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ANALYSIS OF FOREIGN EXPERIENCE OF TRAINING FUTURE ENGINEERS FOR INNOVATION ACTIVITY

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ABSTRACT
The article deals with the training of engineering technologists for innovative activity in the context of global trends and best practices of international education. The main attention is paid to the analysis of key aspects such as cluster approach in education, participation in international programmes, innovative teaching methods and cooperation with industrial partners. Examples of successful practices from leading universities around the world, such as MIT, Aalto University and Technical University of Munich (TUM) are presented. Based on the analysis of foreign experience, recommendations are offered to improve the system of training engineers-technologists in Uzbekistan, aimed at integrating modern technologies and teaching methods, expanding international cooperation and strengthening links with industry.
KEY WORDS: *innovation activity, training of engineering technologists, cluster approach, international educational programmes, project-oriented learning, interdisciplinary programmes, cooperation with industry.*

INTRODUCTION

In today's world, where innovation is becoming the basis of economic growth and a key factor in solving global problems, the role of process engineers is particularly important. These professionals, working at the forefront of technological developments, play a key role in the process of creating and implementing new technologies, which in turn contributes to sustainable development and improved quality of life on a global scale. Their skills and knowledge are the basis for the development of new products, processes and services that open up new opportunities for business, science and society as a whole. In light of the need to adapt to the ever-changing technological environment, educational systems in many countries of the world prioritise the training of process engineers with innovative thinking and the ability to adapt quickly to new realities.

Foreign experience of implementation of cluster policy at the state level in various countries with developed industrial economy is analysed. The relevance of formation and development of scientific-innovative clusters in Uzbekistan is substantiated [1]. The proposed training technology called cluster is aimed at reducing the dropout rate of students in technical universities. It involves the generalization of fundamental knowledge, practical experience and subject activity, turning education into a dialogue of communication and joint activity [2]. The role of innovative industrial clusters in ensuring sustainable development of the region, especially in knowledge-intensive and high-tech sectors of the economy, is emphasised [3]. A comparative analysis of the implementation of cluster policy in foreign and Russian practice is carried out, the characteristic features of clusters and their role in improving the competitiveness of territories and economies are highlighted [4]. Industrial clusters, having advantages in the concentration of resources, can create a favourable entrepreneurial environment and increase the chances of success for young entrepreneurs [5].

The cluster approach in education, which acts as a strategy for integrating theory and practice, highlights key elements aimed at better preparing students for real-life professional environments. Firstly, practical experience gained by students while working on actual projects allows them to apply and deepen theoretical knowledge, contributing to the development of professional skills and competences, which is the basis for a successful career[6]. Secondly, the active participation of employers in the educational process, including contributions to curriculum development and teaching, ensures that the educational content is updated in line with current labour market requirements. Finally, co-operation between educational institutions and industry in the field of innovation and technology transfer accelerates the introduction of innovations into production, thus strengthening the competitiveness of the economy at the international level [7].

The cluster approach finds its application in various countries, demonstrating effective co-operation between educational institutions and industry. In Germany, for example, clusters in the fields of mechanical, electronics and automotive engineering, such as the Automotive Cluster in Bavaria, promote synergies between academia and industry. In the US, the Manufacturing USA programme is leading to the creation of innovative institutes, including the Lightweight Manufacturing Institute (LMI) in Detroit, which focuses

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on lightweight materials research for the automotive industry. And in Finland, the "Education for Innovation" programme strengthens links between educational institutions and companies, as seen in the cooperation between Aalto University and companies in the fields of IT, design and biotechnology [8].

The cluster approach forms an educational ecosystem in which education, research and the business community cooperate to develop specialists ready to innovate and work effectively in a dynamic economy.

Figure 1: The co-creation stages of the innovation process

In addition to this, international educational programmes such as ERASMUS+, Fulbright programme, dual degree systems, MIT International Science and Technology Initiatives (MISTI) and Global Engineering Education Exchange Program (Global E3) play a key role in broadening students' horizons and contribute to their professional and personal development in the international arena [9].

ERASMUS+ is known as a significant initiative of the European Union, providing students with the chance to study, internship and participate in projects across Europe, while promoting their linguistic and cultural development. The Fulbright Programme opens doors for scholars to leading US universities, facilitating academic exchange and professional development. Dual degree systems create bridges between educational institutions in different countries, offering students the opportunity to study in different cultural and academic contexts. MIT International Science and Technology Initiatives (MISTI) provide students with opportunities for internships and research opportunities, collaborating with MIT faculty and students to deepen scientific knowledge and skills. Finally, the Global Engineering Education Exchange Programme (Global E3) facilitates exchange experiences for engineering students by providing educational opportunities at partner universities and participation in global projects.

International educational programmes contribute significantly to the globalisation of the educational process by strengthening professional interaction between different countries and contributing to the creation of an international community of qualified professionals. They open new perspectives for the exchange of knowledge and cultural enrichment.

Modern educational methods such as project-based learning, interdisciplinary programmes, partnerships with industry and the introduction of advanced technologies are reforming the approach to learning, making it more relevant and impactful.

Project-based learning allows students to directly apply theoretical knowledge to practical work, fostering professional and communication skills and increasing their motivation. Interdisciplinary programmes provide students with a holistic understanding of different aspects of knowledge, improving critical thinking and the ability to solve complex problems. Interaction with industrial partners enriches the educational process with relevant practical knowledge and skills, while the use of modern technologies, including 3D printing, virtual reality and artificial intelligence, increases interactivity and understanding of the material, preparing students for careers in high-tech industries [10].

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These educational methods not only enhance the learning process, but also prepare students to be effective in a dynamic and innovative world where multidisciplinary analyses and complex problem solving skills are valued. Leading universities such as the Massachusetts Institute of Technology (MIT), Aalto University and the Technical University of Munich (TUM) serve as examples of best practices in education, illustrating innovative strategies in teaching and co-operation with industry. MIT stands out for its project-based learning and partnerships with leading companies, as well as its integration of design, management and technology through programmes like IDM and Media Lab. Aalto University is known for its emphasis on creativity and interdisciplinary approach, providing an innovative educational environment in its schools of design and engineering. TUM is distinguished by its unique collaboration with business and the integration of educational and industrial space, which facilitates the commercialisation of research. Thus, these institutions have demonstrated how deep integration between the academic environment and industry can enrich the educational experience and foster innovative thinking and entrepreneurship among students.

Based on the above, in conclusion, it can be said that incorporating practical experience, international exchange, interdisciplinary programmes and modern technology into the educational process is critical for the training of qualified process engineers. The experience of educational institutions, such as MIT, Aalto University and TUM, demonstrates successful integration of academic learning with industrial and research activities, contributing to innovative development and professional growth of students.

To develop such practices in Uzbekistan, lead the development of university-industrial clusters, actively participate in international educational programs, apply modern teaching methods, stimulate scientific research and strengthen the infrastructure for innovation. Such actions contribute to the creation in Uzbekistan of a power system for training process engineers who are ready to contribute to the innovative development of the country and its integration into the global threat.

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