

The System of Technical Student's Research Activity (Oil and Gas Specialization Case Study)

El Sistema de Actividad de Investigación Técnica del Estudiante (Estudio de Caso de Especialización de Petróleo y Gas)

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ABSTRACT:

Modern education system undergoes significant changes in order to improve the skills of future specialists. Advanced research activity of university students (especially technical students) is one of renewal priorities. In this connection, the purpose of this research is to improve the quality of vocational training in the course of improving student's research activity with educational, scientific and industrial integration. We have used complementary research methods to achieve this goal, such as: analysis, synthesis and comparison. The experiments were conducted on the basis of the Noyabrsk Institute of Oil and Gas of the Yamalo-Nenets Autonomous District. In developing the training program, we have taken into account the best practices of European countries and the United States. The program, presented in the article, includes a professionally oriented special course that stimulates research activity, increasing the student's knowledge and his or her qualification level.

Keywords: professional competence, technical specialization, upgrade training, research activity,

RESUMEN:

El sistema educativo moderno sufre cambios significativos para mejorar las habilidades de futuros especialistas. La actividad de investigación avanzada de los estudiantes universitarios (especialmente los estudiantes técnicos) es una de las prioridades de renovación. A este respecto, el objetivo de esta investigación es mejorar la calidad de la formación profesional en el marco de la mejora de la actividad de investigación de los estudiantes con integración educativa, científica e industrial. Hemos utilizado métodos de investigación complementarios para lograr este objetivo, tales como: análisis, síntesis y comparación. Los experimentos se realizaron sobre la base del Instituto Noyabrsk de Petróleo y Gas del Distrito Autónomo Yamalo-Nenets. En el desarrollo del programa de capacitación, hemos tenido en cuenta las mejores prácticas de los países europeos y los Estados Unidos. El programa, presentado en el artículo, incluye un curso especial orientado profesionalmente que estimula la actividad de investigación, incrementando los conocimientos del estudiante y su nivel de

1. Introduction

In the context of current situation with the world fuel and energy industry development, the ability of educational sector of science to implement innovations is becoming an important aspect of innovation policy of states (Berezhnova, & Krayevsky, 2013; Volkov, 2016). The high level of science-intensive professional activity of specialists in oil and gas requires a scientifically oriented educational environment that promotes innovation activity. System research is one of the most important aspects in developing a scientifically oriented educational environment (Kalinina, 2012; Shadchin, 2012; Dolganov, Zakonnova, & Sedovskikh, 2015). Research activity is an instrument for creating a new generation of research specialists capable of working in an innovative, prognostic mode under the high level of science-intensive professional activity in the fuel and energy complex (FEC).

Preliminary analysis of the issue of advancing the research activity of students in oil and gas made it possible to identify the following shortcomings: students lack the level of professional competence to use professional knowledge in innovative and predictive mode while solving inter-scientific industrial problems in FEC. The integrative approach to solving complex research industrial problems, ensuring the unity of students' learning and research activities, is not fully implemented. Student's research activity is characterized by a number of contradictions between the high level of science-intensive professional activity of specialists in oil and gas, which requires a scientifically-oriented educational environment in a university, and the lack of system research activity of students, higher-education teaching and management personnel. The latter is a basic condition for creating a scientifically-oriented educational environment in the university. The last shortcoming involves the dynamism of science and technology, conditioned by objective trends in scientific and technical process and by unresolved problem of finding didactic equivalents, reflecting the social experience in scientific and industrial integration within the learning policy.

Objective requirements for advancing the research activity of students in oil and gas and poor theoretical, organizational and methodological foundations for its development have determined the choice and relevance of our study. The contribution of our research to the world pedagogical science in the field of "Theory and methodology of vocational education" involves the innovative didactic system based on the target, content, procedural and organizational aspects and designed to advance the research activity of students in oil and gas. It allows transforming scientific knowledge into academic knowledge and adapting technical training of specialists to modern requirements of science-intensive FEC. The integrated approach (basis for designing) will determine the target technological support basis for the system, improving student's research activity, including the choice of methods and means of instruction, of transforming the main areas of meaningful synthesis within student's research activity built into the learning process or complementing the learning process.

