

Concept of Advanced Electrical Engineers Education in the Context of Innovative Development

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Abstract – The concept of advanced electrical engineers education is proposed in the context of innovative technologies for training highly qualified personnel for the master's program based on an integrative model of engineers' education. The importance of practical and project-oriented engineers' education is indicated. Various expressions of the integrative approach in innovative organization of the educational process are shown, creating conditions for functioning of learning environment to form students' professional competencies that meet requirements of real project and practical activities.

Keywords – engineers education, practice- and project-oriented education, innovative technologies, linguistic training, highly qualified personnel

I. INTRODUCTION

The power industry, as well as the main engineering industries, has a pressing need for highly qualified personnel with a set of specific practical competencies and, especially, knowing foreign languages at a professional level, who are able not only to orient themselves on the international market of new equipment, but also to cooperate with foreign partners. It is necessary to carry out training of personnel capable of integrating into international production cooperation, scientific, technical and information exchange. Training of such personnel can not be provided by a higher education institution focused only on the implementation of strictly defined educational standards.

In our opinion it is possible to bring in line the needs of the real industrial sector and personnel training and moreover – to bring the sector to the international level with a use of other advanced innovative educational technologies. Such models are based on the integration of Russian and foreign experience with practice- and project-oriented learning, for example, such as «Innovation as Part of Electrical Engineers Education» [1–3].

Such process should be quite dynamic and able to quickly adapt to the needs of actively developing branches of the real sector of the economy.

It is necessary to study for 4–5 years according to the standard educational program, (abroad - 3 years) during which students mostly study extensive theoretical material. In this period students devote their study time to training practical skills only during training and work practice, lasting for 2-4 weeks a year, and linguistic training - 3-4 hours a week for 1.5-2 years.

At the same time, modern problems are the complexity of problem solving by specialists of various profiles, various educational levels and the integration of Russian and foreign experience. It is the symbiosis of various profiles, levels of training and foreign experience that allows us to solve breakthrough, high-tech tasks today. Cooperation with European higher schools will allow the maximum use of the world experience in the practice of training highly qualified personnel [4–8].



Fig. 1. The territory of Yakutia and Chukotka on the map of Russia.

Training of such personnel is the most relevant for the sparsely populated part of the Arctic zone of the Russian Federation: the Republic of Sakha (Yakutia) and the Chukotka Autonomous Region. Thus, the uniqueness of training highly qualified engineering personnel in electricity in the Far North implies training of a small number of specialists, but in a wide range of specialties (profiles), who know not only the technology of transmission and distribution of electricity, but also the specifics of the northern territories of the Arctic. At the same time, it is the system of personnel training that should be developed - obtaining high-quality practical and project-oriented education, linguistic training and efficient refresher course and advanced professional training [9]. Such uniqueness requires, at the same time, solution of the innovative tasks facing the country's economy today.

The system of practical and project-oriented, as well as linguistic education, should be aimed at developing new educational standards and, accordingly, educational programs based primarily on professional standards [10]. At the same time, training should organize the environment for the formation and testing of professional competencies, focused both on corporate domestic and on the best international foreign practices that manage technological energy processes. This will also contribute to the elimination of barriers between the real sector (business) and state educational institutions [11].

So, the problem of project-oriented training of power engineering specialists with linguistic basics is not only the problem of training specialists in a narrowly focused electric power industry, it is the problem of training qualified personnel for the economy as a whole [12].

II. RESULTS AND DISCUSSION

One of the possible solutions to the problem is to create an integrated model of engineering education. In this way in 2017, the North-Eastern Federal University of M.K. Ammosov won a grant for development of the educational program "Establishing smart energy system curriculum at Russian and Vietnamese universities" together with Russian partners. They were Irkutsk National Research Technical University, Tomsk Polytechnic University, Ural Federal University named after the first President of Russia B.N. Yeltsin and Kazan State Energy

University. Foreign partners were Grenoble Institute of Technology (Institut Polytechnique de Grenoble), Technical University in Kosice, Slovakia (Technical University of Košice), Riga Technical University (Rīgas Tehniskā Universitāte), University of Technology of Ho Chi Minh City (Ho Chi Minh City University of Technology and Education), Hanoi University of Mining and Geology (Hanoi University of Mining and Geology).



Fig. 2. Technical faculties building and natural sciences building of The North-Eastern Federal University.

The aim of the project is to support the modernization, accessibility and internationalization of higher education, as well as voluntary convergence with the initiatives of the European Council in the field of higher education. At the same time, the task is to develop a new educational program of integrated engineering education, aimed at improving the quality of higher education and its relevance for the economy while increasing the level of competencies and linguistic training in universities.

This project is objectively based on the state of development of the power industry and modern requirements of employers to the professional competencies of a university graduate. It creates a new master's degree educational program in accordance with the requirements of the Bologna process.

Creating an intellectual energy system of Russia is considered as one of the key tools for implementing the Energy Strategy priorities of the state energy policy and, thus, determines the relevance of the development of this area of energy, therefore training of highly qualified personnel in this area, able to apply innovative technologies in practice, is very important [13].

