



Educators Training in the Context of Socio-Economic and Technological Trends of Kazakhstan

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Abstract. The work presents the results of research carried out within the international project “Engineering educators pedagogical training” (hereinafter referred to as ENTER), co-financed by the Erasmus + European Union programme. There are questionnaires developed for research. The purpose of the survey is to identify ways to modernize the training system for engineering educators. 408 people took part in the survey: teachers of universities (63%), colleges and other educational institutions (23%), employees of state enterprises and corporations (5%), commercial/joint-stock enterprises (9%). An analysis of the results of the questionnaire showed that in the preparation of engineering educators in Kazakhstan, forms of organization of education through electronic education platforms are poorly used (8% of the proposed programs in questionnaire organizations), online courses and mixed-type programs (2% of proposed programs in questionnaire organizations). Not enough attention is paid to forms of networking. Based on the analysis of the requirements of the Kazakhstan labor market for engineering educators, the necessary professional competencies for them are determined. Based on the results of the questionnaire, it was concluded that educational programs should be modernized taking into account regional needs, requirements for key competencies of engineering teachers by employers, and assessment of students’ career expectations. For this purpose, constant monitoring of popular and promising areas of training, improvement of forms and methods of training is required. Educational programs and forms of upgrading qualifications should be focused on using the professional context in the educational process, forecasting and creating conditions for the professional development of teachers, providing them with the right to choose a methodological service and the possibility of implementing an individual educational route [1].

Keywords: Engineering pedagogy · Engineering education · Engineering activity

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1 Introduction

For modern Kazakhstan, the training of engineering personnel is one of the key factors of the country's competitiveness, its technological, economic independence. Specific goals and objectives in this area are defined in a number of strategic documents and state program. These documents laid the basis for the formation of an integral Kazakhstan model of innovative education for all levels and forms of education. Among the important educational reforms of Kazakhstan are new approaches to the formation of the state educational order for the preparation of specialists, determined by industry associations of employers. The State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020–2025 provides measures to improve the qualifications of teachers in various formats in the framework of educational programs, including the optimal ratio of subject, psychological, pedagogical, social and other competencies necessary for a teacher to realize all types of pedagogical activity. The conditions of pedagogical retraining are being developed (entry requirements, terms, pedagogical specialties, etc.), which will allow to engage in pedagogical activities to people who do not have pedagogical education. Foreign and domestic companies are involved in organizing internships, master classes, trainings, coursework for teachers to study new production technologies. The modernization of higher and postgraduate education is carried out in the context of global and interdisciplinary competencies of the 21st century (volunteering, civic and social responsibility, leadership, communication, research skills, entrepreneurship, etc.). Considerable attention is paid to the professional development of the teacher through a system of methodological activities centralized at the state level [1]. Priorities for this are leading professional activities, forecasting and creating conditions for identifying and meeting the potential needs of teachers in professional development, ensuring the right to choose a methodological service and the possibility of implementing an individual educational route for a teacher [1]. The measures taken in the country to expand the academic and managerial independence of higher education institutions will make it possible to involve employers more widely in the educational process, determine their coordinating role in training personnel, create new structural management systems, and build the potential of long-term competitive advantages [2, 3]. In turn, labor markets are becoming the main evaluators of universities. To ensure their competitive advantages, universities seek to modernize educational activities, integrate intellectual, human, information, financial, investment resources, infrastructure elements and transform them into a “knowledge network” [2].

In this regard, in the framework of the international project ENTER, a multi-level modular system of pedagogical training of engineer-educators based on international network cooperation is being developed. At the same time, educational programs for the training of teachers of an engineering profile will correspond to such principles as student orientation, parity, dynamism, a conscious perspective, continuity, and versatility of methodological consulting [4].

2 Methods of Research

In order to analyze the content, means and forms of training of engineering educators, the principles underlying the development, implementation and achievement of learning outcomes in educational programs, a survey was conducted in different target groups. The total number of respondents is 408 people. Respondents were classified by place of professional activity and length of professional experience. The respondents included university teachers (63%), teachers of colleges and other educational institutions (23%), employees of state enterprises and corporations (5%), and employees of commercial/shareholding enterprises (9%). In terms of professional experience, the composition of respondents was as follows: more than 20 years (9%), from 15 to 20 years (7%), from 10 to 15 years (6%), from 5 to 10 years (10%), to 5 years (68%). The predominant involvement of respondents with up to 5 years of work experience in the survey was determined by the need to find out the main difficulties of young professionals in their professional activity, the lack of competencies. Also, a large share of respondents to educators of educational institutions is justified by the fact that in Kazakhstan the system of training engineering educators, their professional development, as well as additional pedagogical retraining of graduates in engineering and technical specialties is carried out mainly on the basis of universities (65% of all proposed programs). 65% of all proposed programs in surveyed organizations. Other forms of training of engineering educators are used less frequently and include e-learning platforms and online courses (10% of the proposed programs in the surveyed organizations), on the basis of external organizations and in the form of professional practices at work (25% of the programs offered in questioned organizations). Respondents were asked to provide their assessment of existing engineering educator education programs as part of complementary or self-study programs, as well as engineering or technical training programs at different levels with pedagogical education modules included.