2. Literature review

It is important to note that the foreign higher education system has accumulated a rich experience in organizing student's research activity, as the academic process is increasingly becoming a real professional activity (Arends, 2014; Linn, 2013; Talbot-Smith, 2013).

Foreign experience in organizing student's research activity is of great interest in current conditions of Russia's entry into the world educational space and in the context of forthcoming inclusion of Russian universities in the Bologna Process.

There are traditional organizational forms of student's research activity that traditionally have

been and are being applied by modern foreign higher educational institution (Rider, Hasselberg, & Waluszewski, 2013; Frost, Hattke, & Reihlen, 2016; Moss, & Pini, 2016): scientific propaedeutic courses and pro-seminars (Germany); research projects (Germany, USA, Japan); problem-oriented courses (England, Germany, France); project technologies in small research groups (USA, Japan).

N. Yurko reveals the features of higher education system in Scotland. There are two postgraduate programs in the country. "Taught" is similar to the Russian version; it includes lecture classes, seminars, intermediate exams and tests. Unlike the first program, "Research" is designed for people conducting research. It is based on joint work with the research adviser. The author notes that the programs of distance learning have become very popular in the West (The High Shepherd in the Federal Republic of Germany, 1990).

Its specificity is inherent in scientific activity system in German higher education. In the article "Improving Higher Education in Germany", E. Frank and C. Opitz note that the country is actively discussing the problems of increasing the university system competitiveness. Politicians agree that a training system that will be able to succeed under fierce competition is necessary. Thus, it has to be created by reforming Germany's higher education. They propose to change the structure of German educational services market radically. The hierarchy system of universities will force them to engage in "reputation management" in order to attract the most talented students and to be able to conduct research at a high level (Veretennikova, 1996).

The so-called "research training", introduced in the late 1960s and fully justified, is a striking feature of the educational process in German universities, which essence is that the senior student, who has shown an ability to scientific activity, is awarded with the title "student-researcher". He receives not the theme of the degree work, but the theme of a thesis research. Such training must end with viva. At this time, students learn according to an individual plan, form research teams and sections, have a research advisor. The so-called "signs" of the student-researcher are developed: the ability to generate scientific ideas, knowledge of foreign languages, perseverance in solving scientific problems, the ability to work in a team, desire for publications and the interest in scientific issues of related disciplines (Naeve-Stoß, 2013).

In German higher educational institution, specific forms of special encouragement for highly gifted students are being successfully implemented in the form of experimental training clubs for highly qualified personnel: "rector's reserve", "master classes", "research staff for industry", "high-performance scientific shift". An agreement between the rector and each participant is an obligatory condition for performing in such teams.

New complex forms of scientific cooperation of universities with leading industrial associations are being developed and widely spread: temporary research groups, so-called "application groups", consulting centers, joint scientific commissions, methodological-diagnostic centers, student scientific technological centers in the framework of interdisciplinary scientific research, etc.

The experience of US universities in organizing student's research activity is of great interest. In addition to the university, a large role is played by a manufacturing enterprise or a firm. Thus, T.S. Georgieva has analyzed the experience of US universities in interacting with industrial enterprises. She also considers the role of student science in this process (Georgieva, 1989). In recent years, there is a tendency for a wider participation of private firms in financing university research in the US. Cooperation between the universities and industry is being steadily developed. It usually begins with the fact that firms use university scientists as consultants in conducting their own research. In this case, a contract for joint work is concluded. Currently, the number of design institutes independent from the university administration of research organizations, which employ teachers, students and graduate students, is growing. Such organizations enable students to start scientific research during junior courses and to continue them while graduating or being a graduate student and teacher-researcher. Research and scientific parks are another form of interaction between universities and industrial enterprises that has good prospects. Its main purpose is to realize the scientific

surveys of students, to support the attractive scientific research.

Student's research activity in the universities of Great Britain grounds his or her scientific postgraduate training (Weedon, & Riddell, 2015; Jackson, 2015; Smyth, et al., 2016). PhD educational programs of British universities include NewRoutePhD – integrated postgraduate programs, combining research activities with the professional training program. Successful leavers of such programs are independent researchers with professional, personal and transferable skills that can make a significant contribution to the chosen field.

