor in preserving the unity of the social space of the Arctic. The development of international cooperation in the field of personnel training, in addition to practical educational tasks, makes it possible to strengthen cross-cultural ties that create the basis for sustainable development of the region.

As the results of the study showed, training personnel for work in the Arctic has a special specificity and often falls out of the general principles of ensuring the educational process. Global trends in training “Arctic personnel” show the need to develop an interdisciplinary approach, basic knowledge of natural sciences, to study the socio-cultural specifics of the region, to develop new educational standards, to implement the concept of ‘Life Long Learning’, to widely introduce digital technologies and internationalize education.

The analysis of Russian educational programs for training specialists allowed us to conclude that, in general, the domestic system of training is adapting to changing conditions, in particular, certain progress has been made in the formation of “digital” competencies and skills in the conditions of a developed IT infrastructure.

The introduction of “digital fields” has led to an increase in the demand for IT specialists in the Arctic oil and gas sector. With the help of an expert survey, it was revealed that in the future, the most popular professions, along with “drillers” and specialists in transport, will be IT specialists who ensure the functioning of “digital fields”.

Leading universities that train specialists for modern oil and gas projects in the Arctic are Gubkin Russian State University of Oil and Gas, Saint Petersburg Mining University, Peter the Great Saint Petersburg Polytechnic University, Lomonosov Northern (Arctic) Federal University, and Murmansk State Technical University.

At the same time, it should be noted that not all leading Russian universities are included in international educational projects and organizations, and there is skepticism about the internationalization of education. In addition, there is a catch-up nature of Arctic education in Russia and the lag of the education system from the general trends in the training of Arctic personnel, and the low competitiveness of Russian universities at the world level. Probably, the processes of

cooperation, primarily in the field of oil and gas projects, are constrained by the continuing tense relations between the largest states of the Arctic region.