3 Research Results

The development of engineering education today is closely linked to the global processes of social development, the digitalization of the economy, and the rapid growth of technology and communications [5, 6]. The process of modernization of engineering education is stimulated by such global phenomena as internationalization, massization, electronization, commercialization, optimization, etc. These factors imply resource mobility, reduction of international barriers in professional interaction [5, 6]. At the same time, the role of engineering pedagogy is also growing [7]. As the experience of different countries shows, engineering and pedagogical education is defined by national education systems and can usually take the following organizational forms: self-study after the engineering or technical education and integrated engineering and pedagogical education in the training programs for engineering or technical specialists. Graduates of engineering and pedagogical training should have, in addition to technical vocational competencies and engineering and pedagogical competencies [8, 9].

An educator -engineer should be ready to independently create a favorable working and educational atmosphere using various engineering and pedagogical models of the educational process; to build partnership and creative relations with students; to use dynamic forms of classes organization and interactive forms of interaction; to motivate and encourage students to professional development and awareness of their own ethical positions; to stimulate their value orientation, to use various information sources, images.

An educator-engineer should know the conditions for effective organization of the educational process and use them in choosing the training method, create tools for assessment and self-assessment of professional engineering competence of students taking into account the differences between them, know the normative and legal documents in the field of education and the corresponding engineering industry, government programs and other strategic documents in the field of public education and industrial policy [6, 7, 10–16].

A special place in the training of engineering educators and their further professional activity is occupied by the problem of readiness for new digital education and application of new methods and digital tools. In the conditions of digital education, the educator's activity will have an external evaluation by the participants of the educational process, and on the other hand - self-evaluation through reflexive practice, analysis of own mistakes, preliminary analysis and forecasting [5].

Networks of communications and interactions, methodological and communicative forms, network interaction with industry (joint projects of universities and enterprises, participation of business representatives in training of engineers), branch associations and other dialogue platforms, allowing to analyze and discuss the results of training, to optimize training methods and strategies, to integrate new achievements in the field of engineering and didactics into their own activities, through the platform.

In order to rank the key competencies of engineering educators, respondents were asked to rate them on a five-point scale (very important - 5 points, important - 4 points, slightly important - 3 points, not important - 2 points, not necessary - 1 point) [11] Based on the results of the key competency assessment, average weighted assessments (AWA) were calculated separately for each target group and common for all respondents. As a result, the following distribution of key competencies of engineering educators was obtained (from the most important to the less important).

- the use of modern educational technologies (AWA = 4.54);
- professional self-development and self-education, professional development, movement towards success (AWA = 4.46);
- knowledge of real technological and production processes (AWA = 4.43);
- application of information and communication technologies (AWA = 4.39);
- application of practice-oriented methods in pedagogical activity (AWA = 4.36);
- knowledge and application of the basic laws of natural - scientific disciplines, methods of mathematical analysis and modeling, theoretical and experimental research (AWA = 4.34);
- knowledge and application of various methods and approaches to solving technological problems, their optimization, modernization (AWA = 4.33);

- professional interaction with enterprises and organizations (by profile) (AWA = 4.33);
- integration of professional experience in the educational process (AWA = 4.28);
- ability to find, transform and transmit professional information (AWA = 4.27);
- the ability to conduct search and information work (AWA = 4.25);
- selection, adaptation and development of interactive learning methods (AWA = 4.24);
- professional communication and interaction with other people, with the objects of the world and its information flows (AWA = 4.22);
- conducting scientific, innovative activities in the field of engineering (AWA = 4.22);
- analysis and interpretation of professional data in the field of engineering and preparation of recommendations for their practical use (AWA = 4.21);
- ability to work in a team (AWA = 4.20);
- conflict management and resolution (AWA = 4.17);
- development and application of project training technology (AWA = 4.16);
- development of educational and methodical documentation, design of training methods (AWA = 4.12);
- the ability to perform various social roles in the group and team (AWA = 4.09);
- knowledge of project management methods (AWA = 3.8).

It is important to note that according to the results of ranking of key competencies, the best correlations were observed in the responses of teachers of various educational institutions. The answers of teachers and representatives of enterprises are weakly correlated with each other (correlation coefficient less than 0.5). This indicates a weak interaction of educational institutions with the economic sector in the formation of educational programs and determining the key competencies of graduates. At the same time, representatives of enterprises from the list of key competences presented above highly rated professional communication and interaction, professional self-development and self-training, the use of information and communication technologies, analytical skills in interpreting professional data, knowledge of real technological and production processes, the ability to work in a team, the development of educational and methodological documentation and the design of training methods.