Personal research project is implemented in close cooperation with the research advisor (Lagkueva, & Gurieva, 2015; Sinichenko, 2013). The training module includes specialization courses, courses aimed at developing training and research competencies, as well as interdisciplinary courses aimed at developing professional skills.

The purpose of the study is to improve the quality of vocational training of students with oil and gas specialization in the course of improving student's research activity with educational, scientific and industrial integration.

Objectives of the study:

- determining the peculiarities of professional activity of specialists in the fuel and energy complex, which affects the scientifically oriented component and requires student's research activity in creating educational environment based on practice-oriented training and interaction with production;
 - revealing the content specifics of student's research activity and identifying the pedagogical conditions that can ensure the student's research activity advancement in the university;
 - developing technological support in implementing an integrative approach in all forms of student's research activity (SRA), built into the learning process and complementing the educational process, as well as the upgrade training process of the teaching staff.
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3. Method

We have used the following research methods to achieve the goal of the study: analysis of philosophical, psychological-pedagogical, sociological and methodological sources; didactic theory generation, synthesis, comparison, systematization, abstraction, analysis, generalization of theoretical and research data; study and generalization of university experience in forming professional readiness of students; observation, discussion, peer review, survey, documentation study, testing; pedagogical experiment, which allowed obtaining data about the level of professional readiness of students; mathematical statistics and applied software application for processing the results of a pedagogical experiment. The experiments were conducted on the basis of the Noyabrsk Institute of Oil and Gas of the Yamalo-Nenets Autonomous District.

Significance and scientific validity of results are determined by methodological substantiation of theoretical positions, assessment technique development adequate to the objectives, subject and object of the study, and by sample representativeness, quantitative and qualitative analysis of experimental data; by the use of research results in pedagogical practice. In developing a technique for experimental testing of results obtained in a pedagogical experiment, students' readiness to research activity in conditions of the high level of science-intensive professional activity was selected as an integrative efficiency indicator of technological approaches developed during the thesis work. This integrative indicator is represented by differentiated indicators: the level of research competence and the level of personal contribution to fulfill complex tasks and events related to student's research activity. The second differential indicator – the level of personal contribution to fulfill complex tasks and events related to student's research activity – allowed assessing the student's performance in all forms of research activity, built into the learning process or complementing it.

Student's performance was assessed by the ranking method depending on the level and forms of holding mass events. The sequence of determining the recommended rank was consisted of the following procedures:

- definition of ranking criteria for the events of the student's research activity system;
- SRA ranking on each criterion;
- conditional score setting for SRA ranking;
- total conditional score determination for ranking a specific event of the student's research activity system;
- rank determination of a specific event of the student's research activity system.

This sequence made it possible to determine the rank of any mass and competitive scientifically-technical event of the student's research activity system in accordance with additional personal results of students (differential indicator of the level of personal contribution to fulfill complex tasks and events). The differences between the samples of the control and experimental groups were evaluated by a Q-Rosenbaum criterion in terms of the level of personal contribution to fulfill complex tasks and events.

In determining the level of research competence that allows determining whether the knowledge and skills of future technical specialists correspond to the real level of tasks performed by them in the field of scientific and research activity, we have assessed the generalized professional knowledge, skills and competencies related to:

- independent study of technical objects with unknown modifications;
- technical object design at the level of design intent;
- optimal procedure specification;
- diagnostics of defective main equipment.

We have studied the dynamics of differential indicators describing the level of student's readiness (in experimental groups) to research activity under the high level of science-intensive professional activity on the basis of results, obtained by mathematical statistics. The level of research competence, formed on the basis of an integrative approach, was evaluated by a non-parametric criterion was used χ^2 (chi-square). In general, we have tested the hypothesis of technological approaches to student's research activity advancement being successful.

4. Data, Analysis, and Results

According to advanced foreign experience, student's research activity, built into the learning process or complementing it, contributes to the gradual student's technical creativity development.

In determining the major areas for target, content, procedural and organizational aspects of educational, scientific and industrial integration, we have allocated the main blocks of the system improving student's research activity (Table 1).

