Journal of Vasyl Stefanyk Precarpathian National University
http://journals.pnu.edu.ua
Vol. 9, No. 1 (2022), 58-68

UDC 37.047:37.013.8
doi: 10.15330/jpnu.9.1.58-68

IMPROVEMENT OF THE QUALITY OF FUTURE ENGINEERS' SOCIAL AND HUMANITARIAN TRAINING IN THE HIGHER TECHNICAL EDUCATION INSTITUTION

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Abstract. The article highlights the urgency of training highly qualified and competitive engineers in the labor market under the requirements of the world economy, the level of technological development, and taking into account societal demands for the quality of educational services. International experience of training future specialists and directions of improving the skills of engineering and technical personnel are analyzed. The results of the study of educational programs for the training of future engineers in the institution of higher technical education are presented. The necessity of updating the content of education based on professional and creative training of specialists in the field of engineering has been proved, considering it as a holistic process of personal and professional development of the graduate. The pedagogical potential of social sciences and humanities about the professional development of engineering and technical specialists is presented. Interdisciplinary courses are offered, which are aimed at philosophical understanding of the socio-economic situation in the country and the world, the development of critical thinking and abilities to organize one's own business, management skills, and more. Several methodological aspects of the implementation of pedagogical innovations in higher education are substantiated, including business and role-playing games, Problem Based Learning, Project-Based Learning, Oxford Debates, group work, interactive training, and workshops. The importance of professional communication as a complex socio-psychological formation is associated with the process of training future engineers and characterizes the level of formation of integrative knowledge, professional skills, and abilities. Emphasis is placed on the necessity to develop highly qualified specialists' creative thinking, the initiative in decision-making, the ability to work in a team on solving philosophical issues, etc. The author has proven convincingly the urgency for preventing various forms of discrimination against people with special educational needs, as well as avoiding gender stereotypes and ideas in the institution of engineering and technical profile.

Keywords: social disciplines, social and humanitarian training, future engineers, training of specialists, a higher technical education institution of, quality of education.

1. INTRODUCTION

In the context of globalization, integration of countries into a civilized educational community, reforming the world economy requires a competitive specialist in the labor market, able to understand societal challenges deeply, have theoretical knowledge, professional competencies in

innovative technologies, and show readiness for self-learning and self-improvement [17]. The problem of improving the quality of professional training of engineers is also due to the necessity of providing industrial enterprises with qualified, enterprising staff based on thorough training, quickly adapting to changing market conditions, creatively expressing active independence in solving professional problems of resource-saving technologies [9].

The major European models of engineering training (the German, the British, and the French model) spread throughout the world during the twentieth century. In these countries, the national standards inherited are now completed by international standards or are in direct competition with new influences" [6]. European models of training are extremely interesting in terms of "demands from the industry that engineers of the future", the quality of training of specialists engaged in higher engineering education. The problem of "content of an engineer's education" is actualized [5].

Engineering education is developing quite intensively in the United States, where it is proposed to establish close connections between educational institutions and enterprises to combine theoretical and practical training.

Japan, South Korea, India, and other countries pay attention to the implementation of modern innovations in science and technology, improving the skills of engineering and technical personnel.

Although engineering education modes in various countries have different features, they have one thing in common: They all strengthen the engineer's comprehensive quality and train students to lead the development of engineering technology at home and abroad; excellent experiences of foreign engineering education reform can provide information for reform of higher engineering education in different countries [19].

In some countries (for example, Portugal, Ukraine, etc.) it is a question of the introduction of mixed feature courses in university education. After all, the current experience of training shows the need to focus on "ethical and civic education in engineering courses", because "training profile on ethical issues relies heavily on the engineer's concept and the perception of engineering action" [12].

At the present stage, substantial changes are in great demand in the field of humanitarian education, which is important in ensuring the quality of professional training of engineering and technical specialists.

