ABSTRACT
The article provides a holistic analysis of the issues concerning professional training of petroleum engineering specialists at higher educational institutions in the USA. It considers international research related to the education of petroleum engineering specialists, reveals the impact of the world globalization and European integration on the development of higher technical education for oil and gas sphere. The article also emphasized that the energy transition is rapidly changing the playing field for all companies in this sector. This change increases the necessity for innovation exponentially. The oil and gas industry, in itself a relative conservative industry, has to “turn up the heat” and embrace new technology at a high pace to get ahead of the curve. It has been proved that forming the training petroleum engineering specialists in university education requires a proactive approach, purposeful elimination of existing shortcomings. It has been emphasized that in the world of work, professional training is important for oil and gas companies and for employees. For companies, good training ensures that their staff have up-to-date skills and knowledge. For employees, professional training can drive career development and open up new opportunities. New trends in the training of petroleum engineering specialists-to-be were revealed and formed the basis for the instructional guidelines on improving petroleum engineering specialists professional training at technical universities of Ukraine at four levels. It summarizes the results of the studies in this highly developed country, and identifies progressive and constructive ideas of the international experience.

Keywords: professional training, higher education, petroleum engineering specialists-to-be, American education, foreign experience, curriculum, professional educators, engineer professional development, educational environment.

Професійне навчання нафто- і газонагідних спеціалістів - мати увагу зазначеного міжнародного досвіду.
INTRODUCTION

The world is changing rapidly and the speed of those changes is increasing exponentially (Wischmann, 2019, p. 93). Higher education, research and innovation play a crucial role in supporting social cohesion, economic growth and global competitiveness. Given the desire for any society to become increasingly knowledge-based, higher education is an essential component of socio-economic and cultural development. At the same time, an increasing demand for skills and competences requires higher education to respond in new ways.

Modern world integration processes lead to an increase in demand for engineers with international level competences. This requires the improvement of continuous training. American higher educational institutions have been critical in training petroleum engineers and poising the USA to be the major world oil player it is today. US higher education has been the subject of research by domestic and foreign scholars for many decades. On the one hand, this is explained by the uniqueness of American higher education, its fundamental difference from European educational systems, on the other, the recognition of the US higher education as one of the most advanced in the world. Ongoing processes of reform to improve the American educational system, the search for and innovation of the world’s best educational achievements attract scientists and encourage them to study an element or process within the system, to analyze the most pressing issues. Nowadays the American oil and gas industry is the most developed and powerful. In particular, the United States plays a dominant role in the world’s petrochemical industry due to the availability of large reserves of hydrocarbons, developed infrastructure, “know-how”, as well as its ability to make huge investments.

THE AIM OF THE STUDY

Our study is aimed at analyzing the issues concerning professional training of petroleum engineering specialists-to-be at higher educational institutions in the USA.

THEORETICAL FRAMEWORK AND RESEARCH METHODS

The theoretical basis of the study are: leading theoretical and methodological provisions of philosophy, pedagogy, psychology on the dialectical unity of development processes and continuous professional self-improvement of the individual in the context of modern concepts of humanization of education; conceptual principles of development of professional (vocational-technical), higher education in the USA; principles of practical orientation, scientificity, objectivity, integrity and comprehensiveness of studying
phenomena and processes in interrelation and interdependence; system-activity approach as a methodological way of cognition of psychological and pedagogical phenomena and solution to psychological and pedagogical problems of training engineers for the oil and gas industry at institutions of higher technical education; analytical and comparative approach aimed at studying historical and pedagogical, comparative and other references, legislative and regulatory documents, methodological experience of teaching staff; interdisciplinary approach to comparative analysis, identification of didactic features of the educational process at technical universities and opportunities for integrating the content of general and special disciplines and updating the areas of training.


To reach the goal of the study we have used such general scientific methods as theoretical analysis, synthesis, abstraction, systematization, generalization, comparative analysis as well as andragogical, aimed at the relevance of the content of further education, mastery of new technologies in various fields of production and prognostic for revealing independent objective characteristics of this process in order to ground the prospects for higher education of the oil and gas profile.