**Author Contributions:** Conceptualization, E.S. and D.M.; methodology, D.M.; validation, S.G. and A.N.; formal analysis, E.S.; resources, R.-E.K.; writing—original draft preparation, E.S. and D.M.; writing—review and editing, S.G. and A.N.; visualization, R.-E.K.; project administration, E.S. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Savard, C.; Nikulina, A.Y.; Méce mmène, C.; Mokhova, E. The Electrification of Ships Using the Northern Sea Route: An Approach. *J. Open Innov. Technol. Mark. Complex.* **2020**, *6*, 13. [CrossRef]
2. Litvinenko, V. The Role of Hydrocarbons in the Global Energy Agenda: The Focus on Liquefied Natural Gas. *Resources* **2020**, *9*, 59. [CrossRef]
3. Rosen, M.; Thuringer, C. *Unconstrained Foreign Direct Investment: An Emerging Challenge to Arctic Security*; CNA Corp.: Washington, DC, USA, 2017.
4. Zagorskii, A.V. China accepts conditions in the Arctic. *Mirovaya Ekon. I Mezhdunarodnye Otnos.* **2019**, *7*, 76–83. (In Russian)
5. Väättänen, V.; Zimmerbauer, K. Territory–network interplay in the co-constitution of the Arctic and ‘to-be’ Arctic states. *Territ. Politi- Gov.* **2019**, *8*, 372–389. [CrossRef]
6. Sokolova, I.; Smorchkova, V.; Yusov, A. Human resources of the Russian Arctic regions. *Public Adm.* **2017**, *19*, 86–93. (In Russian) [CrossRef]
7. Fadeev, A.M.; Larichkin, F.D.; Cherepovitsyn, A.E. Features of Training of Personnel for the Arctic Marine Hydrocarbon Fields Development. *J. Min. Inst.* **2011**, *194*, 332–338.
8. Fadeev, A.M.; Cherepovitsyn, A.E.; Larichkin, F.D.; Tsvetkova, A.Y. Personnel Support for the Implementation of Offshore Projects in the Arctic as an Effective Tool for Strategic Management of the Oil and Gas Complex. The North and the market: Shaping the economic order **2018**, *2*, 16–25. Available online: <http://www.iep.kolasc.net.ru/journal/files/2018-2.pdf> (accessed on 30 August 2020). (In Russian).
9. Fadeev, A.M.; Cherepovitsyn, A.E.; Larichkin, F.D. *Strategic Management of the Oil And Gas Complex in the Arctic*; KSC RAS: Apatity, Russia, 2019; pp. 217–225.
10. Keskitalo, P.; Määttä, K.; Uusiautti, S. Sámi education in Finland. *Early Child Dev. Care* **2012**, *182*, 329–343. [CrossRef]
11. Uusiautti, S.; Hoppo, I.; Määttä, K. Challenges and Strengths of Early Childhood Education in Sparsely Populated Small Provinces the Case of Lapland, Finland. *Br. J. Educ. Soc. Behav. Sci.* **2014**, *4*, 562–572. [CrossRef]
12. Määttä, K.; Uusiautti, S. Arctic Education in the Future. In *Human Migration in the Arctic*; Uusiautti, S., Yeasmin, N., Eds.; Palgrave Macmillan: Singapore, 2019; pp. 213–238.
13. Vasilyeva, O.E.; Dmitrieva, A.A.; Gdalin, D.A.; Ilyinsky, S.V.; Popov, M.I. High education and human resources in the Russian Arctic region: Problems and particular qualities of development. *IOP Conf. Series Earth Environ. Sci.* **2020**, *539*. [CrossRef]
14. Veretennikov, N.P.; Agarkov, S.A.; Kozmenko, S.Y.; Ulchenko, M.V. Features of Marine Education in the Arctic Region. In Proceedings of the 2018 XVII Russian Scientific and Practical Conference on Planning and Teaching Engineering Staff for the Industrial and Economic Complex of the Region (PTES), St. Petersburg, Russia, 14–15 November 2018; Saint Petersburg Electrotechnica University: Saint Petersburg, Russia, 2018; pp. 175–177.
15. Kudryavtseva, R.-E.A.; Guseva, N.A.; Koroleva, J. Arctic education in the field of polar research. *IOP Conf. Series Earth Environ. Sci.* **2020**, *539*. [CrossRef]
16. Nikolaeva, A.D.; Neustroev, N.D.; Neustroeva, A.N.; Bugaeva, A.P.; Shergina, T.A.; Kozhurova, A.A. Regional model of indigenous education: The case of the Sakha republic (Yakutia). *Int. Trans. J. Eng. Manag. Appl. Sci. Technol.* **2019**, *10*, 10A19M.