Therefore, today it is important to analyze the level of the philosophical, socio-ethical, value-oriented direction of the content of higher technical education, as well as connections between areas of training - social-humanitarian, professional-oriented, etc. After all, the socio-humanitarian component of the educational process provides students with the opportunity for the development of critical thinking, their views on the socio-economic or political situation, and possibilities to qualitative assessment of complex realities, and effectively use the competencies acquired in higher education.

Thus, the humanities contribute to the intellectual development of the individual, acquiring an engineering profession, and aims to understand and comprehend oneself. In addition, the content of social and humanitarian courses influences the emotional sphere of students, their understanding of events, facts, views, as well as the development of personal values that determine their attitude to the spiritual, cultural, professional heritage of humanity.

Modern challenges of the coronavirus pandemic have highlighted the need for effective distance education in engineering institutions, and hence the use of information and communication technologies in the study of social sciences, humanities, and vocational disciplines. After all, every student should have access to high-quality opportunities and technologies, regardless of residence, ethnicity, race, or gender.

The purpose of the article is (1) to present public challenges for improving the quality of

training of future engineers; (2) to substantiate the methodological aspects of the implementation of pedagogical innovations in higher education institutions; (3) to present the pedagogical potential of social and humanitarian disciplines concerning the professional development of engineering and technical specialists.

2. RESULTS AND DISCUSSION

In modern conditions, young people are in no hurry to choose an engineering profession, because you can often find a high-paid job without special education. In addition, many countries have experience in creating teaching and learning centers in universities of technology, reducing the quality of university education [7]. Many useful courses can be mastered on their own by acquiring non-formal online education, such as the Master crash course on software engineering in a multicultural environment [2].

Therefore, there is a problem of school graduates' interest in technical professions, as well as optimizing the training of these professionals, the introduction of innovations in the educational process so that the graduate can be competitive in the labor market in the era of rapid technology.

The issues of updating engineering education programs are typical for many countries [1], especially with low and medium levels of socio-economic development. For example, in North Africa and South-East Asia, new educational programs are being introduced in technical educational institutions that would meet the current trends in innovation with a focus on the experience of training engineers in Western Europe. In the pedagogical aspect, we are talking about active teaching methods (Projects, Problem Based Learning, Fablabs, etc.) [10].

In the context of humanization of higher engineering education, improvement of the methodological aspect of professional training, the following areas should be identified:

1) the penetration of humanities knowledge and its methods into the very content of natural sciences and technical disciplines;

2) redirection of historical fragments of natural science disciplines to social and humanitarian orientation;

3) comprehensive assimilation of theoretical knowledge about a person who is included in technical systems, which will contribute to the disclosure of human, cultural content of vocational education.

This content must have a strong impact on the worldview of scientific and engineering concepts, in the history of inventions and discoveries, in prominent scientists and engineers' dramatic life paths. The reserves of ethical experiences and aesthetic education laid down in the field of science and technology are practically inexhaustible [11, p. 272].

Therefore, in our study, we consider the future specialist in the context of personality-oriented education as a self-sufficient value, and pedagogical interaction in the educational process between teacher and student - as a joint subject-subject activity based on mutual understanding, empathy, and co-creation to achieve the united purpose of professional growth.

Guided by a common goal and objectives in the training of future engineering professionals, a prominent place belongs to the content of higher education, which needs to be updated by societal challenges, the development of science and technology.

To do this, we analyzed the international experience and curricula of different countries.

"Excellent engineer education training program is proposed by China's Ministry of Education, which is also known as "excellence engineer program."... To promote the smooth implementation of the excellence engineer plan, it is a matter of the utmost urgency to mobilize the powers of all stakeholders concluding enterprises, industries, and universities. An excellent engineer program is an important approach to training practical talents, which aims to change the talent-training mode of engineering education and create a new talent training mechanism through school-enterprise

cooperation. The Excellence engineer program is one of the methods to promote the quality of engineering education in China, which can form a novel talent education process with stable teaching contents, curriculum system, management system, and evaluation method based on modern educational theory" [18].

Without going into a detailed analysis, it is important to point out that their structure is mostly identical and contains fundamental and vocational training (Fig. 1).