RESULTS

American universities of oil and gas profile are one of the most well-respected training providers in the industry. They provide their graduates with extensive training and educational opportunities, along with numerous tools and resources. These higher educational institutions help their students multiply and expand their competencies and develop their careers. Petroleum engineering specialists-to-be receive good learning and development opportunities, including continuing skills development and technical training online, classroom and on-the-job courses and video conference systems. Moreover, comprehensive training that American universities (California Institute of Technology, University of California, also known as Berkeley, Massachusetts Institute of Technology, Princeton University, University of Minnesota at Twin City, Stanford University, University of Texas at Austin, University of Wisconsin University of California, Santa Barbara) provide not only helps future specialists acquire hands-on field experience right away, but it also gives them a head start on the path toward developing a long and successful career in this industry. During their studying petroleum engineering specialists-to-be are right in the thick of things; collaborating with customers and experienced engineers; ensuring project quality control; supporting project changes; troubleshooting and solving customers’ problems at a moment’s notice. These essential skills can put opportunities in areas such as research and development, business development, marketing, operations management and technical leadership in their reach much faster. The graduates of American universities have the opportunity to put their careers on the fast track and begin making an immediate impact on their future and the company’s success (McDavid, Echaore-McDavid, 2006).
It should be outlined that the training of petroleum engineering specialists-to-be starts with preuniversity engineering training in multipartner educational environment. Preuniversity engineering training is considered as a stage of applicants’ orientation to engineering education and their adaptation to the complex educational process at university. This can be achieved by improving the content of education and including the technological, applied research and special linguistic components. The main directions of the content of the preuniversity training are variable and have to be determined according to the tendencies of high-tech industries integration into the international technological space. An important factor is the implementation of training in an international multipartner scientific and educational environment, which involves the international production companies, international profile network associations and the international academic community in the educational process. This allows implementing effective forms of training, including the work in real research teams, networked educational programs, the usage of virtual platforms and simulators. Most American higher educational institutions of oil and gas profile implement preuniversity training on the basis of schools with their advanced curricula. Such training is organized with the participation of regional oil and gas companies. Preuniversity engineering training develops students’ motivation for engineering education, has a professionally specified character of training and also comprises the changes in the content of the engineers’ future professional activity (Beynon, 2014).

As for Graduate Studies at Texas A&M University (2020) it is generally known that this university and Institut francais du petrole (IFP) together offer an advanced, collaborative international program geared to meet the needs of the oil and gas industry. The International Program in Petroleum Management and Economics is designed for students and professionals with an engineering degree or higher qualifications seeking in-depth training in the technical, economic, and financial aspects of oil operations. Course work for the program includes classes in finance, economics, statistics, reservoir simulation, and production evaluation plus electives at Texas A & M. This university is highly experienced and internationally recognized faculty teach courses and conduct research in their areas of special interest and expertise. It should be mentioned that Texas A & M’s professors helped shape the development of the petroleum engineering industry beginning in the 1950s. Also, they began setting industry standards during the 1960s and 1970s. Professors at Texas A & M University are world leaders today in well stimulation and logging; they are developing ways to use technologies that will carry the industry into the future.

With an average graduate load of five students per faculty member, the Petroleum Engineering Department continues its long tradition of placing the student first. The success of our former students who have received graduate degrees in Petroleum Engineering is a source of pride among the faculty. Petroleum engineers’ training is run by educational development programs whereby all training stages’ duration and competency requirements are defined. Current educational development programs include well construction, flow assurance and artificial lift, reservoir engineering, production operations, formation evaluation, and hydrocarbon processing and metering. The Petroleum Engineering Curriculum at the Department of Petroleum Engineering and Geosciences is designed to prepare graduates for useful employment or graduate study in the petroleum industry by providing instruction in topics of drilling, production, pipelines construction, underground gas storage facilities, reservoir analysis and logging; they are developing ways to use technologies that will carry the industry into the future.
includes courses developing a proficiency of computer application, humanities and social sciences, communication and engineering topics. Student creativity is developed throughout the curriculum by use of open-ended problems, development and use of design methodology, formulation of design problem statements (Mitcham, Englehardt, 2016).

The laboratories are designed to familiarize the student with practical and theoretical problems encountered in the petroleum industry and to promote communication in technical activities. Wherever practical in the course of study, trips are utilized to illustrate equipment and problems studied and to promote professionalism.

