INTERACTIVE TRAINING IN THE OUTSTRIPPING SYSTEM OF PROFESSIONAL ENGINEERS TRAINING

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Abstract: The job of exceeding proficient preparing of designers ascends in the states of expansive scale logical and innovative change of the cutting edge ventures of Russia. The fundamental objective of arrangement of overwhelming proficient preparing is shaping able, prognostically and imaginatively situated faculty. Particularity of expert action of workers requires the association of unique instruction. In such manner, it is important to distinguish the highlights and conditions for actualizing exceeding preparing of designers for the oil and gas complex. Surpassing instructive procedure includes the utilization of new educational innovations, strategies and structures. The usage of intuitive encouraging techniques in the preparation of future designers explored as a powerful component for building up the capacity to develop multifunctional exercises. The conclusive aftereffect of utilizing intelligent training strategies in surpassing instruction is that they invigorate self-advancement, self-acknowledgment, structure the expert position of future designers.

Keywords: outstripping training, petrochemical complex, project-activity training.

1.Introduction

The fuel and energy complex of Russia is the most important component of the state economy. The priority task in modern conditions is its innovative development. It determines the heightened interest in assessing the status and priorities of technological changes in the basic industrial sectors. These include oil and gas production and processing petrochemical industries. Prospects for the development of the petrochemical complex formulated in the Energy Development Strategy of Russia until 2030 (2013). It characterized by the improvement of the scientific foundations in the organization of industrial processes, the implementation of the technological revolution, increasing attention to the safety of production in accordance with the Concept of Sustainable Development, increasing the effectiveness of management decisions. Trends in the development of the oil and gas complex determine a significant change in the content and structure of the professional activities of the engineering corps.

World priorities for ensuring competitiveness require countries and regions to carry out scientific, technological and innovation policies based on the advanced creation of new industries and technologies, transition to standards of digital economy, intensive improvement of basic industries. In Russia, it is petrochemical and gas complex.

A key condition for the competitive development of the oil and gas chemical complex is the provision of the latest scientific and technological base. The scientific and technological "leap" of its development characterized by the conduction of fundamental scientific research, the introduction of applied developments, distinguished by the principle of novelty of technical solutions as quickly as possible; intensive modernization of productions; design and implementation of new technologies.

Prospective directions of development of the oil and gas chemical complex deter-mine the change in the nature of professional activity since its development occurs directly or indirectly under the influence of science, technology, production. Modern engineer ensures safe and efficient functioning of existing and new technological processes, owns the skills of applying new scientific methods and information technologies at their research and implementation, is capable of developing innovation, evaluation and implementation of innovative proposals, economically literate, perfects the organization and management of production (Fartash et al., 2018; Tastan & Davoudi, 2015; Bernasconi, Andrés, and Emilio Rodríguez-Ponce. 2018.).

In these conditions, it is important to form a new generation of professionals in the field of engineering, who able to use new approaches to problem solving, able to generate new knowledge, develop, implement and manage innovations. The outstripping training of engineers is an instrument to solve this problem. The purpose of the study is to identify the features and conditions for implementing outstripping training of engineers and development of innovative pedagogical techniques that enhance the effectiveness of advanced education.

2. Methodology of Advanced Professional Training of Personnel for the oil and Gas Chemical Complex

Innovative paradigm shift in the industry, that is, a deep-rooted image of ideas, actions and technological solutions, actualizes the outstripping professional training of the personnel of the new formation, which the oil and gas industry is in need of and will need in the near future.

System of outstripping professional training of personnel for the oil and gas chemical complex ensures comprehensive support its implementation. The purpose of the system of outstripping training determines by the specifics of the state and prospects for the development of the oil and gas chemical complex. It consists in the formation of competent, prognostically and innovatively oriented personnel, capable of increasing the competition of petrochemical products, increasing capacities in petrochemicals and refining, rapid technology change, the implementation of energy and re-source-saving technologies, the transition to alternative sources of hydrocarbon raw materials.

The system of advanced professional training allows:

– to monitor the needs of the industry in staffing for the medium and long term;

– effectively use the educational, scientific, methodological and innovative potential of educational institutions for solving priority problems of innovative development of the oil and gas chemical complex;

– develop and implement fundamental and applied scientific developments in practical activities aimed at improving the efficiency of the functioning and development of industry and business;

– develop and implement joint programs within the framework of participants in the regional system, ensuring the development of each of them and aimed at innovative improvement of the scientific and technological potential of the oil and gas chemical complex;

– to search, develop, form and develop effective forms of cooperation with minis-tries, departments, heads of enterprises in the field of staffing, introduction of new educational technologies and information systems;

– to create a modern manufacturing base for production practices;

– to ensure professional growth of scientific and scientific-pedagogical staff;

– to attract investments to strengthen the financial basis of scientific research and educational process at all its levels.