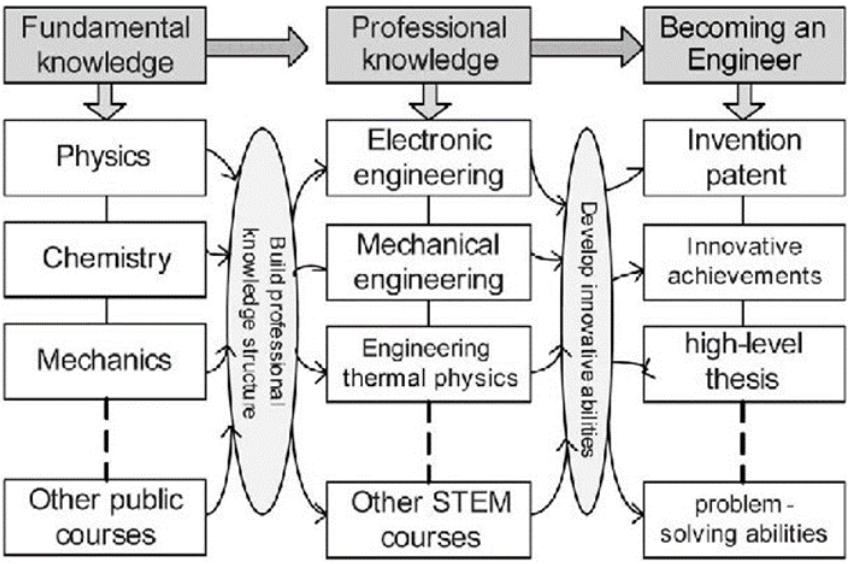

Fig. 1. The process of training excellent engineers (experience of China). Source: [8].

The problem of updating the content of education can be solved based on professional and creative training of specialists in the field of engineering, considering it as a holistic process of the graduate's personal and professional development. Such training should provide conditions for self-realization in educational and professional activities and further development of personal and professional qualities that contribute to success in relevant creative activities. The level of development of creativity is reflected not only in the specialist's professional sphere but also in various types of his/her daily activity – cognitive, ideological, communicative, labor, and emotional.

We have analyzed several educational and professional training programs for future Masters of engineering at the Ivano-Frankivsk National University of Oil and Gas (Ukraine). The disciplines of social and humanitarian orientation are as close as possible to the profile of professional training.

Thus, the program "Software Engineering" of the second (Master's) level of higher education is aimed at training highly qualified specialists in the field of information technology.

The model of specialist training in this area contains the following blocks (Fig. 2):

- The general training cycle (*Philosophy of Information Technology and Software Engineering, English for Professional purposes, Methodology of Scientific and Analytical Research in the field of IT, presentation and defense of results*),
- The cycle of professional training disciplines (*Latest concepts of data and means of their processing, Innovative approaches to IT, Architectural concepts of software and software engineering, etc.*),
- The cycle of professionally oriented elective disciplines and a separate block of the discipline of free choice of students.