Table 1. Major blocks and aspects of student's research activity improving system

№	Block name	Major aspect
1.	Background block	1. Use of professional knowledge in solving various industrial problems based on innovative methods in fuel and energy complex; 2. Technological complication of production processes, dictating the need for a scientifically oriented educational environment; 3. Search for didactic equivalents, reflecting the social experience in scientific and industrial activities and corresponding to production innovations in fuel and energy sector.
2.	Goal orientation block	1. Studying the professional training of specialists in oil and gas industry to find out whether this preparation corresponds with dynamism of science and technology, conditioned by modern scientific and technical progress in fuel and energy complex;

		<p>2. Integration of educational and research activities of the university into a single process;</p> <p>3. Updating the content of education for a new generation of research specialists capable of working under the close integration of science and production in fuel and energy sector.</p>
3.	Conceptual provision block	<p>1. System approach to designing a student's research activity improving system related to oil and gas specialization;</p> <p>2. Practice-oriented approach to learning;</p> <p>3. Organizational, activity-related, content, technological aspects of educational, scientific and industrial integration, as a basis for research activity improvement of university students;</p> <p>4. Consideration of teaching principles as general guidelines for educational activities, linking theoretical research with practice;</p> <p>5. Transition from technological approach to the search one.</p>
4.	Content specification block	<p>1. Adaptation of professional training content for bachelors of oil and gas specialization to modern innovative transformations in science-intensive oil and gas industry;</p> <p>2. Content selection system for upgrade training of teaching staff related to student's research activity advancement in the university;</p> <p>3. Variability of educational activity, which allows improving the student's research activity system, initiating the voluntary search and research activities of students and teachers;</p> <p>4. Educational, scientific and industrial integration as the basis for a practice-oriented approach to professional training of specialists in oil and gas.</p>
5.	Block of methodological features	<p>1. Continuity of future bachelors' professional training in within special courses on a single issue;</p> <p>2. Information and didactic base development for advancing the university student's research activity in: 1) researching on methodological foundations of R&D; 2) organizing of students' performance in the scientific field; 3) studying the procedure of working with scientific information; 4) using the computer and other means of computer technology; 5) improving the practical component of research; 6) writing and publishing scientific works of students.</p>
6.	Activity block	<p>1. Designing a science-oriented environment in the university;</p> <p>2. Advancing: a) student's research activity, built into the learning process; b) student's research activity, which complements the learning process;</p> <p>3. Teaching staff training capable of combining pedagogical activity with research;</p> <p>4. Mechanism development for network interaction in the system "science-education-production" by means of the so-called target-oriented regional projects, administrative and organizational structures, as well as public-private partnership.</p>
7.	Knowledge and skills block	<p>1. Implementation of innovations, learning the fundamentals of scientific and technical creativity;</p>

		2. Transformation of scientific knowledge about well drilling; oil and gas production; field monitoring and regulation of hydrocarbon extraction on land and at sea; pipeline transport of oil and gas; underground storage of gas; storage and marketing of oil, oil products and liquefied gases; vehicle, production machine and equipment service in oil and gas production into academic knowledge based on various forms of scientific and educational process integration.
8.	Block of psychological and pedagogical development conditions for creative personality traits	<ol style="list-style-type: none"> 1. Psychological and pedagogical complex of general competencies development in professional preparation of specialists in oil and gas production to work in new conditions of Arctic development; 2. Studying the basics of psychology and scientific technical creativity during the upgrade training of higher-education teaching personnel of the university.
9.	Staff block	<ol style="list-style-type: none"> 1. Student's research activity improving system as an educational space for training bachelors of oil and gas specialization, combining a high level of fundamental training and experience in research and production activities in the areas of oil and gas industry; 2. Preparation of a bachelor-researcher for science-intensive oil and gas production, which includes research activities as a resource for personal creative activity development based on a deep integration of education, science, production and culture.

In developing the system improving the student's research activity, we have taken into account the best practice of US universities, drawing special attention to the close relationship education and production. The experience presented in foreign sources makes it possible to identify a certain trend of broad involvement in financing research, conducted in higher educational institutions, on the part of various companies. This promotes close cooperation between universities and the industry.