The main functions of the system of outstripping professional training of personnel for the oil and gas chemical complex are socially and professionally adaptive prognostic, innovative-oriented, self-developing and self-educating. Methodological approaches for implementation the training system are systematic, resource, personality-activity, approach, competence, prognostic, cluster. The content of outstripping professional training of personnel for the oil and gas chemical complex determined by the requirements of its innovative development and regulated both by general pedagogical principles (scientific, continuity of the content of education, problems, professional orientation) and the specific principles of regionalization, integration, intensification of learning, differentiation, the variability of teaching, the advancing development of vocational education, social partnership, motivation, orientation to self-development (Zhuravleva 2011; Muhina, T., Aboimova, I., Kulagina, A., Trophimov, V., & Chigarov, E. 2016).

2.1 Features and Conditions of Advanced Professional Training of Personnel for the Oil and Gas Chemical Complex

The analysis of forecasts of scientific and technological transformations in the oil and gas chemical complex of Russia made it possible to formulate the features and conditions for implementing of outstripping training of engineers.

Trends in the development of the oil and gas chemical complex determine the main directions of advanced professional training, including the fundamentalization of training with elements of multi-profile; complexity; variability; international orientation; optimization of training terms based on the cluster approach in the organization of the educational process.

Organizational and pedagogical conditions for implementing of outstripping professional training of personnel for the oil and gas chemical complex includes:

– monitoring the prospects for the development of the oil and gas chemical complex;

– organization of monitoring requirements of the innovative development of the oil and gas chemical complex to the level of personnel training;

– ensuring the integration of education, science and production;

– organization of a multi-level innovative educational process;

– formation of students' readiness for advanced education;

– professional development of the faculty;

– maintenance of modern material and technical base of the educational process;

– development of normative and methodological support for the advanced educational process.

Outstripping professional training of personnel for the oil and gas chemical complex of the Republic of Tatarstan (Russia) implemented in the regional educational, research and production complex, providing integration of education, science and production. The core of the regional educational, research and production complex is the oil and gas chemical research and production cluster, which includes industry enterprises, scientific organizations, enterprises of the branch of business, most often serving as polygons for the development of innovative technologies and organizations that carry out the transfer of innovative technologies.

The implementation of outstripping training in the educational cluster makes it possible to:

– provide the improvement of the quality of professional education;

– the openness of the educational space;

– the intensification of the educational process and its flexible adaptation to the demands of the labor market;

– the integration of the levels of vocational training;

– the continuity of professional educational programs of different levels.

The leading university of the educational cluster of petrochemistry and oil processing of the Republic of Tatarstan is Kazan National Research Technological University (KNRTU). It is the largest educational center in Russia, which carries out out-stripping training of specialists in the field of chemical technology.

One of the important conditions for effective implementation of the professional training of engineers is the organization of an innovative educational process. In KNRTU, the preparation in the bachelor's program includes the implementation of innovative educational programs in the following areas: chemical technology, oil and gas business, energy and resource-saving processes in chemical technology, petro-chemistry and biotechnology, quality management.

The outstripping training of masters ensured by the implementation of multidisciplinary master programs: project profile (formation of unique design competencies), research profile and management (competencies for management of production processes and product quality).

The decision of the task of increasing the competitiveness of graduates of the university on the labor market is provided by the organization of additional education for students, which includes: additional economic education for bachelors in the pro-gram "Economics and management in the enterprise"; getting a working profession: operator of technological installations, laboratory assistant-analyst.

The current stage of development of the chemical complex of Russia characterized by a powerful international integration, implementation of a large number of major international projects. This forms the need for companies to work in these projects providing the international prestige of companies. To prepare such engineers, joint international programs have been developed and implemented ("Engineering of Lean Manufacturing of Organic and Petrochemical Synthesis Products").

2.2 Project-Activity Training - an Interactive Model of Outstripping Training of Engineers

The novelty and dynamics of changes in production technologies determine the development of specialist's competence for implementation of integrated approaches to solve engineering problems. Leading role in their formation assigned to project-activity education. It involves the students mastering the ways of professional activity through their active participation in the development and implementation of scientific, technical, socio-economic projects based on the strategic partnership of the university, state, industry, scientific organizations, small and medium business (Kazan National Research Technological University, 2008).

Project-activity training of future engineers received serious development in the KNRTU by the implementation of the state program "Engineering and Technical Staffing of Petrochemical Production in the Republic of Tatarstan". The key position of the program was the unification of efforts of the university and enterprises in the formation of a specific list of required professional competencies of future specialists. The organization of project-activity training carried out on the orders of the industry with pre-agreed plans and specializations; in the framework of innovative projects with the establishment of small and medium-sized enterprises; in the framework of federal and regional projects.