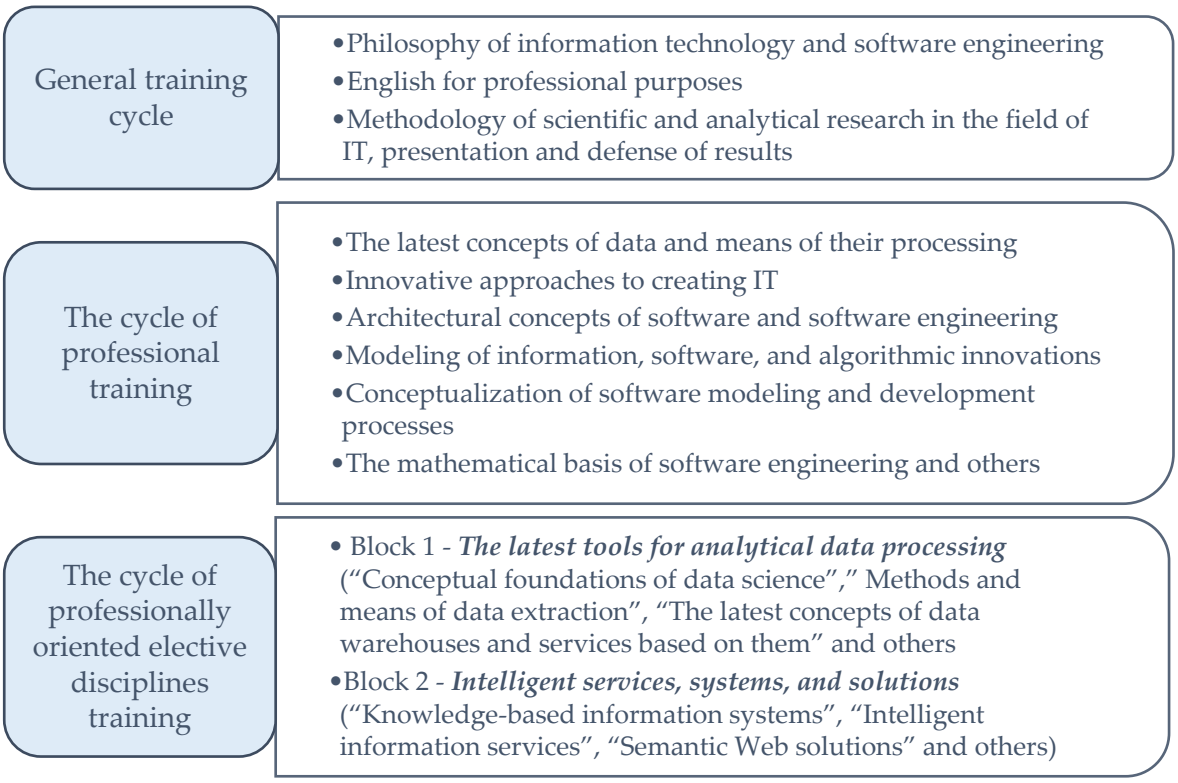

Fig. 2. Model of Master's degree training in the program "Software Engineering" (experience of Ukraine). Source: Copyright.

Fig. 3 presents an approximate integrated cycle of social and humanitarian training of future specialists in the field of engineering. In this model, we emphasize educational innovations in working with students, as well as interdisciplinary courses in the relevant field. After all, an important aspect in the training of engineers – students' ethics and civic education [12]. Theoretical and methodological substantiation of the structure and content of integrated training courses is the basis for the transition from the descriptive category "taking into account the creative pedagogical sphere" to the activity category "creating a creative pedagogical sphere" [11].

Therefore, we offer several courses that reflect this topic in line with the socio-humanitarian component of the content of higher engineering education. Among such integrated disciplines for study at the choice of future professionals, we propose to include in the educational and professional program of technical universities the following: "Philosophy of Business", "Heuristics", "Professional Ethics", "Philosophy in Culture", "Philosophy of Management", and "Futurology". These courses are mostly addressed to undergraduates. Let us analyze some of them.