The most realistic, in our opinion, is the development of new learning technologies, which allow organizing such working space for engineering activities in which it would be possible to train students on the basis of the integration of science, practice, new innovative technologies, including foreign ones and mandatory linguistic training [14, 15].

It is necessary to create such a real space, which would become a learning analogue of the forecasted professional and social activities of a specialist, in which the procedural development of a student's educational activities would be carried out. As a result of that he would be able to proceed from the school form of activity he had learned to the professional and social ones on graduation from the university.



Fig. 3. Students of NEFU in the national championship WorldSkills

When organizing practical and project-oriented learning technologies and basic linguistic training, one should understand that these educational technologies are possible only under the condition that the projects the students work on must be, firstly, real and, secondly, innovative and breakthrough. Only this will allow to captivate students and also show them the opportunity, looking into the perspectives of the profession, to create real projects of the future and integrate into the world scientific and technical community. First of all, these are grants from RFBR and economic contract works.

The main element of this technology of education is the specialized department. Such department together with the university today, taking into account the regional uniqueness, and the conditions of not sufficiently reliable forecast in the needs of specialists, and the educational system lags behind the needs of the real labor market. This unit will be able to quickly respond to the labor market, organizing a dynamic and flexible system of training bachelor and undergraduates both in areas and engineering specialties that are currently absent in the region and to organize the education system in all necessary engineering programs. Such system will work equally well for a separate region with small population, but large territory, and for the entire Russian Federation. Objectively, a small number of highly targeted highly qualified specialists is required, while having a flexible system for replenishing them.

This project is integrated with the training of mid-level specialists. The project includes vocational skills training, which will enable the implementation of a cross-cutting multi-level education system. In the future, this project will help to dynamically fill the labor shortage in the labor market.

The indicator of professional skills in the field of applied engineering specialties and professions is an auxiliary element of the list of competencies in the academic nature of teaching at the university.

FutureSkills Block is responsible for the tasks of academic areas of the university. The main characteristic of FutureSkills Block is multitasking and multifunctionality from the existing list of professional competences of the specialties declared in competences. Therefore, the competence of FutureSkills, according to the developed model, is in the process now. For example, students participating in FutureSkills "Reverse

engineering" and "Prototyping" can take part in national competitions as members of the team WorldSkills Yakutia. And they can be members of the university of the WorldSkills competition at the same time. They will also be able to take part in other initiatives of the Agency for strategic initiatives. For example, the National Technology Initiative Energynet will contribute to the formation of ecosystems of energy producers and consumers, which are seamlessly integrated into the overall infrastructure. Participants of information competencies have the opportunity to take part in competitions and Olympiads of different formats successfully, such as the hackathon, competitions of professional skill (for example, the Olympics "IT-planet", VolgaCTF, Cisco Networking Academy NetRide, etc.). This increases the academic quality of the students involved in the movement significantly. In addition, the participation of students in research using new technologies can improve the quality and speed of research.



Fig. 4. Students of NEFU in the championship WorldSkills in Moscow

Meanwhile, FutureSkills is becoming the main driver for a sustainable intellectual platform, which, in turn, will be the basis for the transition of the regions of the North-East of Russia to the "knowledge economy" and the entry into full force of the digital economy.

Factors that are the cause of the digital economy and other global processes generate a new corporate culture at the University. That strives to develop and improve the quality of professional skills, unusual for the region. This is the policy of the future, this is the method of future skills.

The work of the FutureSkills research unit focuses on the forecast of competencies. These competencies are essential for Industry 4.0 (the fourth industrial revolution). Analytical work is carried out to determine competencies and ways of their transformation. In addition, finding the answer to the question is crucial for the employment of people. Those people risk losing their jobs as a result of the technological revolution.



Fig. 5. Students and Director of FutureSkills NEFU participated in the selection of candidates for the national team to participate in the WorldSkills Kazan 2019 championship. The qualifying stage for future Skills competencies was held in Moscow.

Representatives of industrial enterprises are partners of the NEFU line participate as Russian and international experts of the Future Skills block. Their linguistic training allows us to formulate requirements for personnel in promising professions and competencies. This helps to develop appropriate educational programs in the future. Support and development of the Future Skills initiative are in-depth linguistic training. International collaboration of Russian and foreign universities allows you to set up cooperation with industry associations on cross-cutting competencies and develop criteria for the entry of competencies into promising blocks. Thus, it will ensure the advanced development of engineering education in the Russian Federation.

III. CONCLUSION

As a result of the project, a didactic cyberspace will be formed, filled with textbooks, electronic learning resources, and regulatory documents of the Russian Federation and the European Union.

Meanwhile, a conceptual task will be solved - a change in the traditionally established system of training engineering personnel. It is necessary to develop effective linguistic, flexible project and practice-oriented educational technologies, allowing for the continuous training of engineering personnel, starting with SPE, continuing in HE and further teaching professional standards. The task can be solved only by high motivation of managers of the real sector of business and educational institutions, development and testing of new forms of interaction between business and state (federal) educational structures during the implementation of project – oriented educational programs. Only with this, engineering personnel will be able to successfully create high-tech production, implementing innovative and breakthrough technologies.

This project is integrated with the training of mid-level specialists, which will make it possible to carry out a multi-level educational system and dynamically fill the labor shortage in the labor market.

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