The educational process includes:

– training of engineers on individual curricula, taking into account the specifics of production. Such specialists are necessary for enterprises to solve specific production tasks. Specialized training of engineers for JSC "Ammoniy" is carried out in accordance with the developed "Individual curriculum for project-activity training of specialists for JSC" Ammonium ", which is formed in the direction of "Chemical Technology" and involves studying the specificity of petrochemical production;

– preparation of engineers in the production branches of the departments of the university, where both theoretical and practical training is conducted under the guidance of representatives of enterprises. Such training system is used in the training of design engineers for oil and gas refineries at JSC "LUKOIL-Nizhegorod Nefteproject", chemists-technologists of the production of basic organic and petrochemical synthesis in the production association "Kazanorgsintez";

– scientific research training of masters jointly with PJSC Gazprom in the complex laboratory "Oil and gas business and gas chemical technologies for the production of raw materials for polymers", in JSC "VNII NP" at the basic department "Designing and technologies of deep processing of hydrocarbon raw materials".

2.3 Multi-Level Project Teams - an Effective Interactive Method of Forming Engineering Competences

A modern engineer must have a high level of professional training, be capable of various types of activities, and, depending on this, have a certain set of competencies (Guravleva et al., 2017). The training of such engineers is possible only in the system of continuous vocational education, each level of which provides a step-by-step formation of the specialist's competences. To do this, the process of preparation of engineers includes research and design of the actual production facilities. Efficiency and improvement of the quality of work results with the subsequent possibility of their commercialization ensures the creation of multi-level project teams.

Multi-level project team is an actual form of joint activity of the subjects of the educational process, providing a solution to a single educational and professional task of improving or creating technologies and facilities. At the same time, each participant makes an individual contribution to the solution of the problem by sharing knowledge, ideas and methods of activity.

In KNRTU training engineers for petrochemical complex activities of multilevel project work groups aimed at solving the challenges in the petrochemical and oil re-fining. The activities of the groups organized on the topic of enterprises and research of joint laboratories with leading companies and carried out at the basic departments.

Multilevel project teams can have a variable composition: the teacher - the master - the bachelor - the schoolboy; the teacher - the master - the schoolboy; supervisor-teacher - bachelor-student; supervisor-teacher - master - bachelor; supervisor-master - a schoolboy, a post-graduate student - master - a schoolboy.

Students trained in such teams are assigned different levels of tasks. Tasks solved by the schoolchild: search of sources and selection of the necessary information about the enterprises of the petrochemical complex, the composition of the sub-stance, its chemical properties, the field of application of the reaction products, familiarization with the methods of work on a particular laboratory installation and mastering the principles of analysis on it. Students get skills in solving and setting the tasks of scientific research. The student, starting to work in the project team, enters the university with an awareness of his own further scientific research in his own team and continues the research project that he started before.

Tasks solved by bachelors: acquisition of practical skills of experiment in the field of professional orientation, application of technical means for studying objects of research (observation, control, measurement), step-by-step analysis of scientific literature.

Magistrates solves the following tasks: acquiring practical skills for confirming theoretical positions (patterns, laws, dependencies), conducting experiments according to the technical task of the partner company or the head. Magistrates can take supervision over the entire project team.

The graduate students, leading the project team, acquire the experience of leader-ship over the whole team, solve managerial tasks, they are responsible for the professional results of each member.

The result of the work of the project team is the project, which is jointly presented at the scientific session of the faculty (experts are representatives of enterprises), articles in scientific journals, as well as each student individually participates in various university, city, all-Russian and international research conferences and competitions.

Multilevel project teams provide step-by-step formation of engineering competencies, active productive interaction between trainees, teacher, representatives of production, development of teamwork skills, independent group search for solution of the problem, formation of community of future engineers.

3.Results

Outstripping professional training of engineering personnel is one of the conditions for the competitive development of the oil and gas chemical complex of Russia. A sur-vey of all participants of the innovative educational process in the KNITU on the assessment of the urgency of implementing advanced professional training shows that 78.3% of the students, 84% of specialists directly working in this field, 68% of teachers consider that outstripping training is necessary. Interested in graduates of KNRTU employers are more than 100 enterprises of Russia, such as: PJSC "Sibur-Holding", PJSC "Nizhnekamskneftekhim", PJSC "Nizhnekamskshina", PJSC «Kazanorgsintez», PJSC «TANECO», large corporations of PJSC “Gazprom”, PJSC “Lukoil”, PJSC NK “Rosneft”, and international oil companies "Schlumberger"(France), “Baker Hughes” (USA), PJSC "Uralorgsintez", PJSC "Kaustik", OJSC "Surgutneftegas", OJSC “Ryazan Oil Refinery”, PJSC “Taif-NK”, PJSC" Nefis-Kostmetik", sectoral research institutes, Kazan Research Center of the Russian Academy of Sciences. The percentage of graduates who after graduation work in the specialty is 100%, while an annual demand exceeding 150% of the out-put.