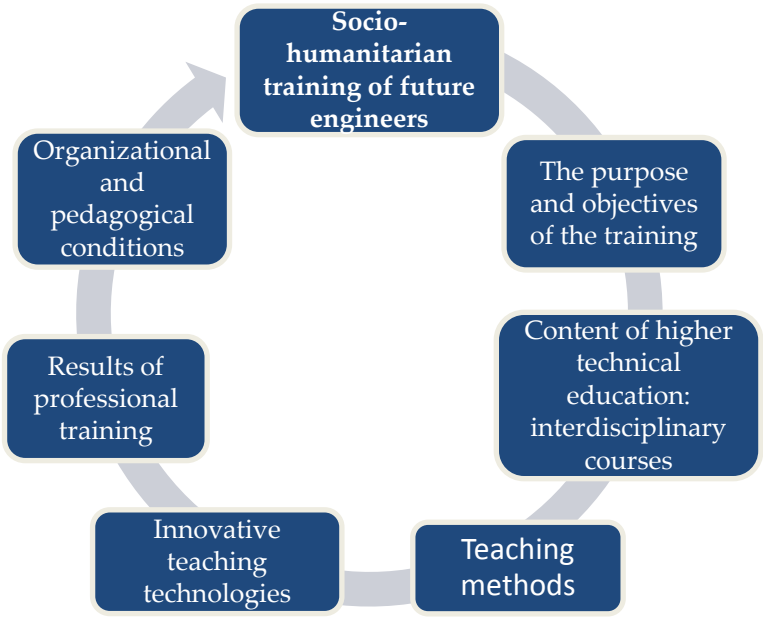

Fig. 3. Approximate model of an integrated cycle of social and humanitarian training of future engineers.

The field of study of *Futurology* is philosophical ideas of thinkers to design the future: a human, a society, a state, or a socio-political system. The course is interdisciplinary, as it synthesizes knowledge of sociology, psychology, history, history of philosophy, political science. Students' acquisition of systematic knowledge of futurological predictions about the milestones of human society will promote the development of analytical thinking, practical skills to identify trends and patterns of development of futurological predictions and argue them.

Philosophy in the system of culture is a discipline aimed at deepening the knowledge and practical skills of graduate students about the basic cultural heritage of humanity and their philosophical significance, historical and philosophical forms of cultural manifestations, current problems of cultural philosophy, the most common cultural theories and concepts of different periods. The study of this course aims to form the students' philosophical worldview in line with a deep understanding of cultural manifestations in human life and society. After all, culture influences how we perceive the world, evaluate the ethics of interpersonal interaction, including in a professional environment. Therefore, it is important today to be able not only to analyze the philosophical content of historical and cultural sources based on methods of philosophical and cultural knowledge but also to have the necessary experience of analysis of modern world and national culture and apply these competencies to improve professional skills.

"Ethno cultural factors of technical and natural science creativity should not be neglected, which is also one of the means of forming students' understanding of the content of knowledge, and hence all human activity" [11, p. 272].

The course *Philosophy of Business* is particularly in demand among students of various engineering specialties under market economy conditions. Its purpose is to teach graduate students a philosophical understanding of the socio-economic situation in the country and the world and to focus on this in the process of organizing their own business. The entrepreneurial activity requires critical thinking and appropriate communication skills to create your own business, analysis of the situation in socio-cultural and historical contexts. Therefore, when studying the course of socio-economic relations in different countries, their comparison in historical retrospect and modern economic conditions are of great importance. It is necessary to focus on the system of values, citizens' qualities, existing mental stereotypes, etc. The success of conducting one's own business significantly depends on these factors. Thus, studying the course

will enable future professionals to acquire skills and abilities of effective analysis, analytical forecasting, and strategic business management.

Heuristics is a discipline that aims to develop students' creative thinking. After all, in the professional activity of the technical profile, there are many situations when it is necessary to identify non-traditional, unusual, and create something out of the ordinary. To do this, the specialist requires active thinking, correct decision-making, and a rational-critical scientific approach to the analysis of socio-economic situations, phenomena, or problems. We assume that heuristics perform several social functions: cognitive, ideological, normative-thinking, ideological-evaluative, propaedeutic-educational, informational, which increase the future graduate's culture of thinking, his/her level of education, and professional skills. Therefore, it is important in every field of professional activity, in particular in engineering, to be ready for discoveries based on scientific thinking, philosophical and heuristic discourse. Moreover, it is important to be able to navigate global problems of heuristic science; make practical decisions on the optimal application of acquired knowledge in the performance of their professional duties; use scientific principles and laws to analyze specific situations, etc.

Professional ethics is an applied socio-philosophical discipline that studies the origin, essence, specificity, social functions of moral and professional norms and relations, and the laws of their development at different historical stages. Every professional focuses on success in the professional sphere, and hence career growth. To do this, you need to know philosophical and socio-psychological aspects of management, understand the philosophical context of basic management principles and laws, as well as practical skills of teamwork based on mutual respect.