The Bachelor of Science degree in Petroleum Engineering is awarded on completion of a comprehensive curriculum of technical and practical courses in programming, systems analysis, information systems theory and design, and computer technology. This program is designed for individuals seeking specialized technical proficiency, and requires at least 48 semester credits of computer science courses and a sequence of mathematics through Calculus II and Discrete Mathematics.

Students selecting either a degree in Petroleum Engineering (Bachelor of Science) will be developing the intellectual and practical skills of the natural scientist to enable them to understand interrelated physical, chemical, and biological processes in the geosphere, hydrosphere, atmosphere, and biosphere. In addition, students will develop the equivalent skills of the social scientist to allow them to understand the social, cultural, political, and economic impacts of environmental changes caused by human activities. According to the program features special attention is given to extensive coordination and integration among courses from the natural and social sciences, integration of qualitative and quantitative communication skills; practical experience from research projects or internships laboratory experiments.

This program prepares students to enter the professional graduate fields of study, work in complex environments, develop unconventional hydrocarbons, including heavy oil, economically, and exploit smaller accumulations more efficiently.

Significant achievements of the American system of technical education include high individualization of education with innovative scientific and methodological support of most disciplines, clearly organized independent work of students and real flexibility in choosing educational trajectories. State support for technical education has a clearly defined targeting and is aimed at ensuring the constitutional rights of citizens in the field of education, and lecturers and students are more motivated in their educational and teaching activities. Progressive legislative maintenance encourages higher technical education, various forms of professional development, future professional work and charitable activities in support of universities, talented students and promising research (Downey, Lucena, 2004).

American technical universities have been found out to offer fewer compulsory technical disciplines, more humanities courses, and especially electives than European ones. At American universities more study time is provided for term papers (Peters, 2007).

Study of educational programs and curricula of American universities (California Institute of Technology, University of California, also known as Berkeley, Massachusetts Institute of Technology, Princeton University, University of Minnesota at Twin City, Stanford University, University of Texas at Austin, University of Wisconsin University of California, Santa Barbara) proves that the attention to the formation of students’ entrepreneurial skills is growing. They are offered educational programs in entrepreneurship, as well as separate courses (finance and entrepreneurship, venture capital, legislation in the field of entrepreneurship, entrepreneurship in the social sphere). The close role of
universities with various industries plays a positive role. University and college professors and faculty have entrepreneurial experience, and are often entrepreneurs themselves, overseeing startups or participating in business incubators located on the university campus.

Based on the research results and progressive constructive university practices in the USA, new trends in the training of petroleum engineering specialists-to-be were revealed and formed the basis for the instructional guidelines on improving petroleum engineering specialists professional training at technical universities of Ukraine at four levels: at the national level, at the industry level, at the university level, at the individual level. The highest, national, level determines the strategic direction, while purposeful execution is carried out at other levels. The individual level provides guidance for students with due regard for their future professional activities in the oil and gas industry. As of today, these levels are still insufficiently specified and insufficiently interconnected. For this reason, we consider them in the prognostic aspect. They should be definitely interconnected since their fragmentary implementation lacks efficiency and cannot create a synergistic effect.

CONCLUSIONS

Thus, at the technical universities of the USA there is an active implementation of innovations in order to form an information infrastructure, ensure individualization, accessibility and quality of the educational process; the tendency to increase the applied component in the content of professional training of oil and gas specialists; transition to individual-group teaching methods using distance and digital learning technologies. Due to the tendency of conceptual similarity of educational policies of technical universities, interests of American universities, an international space of higher education in the oil and gas engineering profile is created. Common features for this country is the possibility of professional training, retraining, advanced training and professional development in formal, non-formal and informal education, participation in the training professionals for the oil and gas industry, both public and private educational institutions.

Summing up the analysis of the peculiarities of professional training of specialists for the petroleum industry considering the experience of American universities we should single out high individualization of education with innovative scientific and methodological support; precisely organized independent work of students; real flexibility in the selection of educational trajectories; fewer compulsory technical disciplines, more courses in humanities, especially electives; development of entrepreneurial skills; system of university relationships with different branches of manufacturing; lecturers possessing entrepreneurial experience.

Several areas for further research are suggested, among them: historical and comparative pedagogical studies of establishing and developing national systems of training specialists for the oil and gas industry in the European Union and Canada; didactic principles for the educational process at higher education institutions of oil and gas profile in the digital society; comprehensive research into the partnership between oil and gas businesses and related universities.

REFERENCES