To ensure high starting opportunities for graduates in the labor market, the KNRTU organizes pre-university engineering training (80% of entrants). Specialized classes have been established in schools and lyceums with the participation of the leading oil and gas corporations of Russia. KNRTU implements training on the basis of the lyceum with in-depth study of chemistry with the participation of regional partners danish corporation "Haldor Topsoe" and European Chemical Thematic Network Association (ECTNA). The effectiveness of pre-university engineering training confirms the high average score of the Unified State Examination in natural science subjects, which allowed all to become university entrants, to get high scores of international testing in chemistry "EChemTest", increase the interest and growth of activity of schoolchildren's participation in conferences and competitions, olympiads of various levels.

The university realizes more than two hundred programs of preparation of engineers on the system of outstripping training. The formation of unique design competencies of future engineers provides training in 3D-design of oil production, refining and petrochemical processes using modern software products Autodesk, Integraph, Honeywell, CADWorx, UniSim, Aveva PDMS. To ensure the advanced research base for the preparation of masters, more than 30 basic departments have been created at chemical industry enterprises. The formation of highly specialized knowledge of masters of Chemical Technology promoted by joint international programs and included training in the universities of the European Chemical Thematic Network Association, Aristotle University of Thessaloniki (Greece), Technical University of Denmark, universities of China and Canada.

Introduction to pedagogical practice of multi-level project teams ensures the formation of a professionally oriented contingent of university entrants in engineering universities (up to 40%), activates research project activities of students (up to 75% on 1-3 courses, 100% on 4 course and during training in a magistracy), develops skills of

breakthrough research, ensures the competitiveness of graduates (up to 97% work by profession), promotes the development of small innovative project companies with the participation of students.

4.Conclusions

High rates of change and creation of technologies require the preparation of competent, prognostically and innovatively oriented engineering personnel. It could be provided by outstripping training with interactive methods and technologies. An innovative educational process forms future engineers with:

– readiness for self-development, self-realization, use of creative potential;
– ability to professional growth, to independent learning new methods;
– readiness to change the scientific and production profile of their professional activities;
– the ability to professional use of modern equipment and instruments;
– readiness to protect intellectual property and commercialize intellectual property rights
– the ability to quickly orientate in an innovative update in the industry;
– the ability to predict changes in production;
– the ability to develop, evaluate and implement innovations;
– a high level of creative thinking and social adaptability.

Students show great interest in learning in real production conditions. Graduates of Kazan National Research University confirm quick adaptation to professional activity and show fast career growth.

References

1. Bernasconi, Andrés, and Emilio Rodríguez-Ponce. "Importancia de la gestión institucional en los procesos de acreditación universitaria en Chile." Opción 34.86 (2018): 20-48.

2. Fartash K., Davoudi, S.M.M., Tatiana A. Baklashova, Natalia V. Svechnikova 4, Yulia V. Nikolaeva, Svetlana A. Grimalskaya (2018). The Impact of Technology Acquisition & Exploitation on Organizational Innovation and Organizational Performance in Knowledge-Intensive Organizations, EURASIA Journal of Mathematics Science and Technology Education, 14(4), 1497-1507.

3. Guravleva, M., Cherkasova, E., Bashkirceva, N., Zinnurova, O. (2017). Efficient Modes of Advance Training the Masters of Chemical Engi-neering. *Eurasian Journal of Analytical Chemistry*, *12*(5), 481-491.

4. Kazan National Research Technological University. (2008). University in the structure of an educational cluster. Interview with the Rector of KNTRU Dyakonov G.S. *Higher education in Russia, 2,* 48-56.

5. Muhina, T., Aboimova, I., Kulagina, A., Trophimov, V., & Chigarov, E. (2016). Development of emotional intelligence of students as a condition of successful adaptation to training. International Electronic Journal of Mathematics Education, 11(10), 3463-3467.

6. Strategies for the socio-economic development of Russia until 2030. (2013). URL: http://open.gov.ru/events/5514805.

7. Tastan, S.B., & Davoudi, S.M.M. (2015). An Examination of the Relationship between Leader-Member Exchange and Innovative Work Behavior with the Moderating Role of Trust in Leader: A Study in the Turkish Context. Procedia social and behavioral sciences, Elsevier, 181, 23-32.

8. Zhuravleva, M. (2011). Regional system of outstripping professional training of specialists for the petrochemical complex. *Gerald of Kazan state technological university*, *1*, 318-320.