Network forms of R&D and SRA are actively used within the framework of "Techniques and Technologies of the Fuel Energy Segment, including Deposit Development, Transport and Storage of Hydrocarbons" at the basis of the Tyumen Industrial University (Noyabrsk branch) with due account for experience of foreign universities in organizing student's research activity. In the Noyabrsk branch of Tyumen Industrial University, there is an educational, scientific and industrial integration during the professional training of students in oil and gas within the network interaction with enterprises of FEC of the Yamal-Nenets Autonomous District (LLC Noyabrsk Service Technology Company, LLC NoyabrskNefteGazAvtomatika, OJSC Gazpromneft-Noyabrskneftegaz) in the field of well drilling; oil and gas production; field monitoring and regulation of hydrocarbon extraction on land and at sea; pipeline transport of oil and gas; underground storage of gas; storage and marketing of oil, oil products and liquefied gases; vehicle, production machine and equipment service in oil and gas production.

In the Noyabrsk branch of Tyumen Industrial University, network forms of R&D and SRA are actively used within the network interaction with employers with due account for the experience of US universities in organizing student's research activity. Thus, there were scientific and practical seminars held within the framework of "Techniques and Technology of the Fuel Energy Segment, including Deposit Development, Transport and Storage of Hydrocarbons" on the basis of the Noyabrsk branch and fuel-and-energy enterprises in 2015.

Thus, the following scientific and practical seminars were held within the framework of network interaction with employers on the basis of the Noyabrsk branch of Tyumen Industrial University in 2015-2016:

- Services rendered to oil and gas industry;
- Original repair and insulation technologies in the oil and gas sector;
- Backfill materials for well casing and squeeze job;
- Research on multi-stage fracturing by tracer (indicator) methods;
- Professional staff training in the structure of higher education under innovative strategy for developing the Far North and the Arctic shelf;
- Methods of increasing the amount of recoverable oil.

Educational, scientific and industrial integration is reflected in the following types of student's research activity: 1) research activity, built into the learning process; 2) research activity, complementing the learning process.

Developed information and didactic base has allowed to realize the major areas of educational, scientific and industrial integration in student's research activity built into the learning process (elements of scientific research in writing lectures, practicum, course paper and degree work), to consider inter-scientific industrial issues in student's research activity, complementing the learning process (special courses on a single issue, scientific and practical seminars).

The mechanism regulating student's research activity, built into the learning process, involves a systematic curriculum review (plan and course of study) and adjustment of teaching methods. This determines the prerequisites for a future specialist-researcher formation. In the complex plan of organizing the research activity of students in oil and gas, *research activity built into the learning process* includes the following areas:

- petroleum-gas field equipment;
- well delivery management;
- Methods of deposit development monitoring;
- oil and gas well drilling;
- backfill materials for well casing and squeeze job;
- original technologies of well repair;
- physicochemical aspects of regulating drill mud properties.

Continuous and gradual formation of students' creative abilities and skills in research is a special feature of a comprehensive program of involving students in scientific research for the entire period of the study. This requires the use of such forms that allow training the specialist-researcher creatively and continuously through the predominance of independent (not typical) research project challenges with ever-increasing complexity in case when the research can be much larger in volume and more profound.

Thus, advancement of research activities of future technical specialists involves innovative changes in SRA structure. These changes involve special courses development to form student's scientific and creative activity, and training modes used consistently and systematically with the same students on a single issue throughout the all study period. This form of SRA serves as an effective mean of training highly qualified specialist-researcher capable of solving inter-scientific industrial problems and conducting an independent scientific search to create progressive procedure specifications and means for their implementation. At the same time, the complexity of inter-scientific problem studied at special courses allows one to consistently raise the level of abstraction and generalization in solving them. The mechanism of entering the inter-scientific problem-based situation of industrial and technical nature is based on student's cognitive need of considering the fact, phenomenon, process in terms of his or her knowledge from different subjects. In this case, the student realizes the lack of knowledge from one subject necessary for conducting research (foreign experience). Thus, cognitive activity and cognitive interest in issues inherent in different subjects arise in students.

Inter-scientific industrial problems of student's research activity, complementing the learning process, were considered through a system of special courses on a single issue:

- original repair and insulation technologies in the oil and gas sector;
- physicochemical aspects of regulating drill mud properties;

- methods of increasing the amount of recoverable oil;
 - hydraulic fracturing in horizontal wells in developing low-permeability reservoirs of Western Siberia.
- We propose a system of special courses on a single issue for the training program 21.03.01 "Oil and Gas Business", specialization: "Exploitation and Maintenance of Oil Production Facilities" as an example.