17. Pitukhina, M.; Tolstoguzov, O.; Privara, A.; Volokh, V. Transarctic cooperation potential evaluation of northern universities: Research performance of arctic universities' education indicators. In Proceedings of the 12th International Technology, Education and Development Conference, Valencia, Spain, 5–7 March 2018; IATED: Valencia, Spain, 2018; pp. 4103–4113.
18. Gaski, M.; Halvorsen, P.A.; Aaraas, I.J.; Aasland, O.G. Does the University of Tromsø- The Arctic University of Norway educate doctors to work in rural communities? *Tidsskr. Den Nor. Legeforening* **2017**, *137*, 1026–1031. [[CrossRef](#)]
19. Arruda, G.M. *Sustainable Energy Education in the Arctic: The Role of Higher Education*; Routledge: London, UK, 2020; p. 278.
20. Kudryashova, E.V.; Nenasheva, M.V.; Saburov, A.A. Network Interaction of Universities in the Context of the Russian Arctic Development. *Vysshye Obraz. v Ross.* **2020**, *29*, 105–113. (In Russian) [[CrossRef](#)]
21. Djamila, S.; Kuzaeva, A.; Glushkova, A. Formation of a database of indicators and analysis of the environmental and socio-economic vital activity spheres of Russian Federation Arctic zone municipalities. *Int. J. Syst. Assur. Eng. Manag.* **2019**, *11*, 1–25. [[CrossRef](#)]
22. Skripnuk, D.F.; Kikkas, K.N.; Safonova, A.S.; Volodarskaya, E.B. Comparison of international transport corridors in the Arctic based on the autoregressive distributed lag model. *IOP Conf. Series Earth Environ. Sci.* **2019**, *302*. [[CrossRef](#)]
23. Kruk, M.; Semenov, A.; Cherepovitsyn, A.; Nikulina, A. Environmental and economic damage from the development of oil and gas fields in the Arctic shelf of the Russian Federation. *Eur. Res. Stud. J.* **2018**, *2*, 423–433. (In Russian) [[CrossRef](#)]
24. Didenko, N.I.; Skripnuk, D.F.; Mirolyubova, O.V. Urbanization and Greenhouse Gas Emissions from Industry. *IOP Conf. Series Earth Environ. Sci.* **2017**, *72*, 012014. [[CrossRef](#)]
25. Sharok, V.; Iakovleva, I.; Vakhnin, N. Social and psychological aspects of individual adaptation in Arctic conditions. *IOP Conf. Series Earth Environ. Sci.* **2019**, *302*, 1. [[CrossRef](#)]
26. Tatianina, L.; Vakhnina, E. Personal determinants of trust in Arctic ships' crews. *IOP Conf. Ser. Earth Environ. Sci.* **2020**, *554*, 012007. [[CrossRef](#)]
27. Berge, S.T. Pedagogical Pathways for Indigenous Business Education: Learning from Current Indigenous Business Practices. *Int. Indig. Policy J.* **2020**, *11*, 1–20. [[CrossRef](#)]
28. Vizina, Y.; Williamson, K.J. *Indigenous Peoples and Education in The Arctic Region*; United Nations Department of Economic and Social Affairs: New York, NY, USA, 2017; pp. 41–64.
29. Määttä, K.; Hyvärinen, S.; Äärelä, T.; Uusiautti, S. Five Basic Cornerstones of Sustainability Education in the Arctic. *Sustainability* **2020**, *12*, 1431. [[CrossRef](#)]
30. Arctic National Scientific-Educational Consortium. Available online: <http://arctic-union.ru> (accessed on 30 August 2020). (In Russian).
31. Center of Competence in the Sphere of Engineering and Technology of Field Development in the Arctic. Available online: <https://spmi.ru/rezultaty-nauchnoy-deyatelnosti> (accessed on 30 August 2020). (In Russian).
32. 'Gazpromneft-Polytech' Research and Education Center. Available online: <https://gpn.spbstu.ru/projects/> (accessed on 30 August 2020). (In Russian).
33. Arctic Floating University. Available online: [https://narfu.ru/science/expeditions/floating\\_university/2020/](https://narfu.ru/science/expeditions/floating_university/2020/) (accessed on 30 August 2020). (In Russian).
34. Areas of MSTU Training. Available online: <http://abit.mstu.edu.ru/> (accessed on 30 August 2020). (In Russian).
35. Comprehensive Research of the Arctic Shelf. Available online: <https://tpu.ru/research/fields/arctic> (accessed on 30 August 2020). (In Russian).
36. Master's Program "Study of Siberia and the Arctic". Available online: <http://tssw.ru/page/magisterskaya-programma-izuchenie-sibiri-i-arktiki/> (accessed on 5 November 2020). (In Russian).
37. Arctic Field Study Semester. Available online: <https://www.mcgill.ca/arctic/academic> (accessed on 13 September 2020).
38. Northern Studies. Available online: <https://www.unbc.ca/northern-studies> (accessed on 13 September 2020).
39. Arctic and Northern Studies Program. Available online: <https://www.uaf.edu/arctic/> (accessed on 13 September 2020).
40. Programs and Courses of University of Northern British Columbia. Available online: <https://www.unbc.ca/programs> (accessed on 13 September 2020).