Thereby, the content of the training and professional development of engineering educators should be based on the idea of “integrating the different branches of knowledge that are part of the teaching profession” [7, 10–13, 17]. Engineering educator training programmes should have clearly defined objectives and good methodological support. The training process should be optimized according to a certain set of indicators (compliance with social development trends, social order of the state, regulatory documents, ideas of modern pedagogical science, professional interests of teachers and students, optimal use of all resources to achieve sustainable positive results, combination of elements of different methods, etc.). Training should be organized using modular, problematic, concentrated, contextual, information and communication, project and other educational technologies [7, 10–13, 18, 19]. Education curricula for engineering educators should include modules on innovative production and teaching technologies, entrepreneurship and commercialization of professional

results, on concepts of engineering education for different industries. At the same time, our respondents with up to five years of professional experience note a lack of economic and psychological knowledge, and point to problems related to communication and management skills. When organizing independent work of students, it is important to ensure flexibility of training, its focus on individual characteristics and needs of the individual [5–7, 10–16].

In general, from the results of the questionnaire it follows that the content of educational programs should ensure the achievement of the following learning outcomes [11], arranged in descending order of the average weighted assessment (AWA):

- knowledge of technologies of self-learning, self-development, self-regulation and self-support (AWA = 4.52);
- the ability to classify and combine theoretical and practical knowledge (AWA = 4.39);
- the ability to systematize, analyze approaches to the study of the development of engineering fields (AWA = 4.37);
- demonstration of logical and analytical thinking skills (AWA = 4.32);
- use of modern information and communication technologies (AWA = 4.28);
- planning and conducting scientific and technological experiments to solve complex engineering problems (AWA = 4.26);
- design and operation of production lines, development and modernization of production technological schemes (AWA = 4.25);
- ability to document the results of professional activities (AWA = 4.24);
- application of innovative methods (AWA = 4.22);
- knowledge of educational design technology (AWA = 4.16);
- conducting resource assessments and proposing technological / practical solutions (AWA = 4.14);
- knowledge of the basics of management (AWA = 4.09);
- knowledge of the basics of the organization of pedagogical activities to improve the skills of employees (AWA = 4.06).

In the ranking of learning outcomes, the average correlation coefficient between the responses of university teachers and enterprises was 0.7. The average coefficient of correlation of the responses of teachers of colleges and other educational institutions (except universities) with the answers of representatives of other enterprises is 0.18. Thus, we can conclude that for educational institutions (except universities) it is necessary to modernize educational programs for the training of engineering teachers taking into account the requirements of the economic sector and to update the learning outcomes based on monitoring the labor market and modern development trends.

Special attention should be paid to the issues of professional development of engineering educators. The choice of forms of training organization in the professional development system is a complex and largely contradictory process. It generates new pedagogical technologies, changes the idea of inter-subject relations, modifies the previous scientific and methodological support, and determines the variability of programs and training courses. To date, the most common forms of professional development of engineering educators in Kazakhstan are programs organized on their own base, which is confirmed by 41% of respondents participating in the survey. According

to 24% of respondents, it is possible to implement professional development programs for engineering educators on the basis of third-party organizations of the related profile or on the basis of the departments of professional development of universities. Much less frequently such forms of professional development are used, as the organization of training through platforms of electronic education, online courses, in the form of industrial practice, programs of mixed type, which account for about 10%. This situation clearly requires the expansion of the role of electronic, digital and Internet learning in the training and retraining of engineering educators, which will make it possible to effectively transfer innovative experience, conduct innovative experiments, provide high-quality educational services tailored to the individual needs of the student, expand opportunities for students, develop their leadership skills, personalize training and provide effective feedback [5]. This issue has received considerable attention in recent years at ICL (International Conference on Interactive Collaborative Learning) conferences [5].

4 Conclusions

The transition to a digital economy, the international division of labour, the intensive exchange of information are now placing greater demands on the quality of engineering education, making fundamental changes in the professional training of engineering educators, and enabling the use of new tools and forms of teaching [5, 14–16]. The development of the system of retraining and professional development of engineering educators presupposes a new methodology for defining and coordinating the goals of educational, research and production activities, orientation to a high level of personal potential development, development of abilities to integrate, generate ideas from various fields of science, industries, operate interdisciplinary categories, use professional context in the learning process. Modernization of educational programs should go through the identification and strengthening of relevant and promising areas of training, development and improvement of forms and methods of training, evaluation of learning outcomes, professional skills and competencies of students, creating conditions for the development of competencies and skills of educators and staff involved in the educational process.

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