Table 2. The system of special courses on a single issue for the training program 21.03.01 "Oil and Gas Business", specialization: "Exploitation and Maintenance of Oil Production Facilities"

№	Oil and gas deposit development
1	Analysis of technologies application for field development monitoring
2	Evaluation of production facilities breaking up into smaller units at the field
3	Evaluation of residual deposit reserves; assessment of activities on their involvement in development
4	Substantiation of technological indicators in implementing various water flooding pattern at the field
5	Justification of actions for further development of a field at the final stage
6	Analysis of hydrodynamic models designed for predicting the field development
7	Assessment of technological efficiency from introducing methods of impact on PTA
№	Borehole production
1	Substantiation of operation conditions of water cut well stock of the field
2	Substantiation of measures on improving operation conditions of wells with a sucker-rod well pumping unit in the formation
3	Insulating work improvement at the field
4	Recompletion analysis
5	Development of measures against paraffin deposits in the wells
6	Justification of technological operation conditions of wells with horizontal tailing-in at the field
7	Hydrodynamic methods of impact on PTA in the deposit (if there is experimental data)
8	Selection of equipment for deposit development
№	Well production gathering and processing
1	Improving the oil, water and gas gathering and processing systems at the field
2	Analysis of using reagent-saving technologies in oil processing at the field

3	Justification of upgrading the gathering facilities
4	Optimization of emulsion breakdown technology in the oil processing system
5	Analysis of introducing new technological means into the oil gathering and processing system at the field
6	Analysis of methods for monitoring and preventing corrosion of gathering facilities in the field
7	Development of measures to improve the oil processing system
8	Technology improvement for deep oil dehydration at the field
9	Optimization of conditions for salvaging at the new areas and sites
10	Substantiation of choosing reagents and technology for oil and gas treatment at the field

SRA, complementing the learning process, involves student's participation in subject olympiads, competitions and research projects in the framework of All-Russian and International Scientific and Practical Conferences. The student's research activity system was designed on the basis of educational, scientific and industrial integration. It also covers an area related to upgrading training of higher-education teaching personnel for continuous learning about advanced technologies in FEC, modern technologies of scientific and academic work, modern pedagogical technologies and new academic management techniques, including new approaches to providing the learning process of high quality. The environment creation initiated by a voluntary research and involving the solution of important industrial problems in the framework of target-oriented projects requires necessary conditions for improving the level of training, retraining and upgrade training of teaching staff in the process of organizing students' research activity. Upgrade training is carried out on the basis of leading state universities, institutes for advanced training, inter-branch regional centers for advanced training and retraining of personnel in Russian Federation, and at the leading enterprises. In 2015-2016, retraining and development programs for specialists and academics were expanded in terms of priority areas of science and technology development in the fuel and energy sector – 72 hours for development programs and 500 hours for retraining programs (Table 3).

Table 3. Retraining and development programs for specialists, academic and teaching staff

Teaching period (in hours)	Retraining and development programs
Development programs (72 hours)	<ul style="list-style-type: none"> ● Developing the hydrocarbon resources of the continental shelf; ● Increasing the efficiency of vehicle operations in the West Siberian oil and gas complex; ● Progressive methods of repairing main trunk pipelines; ● Features of production machine operation in cold weather; ● Fire safety of oil and gas enterprises; ● Ensuring environmental safety at oil and gas enterprises.
Retraining programs (500 hours)	<ul style="list-style-type: none"> ● Development of marine oil and gas fields; ● Ensuring safety in designing oil and gas facilities; ● Procurement management at oil and gas enterprises.