41. Adapting To Change UK Policy towards the Arctic. Available online: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/251216/Adapting\\_To\\_Change\\_UK\\_policy\\_towards\\_the\\_Arctic.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/251216/Adapting_To_Change_UK_policy_towards_the_Arctic.pdf) (accessed on 13 September 2020).
42. Science and Innovation Network (SIN). Available online: <https://www.gov.uk/world/organisations/uk-science-and-innovation-network> (accessed on 13 September 2020).
43. QS Top. Universities. Available online: <https://www.topuniversities.com/> (accessed on 13 September 2020).
44. Youth Policy of “Rosneft” Company. Available online: [https://www.rosneft.ru/Development/personnel/young\\_specialists/](https://www.rosneft.ru/Development/personnel/young_specialists/) (accessed on 30 August 2020). (In Russian).
45. Kudryashova, E.V.; Sorokin, S.E.; Bugaenko, O.D. University-Industry Interaction as an Element of the University’s «Third Mission». *Vysshie Obraz. v Ross.* **2020**, *29*, 9–21. (In Russian) [CrossRef]
46. Professional Retraining Program “Procurement and Logistics of Offshore Projects in the Oil and Gas Industry”. Available online: <http://www.mstu.edu.ru/press/ads/16-07-2019/zakupkiilogistikashelf.shtml> (accessed on 30 August 2020). (In Russian).
47. Additional Educational Program “At the Start!”. Available online: <https://gpn-nastart.ru/> (accessed on 30 August 2020). (In Russian).
48. Makhovikov, A.B.; Katuntsov, E.V.; Kosarev, O.V.; Tsvetkov, P.S. Digital transformation in oil and gas extraction. In *Innovation-Based Development of the Mineral Resources Sector: Challenges and Prospects*; CRC Press: Boca Raton, FL, USA, 2018; pp. 531–538.
49. Dmitrievsky, A.N.; Eremin, N.A. Big geodata in the digital oil and gas ecosystem. *Energy Strategy* **2018**, *2*, 31–39.
50. Abukova, L.A.; Borisenko, N.Y.; Martynov, V.G.; Dmitrievsky, A.N.; Eremin, N.A. Digital modernization of the gas complex: Scientific research and personnel support. *Sci. J. Russ. Gas Soc.* **2017**, *4*, 3–12.
51. Kosarev, O.V.; Tsvetkov, P.S.; Makhovikov, A.B.; Vodkaylo, E.G.; Zulin, V.A.; Bykasov, D.A. Modeling of industrial iot complex for underground space scanning on the base of arduino platform. In *Topical Issues of Rational Use of Natural Resources 2018*; CRC Press: Boca Raton, FL, USA, 2019; pp. 407–412. (In Russian)
52. Gafurov, A.R.; Skotarenko, O.V.; Nikitin, Y.A.; Plotnikov, V.A. Digital transformation prospects for the offshore project supply chain in the Russian Arctic. *IOP Conf. Series Earth Environ. Sci.* **2020**, *554*, 012009. [CrossRef]
53. Litvinenko, B.C.; Dvoynikov, M. Methodology for determining the parameters of drilling mode for directional straight sections of well using screw downhole motors. *J. Min. Inst.* **2020**, *241*, 105. [CrossRef]
54. Chudinova, I.; Nikolaev, N.; Petrov, A. Design of domestic compositions of drilling fluids for drilling wells in shales. In *Youth Technical Sessions Proceedings*; CRC Press: Boca Raton, FL, USA, 2019; Volume 1, pp. 371–375.
55. “Gazprom Neft” on the Path of Comprehensive Digital Transformation. Available online: <https://news.myseldon.com/ru/news/index/203832229> (accessed on 30 August 2020). (In Russian).
56. Tkacheva, V.L.; Grinyayev, S.N.; Pravikov, D.I.; Fatyanov, A.A.; Shushkevich, Y.A. *Fuel and Energy Complex in the Era of Digital Economy Formation: Application of Digital Economy Technologies in Power Engineering*; Gubkin Russian State University of Oil and Gas (SRI): Moscow, Russia, 2019; p. 234. (In Russian)
57. Gubkin University Has Created A Training Laboratory for Studying The Means of Detecting Computer Attacks. Available online: [https://gubkin.ru/news/detail.php?ID=39680&sphrase\\_id=9160622](https://gubkin.ru/news/detail.php?ID=39680&sphrase_id=9160622) (accessed on 30 August 2020). (In Russian).
58. Study in Russia. UArctic. Available online: <https://education.uarctic.org/universities/russia/> (accessed on 30 August 2020).

**Publisher’s Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).