Considerable attention should be paid to the issues of the new philosophy in the context of inclusive education [13], development of tolerance, and prevention of various forms of discrimination against people with special educational needs who get higher engineering education in a particular institution. Thus, humanization, based on the integration of not only different branches of scientific knowledge but also different ways of knowing reality, focused on new perspectives and opportunities for knowledge of the world, its harmonization.

Innovations are largely related not only to the content of higher education but also to teaching methods and technologies, to a "new set of educational tools" in the training of engineers [5]. Among the innovations, while teaching philosophical disciplines [4], the project method, Debates in Oxford Style, dialogue learning [3], problem-based learning, and large and small group work are widely promoted today.

Of particular importance in the training of future engineers is the readiness for professional communication, which is a complex socio-psychological formation, closely related to the training of future technical specialists and reflects the level of their integrative knowledge, skills, and practical skills to perform relevant activities. We believe that competencies in the field of professional communication will greatly help to overcome stereotypes about special needs, gender in achieving success in engineering and technical professions, etc. For example, Debate in Oxford Style is effective interactive training for public speaking, where students learn the principles of speech construction, techniques of nonverbal communication. Debate participants have the opportunity not only to try themselves as speakers but also to acquire useful skills in dialogue, debate, and answering questions correctly and thoughtfully. However, it is equally important to teach students to think critically, to assess the originality of the information or facts, to identify template elements in the information provided, to show creativity and initiative in decision-making, and the ability to work in teams to solve philosophical issues in professional activities. It is equally important to develop a culture of behavior in the information and media space, respond to fakes, compare data with other sources, compare source information with objective data, assess the probability of a particular event and the possibility of its reflection in the message, etc.

To some extent, gender stereotypes and ideas are observed in the engineering professions

choice in the world, especially regarding the ability of girls to work well in the field of high technology. According to the study, 38% of the total number of Ukrainian students surveyed at the Technical University indicated stereotypes in society about the "masculinity" of engineering and technical professions [15].

That is why today it is extremely important to support women who have chosen the profession of engineering and are studying at a technical institution of higher education. We believe that the issue of the formation and development of gender competence of university students is very important nowadays. In the context of technical training, men or women should emphasize overcoming gender stereotypes regarding the performance of certain professional (social) roles. After all, the gender factor and existing stereotypes in some way affect the professional self-determination of future professionals in this field [15, p. 78].

For example, in Indonesian schools, teachers are actively implementing Problem Based Learning. After all, in this country, one of the most important factors influencing the low quality of education is the gender inequality in learning English [14, p. 61].

"Reducing gender inequality has many positive consequences for communities and societies. For example, according to the European Institute for Gender Equality (EIGR), the level of employment in the EU will make a significant leap if women have more equal opportunities in education, STEM (technology, engineering, mathematics), and in the labor market. This would lead to an increase in the level of female employment by 0.5-0.8% by 2030 and by 2.1-3.5 by 2050. Overall, the employment rate in the EU would reach almost 80%. Gender equality has also been found to have a significant impact on Gross Domestic Product. Projected strengthening gender equality could increase GDP per capita by 6.1-9.6% by 2015 and 2% in 2030 due to the increase of female employment in the productive sectors. Improving gender equality in education, employment, and a more balanced distribution of reproductive labor between women and men is also expected to increase birth rates. The EIGR estimates that increasing gender equality could increase the birth rate to 8% by 2030." [16].

In the content of updated training of technical institutions of higher education priority is given to interdisciplinary courses, the content of which reflects the process of integration and differentiation in modern science, containing fundamental (philosophical and methodological) knowledge, which is the basis for general and professional culture. [11].

Considering gender issues in the field of engineering education, it is also advisable to offer an interdisciplinary socio-humanitarian course in the relevant field, which would integrate the knowledge of the philosophy of culture, gender psychology, and gender sociology.