Scientific and methodological seminars were held within the upgrade training of higher-education teaching personnel, which provides the study of modern technologies of scientific and academic work, as well as modern pedagogical technologies (Table 4):

Table 4. Seminar topics

№	Topic	Purpose	Objectives
1.	Practice-oriented training based on modular training in the university	Studying technological approaches to implementing practice-oriented approach in a technical university	Studying the network options for implementing major educational programs; basic requirements for production module development; the role of online courses in implementing network technology
2.	Psychological and pedagogical complex of general competencies development in professional preparation of specialists in oil and gas production to work in new conditions of Arctic development	Studying theoretical and organizational approaches to forming auto-psychological competence in professional preparation of specialists in oil and gas production to work in new conditions of Arctic development.	Studying the general competence in professional preparation of specialists in oil and gas production; organizational and theoretical approaches to forming auto-psychological competence in professional preparation of specialists in oil and gas production to work in new conditions of Arctic development; relations between the components of psychological and pedagogical complex of general competencies development of specialists with due account for the conditions in the Far North and in the Arctic.

The study of foreign experience in creating environment initiated by voluntary research activity and in providing necessary conditions for studying the methodology of scientific creativity, including the curriculum for psychology and creative technology foundations necessitated teachers to learn theoretical and methodological foundations, the practice of organizing and using the student's research activity system.

Continuous and gradual learning of scientific work and research foundations in the following areas is a feature of developed technological approaches to upgrade training in the process of organizing student's research activity:

- methodological, psychological and pedagogical foundations of scientific work;
- methods of working with scientific information;
- technologies of scientific work.

Creative realization of high professional potential requires considering the aspect of research activity in the system of professional development not only in the area related with learning theoretical and methodological foundations and the practice of organizing SRA in the system of higher vocational education, but also by drawing teachers in pedagogical and methodical micro-surveys. The letter ends with:

- new curriculum content;
- professionally-oriented special courses;
- methodological development;
- new author's approaches to achieving certain teaching objective, description of used learning technology;
- teaching aids.

The scientific novelty of the study lies in the fact that:

- technical student's research activity based on a new meaningful aspect of educational, scientific and

- industrial integration is the subject of special pedagogical research for the first time;
- innovative integrative didactic system of technical student's research activity was developed for the first time, allowing us to add organically interconnected inter-cycle links, influencing the systematization of students' knowledge about major inter-scientific industrial problems, to the learning process;
- program providing appropriate conditions for educational and industrial integration in the process of technical student's research activity was developed for the first time;
- problem of transforming the major areas of meaningful synthesis in student's research activity built into the learning process or complementing the learning process, as well as under the upgrade training process of the teaching staff, is solved at theoretical and practical levels for the first time
- system of assessing differential indicators that determine the level of student's readiness to research activity under the high level of science-intensive professional activity is developed for the first time.

Theoretical significance of the research lies in the fact that it substantiates the need for educational, scientific and industrial integration in creating a science-oriented educational environment at the university. The research reveals theoretical prerequisites and provides conceptual provisions of technical student's research activity, which were used to design all the components of innovative pedagogical system of technical student's research activity (target-oriented, content, managerial, procedural and organizational). It provides developed technological approaches to transforming major areas of meaningful synthesis in student's research activity built into the learning process or complementing it, as well as the upgrade training process of the teaching staff.

Practical significance of the research lies in the fact that it defines practical ways and conditions that contribute to the improvement of the system of technical student's research activity. It provides information and didactic base for students, teachers and management personnel of the university to learn theoretical and methodological foundations of scientific work, means and methods of research activity and to work in major areas of educational, scientific and industrial integration in student's research activity built into the learning process (elements of scientific research (ESR) in writing lectures, practicum, course paper and degree work), to consider inter-scientific industrial issues in student's research activity, complementing the learning process (special courses on a single issue, scientific and practical seminars).

The technological approaches developed in the study can be used in designing pedagogical technologies that support student's research activity in the system of continuous vocational education.

The research hypothesis – student's research activity will be effective if:

- student's research activity system is designed on the basis of educational, scientific and industrial integration;
- ways and means for achieving various goals are discussed and agreed at the level of target-oriented and managerial components within a single teaching and educational process;
- system of inter-scientific knowledge and skills, ensuring a high level of students' readiness to research activity in the field of science-intensive production, is formed at the level of content and organizational components;
- integrative approach is implemented during student's research activity with due account for the external and internal policy of the university, regulatory framework of secondary vocational education, current standard provision on educational institutions of secondary vocational education, their objectives and rights;
- educational, scientific and industrial integration is reflected by transforming the major areas of meaningful synthesis in student's research activity built into the learning process or complementing it, as well as under upgrade training of teaching staff and management personnel of the university;
- main goal of the didactic system of student's research activity improvement is determining technical student's readiness to research activity under the high level of science-intensive professional activity.

5. Discussion

The dynamism of science and technology is conditioned by objective tendencies of scientific and technical process and by unresolved problem of finding didactic equivalents, reflecting the social experience in scientific and industrial integration in the educational process.

Current studies cannot pretend to full scientific description of all aspects of such a complex process as advancing student's research activity in the system of secondary vocational education, as the increased requirements for professional training of technicians, who must have a high level of research competence and professional mobility, creative potential, realized in technical creativity while solving complex research problems in a complex information environment, rise the problem of achieving a guaranteed level of knowledge and its quality of graduates of relevant educational institutions.

The problems that need further development include the following:

- improving the system of additional vocational training of teaching staff and management personnel of universities on organizing student's research activity;
- developing methodological approaches to research element implementation in SRA, built into the learning process (elements of scientific research in writing lectures, practicum, course paper and degree work) on the basis of educational, scientific and industrial integration;
- improving modern methods of information support, contributing to scientific information activities of specialists.

In our study, innovative didactic system designed to improve technical student's research activity, developed in terms of target, content, procedural and organizational aspects, allows transforming scientific knowledge into academic knowledge and adapting professional training of specialists in the technical field to the modern requirements of science-intensive industries. Significance and scientific validity of results are determined by methodological substantiation of theoretical positions, assessment technique development adequate to the objectives, subject and object of the study, and by sample representativeness, quantitative and qualitative analysis of experimental data; by the use of research results in pedagogical practice.

We should also note that student's research activity should be encouraged by the teachers, but they should act as consultants, enabling the student to achieve certain results. This has a significant motivational effect and also increases student's interest in the learning process. Although there are researchers indicating that the teacher should take the lead in student's research activities (Zaytseva, 2015). However, this can reduce his or her interest in scientific work.

6. Conclusion

The conducted experimental testing of research results on designing and implementing the system of improving technical student's research activity proves that our hypothesis and its conceptual provisions are correct. This allows us to draw the following conclusions:

- the high level of science-intensive professional activity of a specialist with technical specialization necessitates the creation of a scientifically-oriented educational environment at the university, which activates research activity and contributes to the formation of a new generation of research specialists, who are ready to work in an innovative prognostic mode. System academic and research activity is one of the most important areas in creating scientifically-oriented educational environment at the university. Its realization in teaching and educational process is one of the main conditions for research activity advancement in the university;
- psycho-pedagogical sources and studies on the issue of mainstreaming innovation activity in educational institutions of secondary vocational education were analyzed to develop a concept of improving technical student's research activity on the basis of educational, scientific and industrial integration;
- innovative didactic system designed to improve technical student's research activity, developed in terms of target, content, procedural and organizational aspects, allows transforming scientific knowledge into academic knowledge and adapting professional training of technicians to the modern requirements of science-intensive industries;

- integrated approach, used in designing didactic system of improving technical student's research activity, allows adding organically interconnected inter-cycle links, influencing the systematization of students' knowledge about major inter-scientific industrial problems, to the learning process;
 - conceptual provisions and requirements of the system-forming factor – the principle of integration – have served as a base for determining a target technological support basis for the system, improving student's research activity, including the choice of methods and means of instruction, of transforming the main areas of meaningful synthesis within student's research activity built into the learning process or complementing it;
 - developed information and didactic base for students, teachers and management personnel of the university to learn theoretical and methodological foundations of scientific work, means and methods of research activity and to work in major areas of educational, scientific and industrial integration in student's research activity built into the learning process (elements of scientific research (ESR) in writing lectures, practicum, course paper and degree work), to consider inter-scientific industrial issues in student's research activity, complementing the learning process (special courses on a single issue, scientific and practical seminars);
 - developed system of assessing differential indicators: the level of research competence and the level of personal contribution to fulfill complex tasks and events related to student's research activity, allow determining the level of student's readiness to research activity under the high level of science-intensive professional activity;
 - assessment of students' readiness to research activity under the high level of science-intensive professional activity has showed that technological approaches ensuring the improvement of student's research activity are effective, as well as the conceptual provisions of developed model and method for its implementation.
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