3. CONCLUSIONS

Research on the problem of social and humanitarian education is a necessary and obligatory guarantee of the effectiveness of professional training, as it emphasizes the approval of a new system of values in the context of a general modernization of higher education, which involves an organic combination of national and universal. It is about the training of intellectuals in higher education and the development of future engineers' soft skills.

The basis for improving the content of social and humanitarian training in the institution of engineering and technical education should be based on several basic, fundamental moral and ethical imperatives: universal values; national-oriented values; values of the modern world [11]. After all, the new social and humanitarian paradigm of education must meet the needs of the individual, society, and the state.

To improve the quality of training of future engineers we should take into account the progressive experience of highly developed countries such as the United States, Germany, Japan, China, and others. At the same time, it is necessary to consider the national specifics of specialists

training and adapt the content of social sciences and humanities in the relevant educational and professional program. It is about creating innovative problem-oriented interdisciplinary courses, the implementation of which requires students and teachers to think critically and a comprehensive multi-subject systemic vision of the world.

Focusing on the learning process as a holistic pedagogical system, in addition to the content of education, it is advisable to implement innovative methods and technologies in working with students, such as Problem Based Learning, Project-Based Learning, Debate in Oxford Style, educational dialogue, business games, and group work, interactive training, modern digital platforms for distance learning and non-formal education. The quality of training of a modern highly qualified graduate of a technical university must meet public demands. Therefore, regardless of the format of training (online, blended, or offline), it must meet the highest quality criteria for the professional readiness of the engineer to implement professional tasks in the relevant activities.

Prospects for further research include the development of methodological aspects of using distance-learning technologies when teaching social sciences and humanities in higher education, the introduction of innovative digital resources in teaching professionally oriented disciplines in higher technical institutions, and others.

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Received: 12.01.2021; revised: 27.02.2022.

Палагнюк Михайло. Підвищення якості суспільно-гуманітарної підготовки майбутніх інженерів у закладі вищої технічної освіти. *Журнал Прикарпатського університету імені Василя Стефаника*, **9** (1) (2022), 58-68.

У статті висвітлено актуальність проблеми підготовки висококваліфікованих і конкурентоспроможних на ринку праці інженерів відповідно до вимог світової економіки, рівня розвитку технологій та з урахуванням суспільних вимог щодо якості надання освітніх послуг. Проаналізовано міжнародний досвід підготовки майбутніх фахівців та напрями удосконалення професійної майстерності інженерно-технічного персоналу. Подано результати вивчення освітніх програм підготовки майбутніх інженерів у закладі вищої технічної освіти. Доведено необхідність оновлення змісту освіти на основі професійно-творчої підготовки фахівців у сфері інженерії, розглядаючи її як цілісний процес особистісного й професійного становлення випускника. Представлено педагогічний потенціал суспільно-гуманітарних дисциплін щодо професійного розвитку фахівців інженерно-технічного профілю. Запропоновано міждисциплінарні курси, які спрямовані на філософське осмислення соціально-економічної ситуації у країні та світі, розвиток критичного мислення та здібностей для організації власного бізнесу, управлінських навичок тощо. Обґрунтовано деякі методичні аспекти щодо впровадження педагогічних інновацій у закладі вищої освіти, зокрема: ділові та рольові ігри, методи проблемного та проєктного навчання, оксфордські дебати, групова робота, інтерактивні тренінги і воркшопи. Визначено значення професійної комунікації як складного соціально-психологічного утворенням, що пов'язане з процесом підготовки майбутніх інженерів та характеризує рівень сформованості в них інтегративних знань, професійних умінь і навичок. Наголошено на потребі розвитку креативного мислення висококваліфікованих фахівців, ініціативності у прийнятті рішень, вміння працювати в команді над вирішенням

філософських питань тощо. Автор переконливо доводить потребу запобігання різних форм дискримінації у ставленні до людей з особливими освітніми потребами, а також уникнення гендерних стереотипів та уявлень у закладі інженерно-технічного профілю.

Ключові слова: суспільні дисципліни, суспільно-гуманітарна підготовка, майбутні інженери, підготовка фахівців, заклад вищої технічної освіти, якість освіти.