Developing professional competences in training construction engineering specialists

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Abstract. The article considers the possibilities of developing general and professional competences in students trained under the engineering specialties in an institution of higher education. Modern universities aim at developing general and professional competences, which are characteristic of the future professional activities of graduates. The article notes that training should result in forming soft skills and professional competences in the field of construction, in compliance with the requirements of FGOS VPO 3+. Theoretical basics of the optimal training of engineers in the context of the competency-based approach are described. Obviously, there is a need for training competitive specialists in the field of construction, capable of working in modern economic environment, based on the integration of the educational process and production. A future specialist must be able to successfully fulfill the tasks of their professional activity, and that means that while still studying they need to acquire both non-technical and professional competences, which will facilitate their social mobility and stability in the labor market.

1. Introduction
The global labor market, which is currently being formed and is inducing Russia to enter the European Economic Space, sets forth new serious requirements to the higher school, that should be taken into account when training specialists. The forming of the international labor market is in progress, and the Russian market will inevitably become part of it. The task before the engineering universities in Russia includes supplying highly qualified personnel to all the sectors of domestic production, and first and foremost, to the sectors of knowledge-intensive industries.

Project 5-100 aims at enhancing the competitiveness of Russian universities among the world’s leading scientific and educational centers, as well as at facilitating the build-up of the research-and-development potential of our top universities and the strengthening of their competitive positions in the global market of educational services.

At present, the most important trend in the improvement of the system of higher education is the fulfillment of a competency-based approach to training. In case of its successful implementation into the educational process, besides the acquiring of knowledge and skills, and the control of the level of their mastering, it will be necessary to develop and evaluate the competences of students and graduates of engineering universities. In essence, the educational process in the context of the competency-based approach implies the creation of situations and support of actions, which should lead to forming of a certain complex of competences. Based on the aforesaid, there arises a necessity to create competency-based models, adapted to certain conditions of professional activity. V.I. Baidenko [1] notes that a
Competency acts like a new type of goal-setting, what essentially means that there occurs a shift from strictly academic standards of evaluation to the highest evaluation of the graduates’ professional and social training. A professional competence is when a person is ready for productive professional activity, is completely aware of his/her responsibility for its results, and is striving to work in the given professional sphere. Therefore, while still studying at a university, students should form a comprehensive system of universal knowledge and skills, as well as gain experience of independent professional activity [2-5].

Figure 1. Competences gained by a student at a university.

Figure 1 shows a consolidated university-graduate’s competency-based model, which includes universal and professional competences, which in their turn are divided into general scientific, non-technical, instrumental, general professional and major-specific ones.

The Federal State Educational Standard of professional education stipulates that a specialist must have general competences, as well as professional competences, which correspond to the main types of professional activity in each certain engineering speciality. Meanwhile, the professional cycle consists of the general professional disciplines and professional modules corresponding to the main types of activity [6].

2. Necessity of acquiring professional competences when training as an engineer

In the context of the traditional system of training, students mostly acquire the so called theoretical competences. The traditional engineering education and the training under the competency-based approach are guided by the requirements of educational standards and qualification requirements, related to this or that speciality. Upon graduating from a university, an engineering specialist must have a certain set of knowledge and skills [7-9]. To form a competency-based model of an engineering university graduate, let us consider an engineer, who has completed his/her university studies within the traditional system of training. Obviously, the engineers, who were trained within the traditional system, have quite broad fundamental academic knowledge, and excellent skills of searching for the required information, but it takes long for them to adapt to the conditions of a production, and it is not always easy for them to re-train for a different specialization. Young specialists lack developed independence, sense of self-identity and creativity within their profession [10-13].
However, professional engineering education aims not only at providing a future specialist with this or that professional qualification, but also at teaching him/her how to cope with different situations in profession and in life, where certain competences will be forming and developing.

Over the recent years, various engineering competences have been revealed, which allowed to build different models of engineering education. Meanwhile, the competences of engineers were classified in several different ways. There exist several classifications of competences in the field of professional education. Over the last five years, several types of classifications have been adopted in the course of developing the projects of the new generation of the Federal State Educational Standard of Higher Professional Education:

- classification suggested in the projects of the standards on major-specific training of Bachelor’s and Master’s students (V.A. Bogoslovsky, I.G. Glubokova E.N. et al.) [14,15];
- classification used in the TUNING project [16]; and
- classification combining both types of the classifications.

R.M. Petruneva [17] states that, while considering the engineering competences as per the “glossary of the terms of the labor market, development of standards and educational programs”, there exist four models of competences defining based on:

a) personality parameters;
b) performing of tasks and activity;
c) production activity; and
d) controlling the results of activity.

The results of professional training of an engineering specialist can be quite fully described using the concept of “professional competency” [18]. The research papers devoted to the concept of professional competency can be divided into two groups:

- works devoted to studying the concept of the professional competency in general, which characterized the level of mastering any professional activity; and
- works analyzing the professional competency of the representatives of certain professional groups: engineers, teachers, medical personnel, etc.

In their turn, professional competences are a combination of professional knowledge and skills, as well as of the methods of performing professional activity, which is considered as the general preparedness of students for the activity, their capability to pinpoint connections between knowledge and an actual situation, and to adequately use their skills for solving the arising problems [19].

Within the structure of the general professional training, and as a result of studying practically all disciplines and modules, a student must master general and professional competences. Thus, for instance, the Engineering Graphics discipline is part of the professional cycle, and students start learning it in the first semester of the 1st year of studies, and that means that Engineering Graphics is one of the first basic engineering disciplines which form the professional engineering focus of a student’s training. Using the existing competency-based models of engineering personnel as an example, we may give models based on major 08.03.01 Construction (Bachelor’s level of qualification) [20]. Students of this speciality, wishing to obtain basic competences, need the skills, which they developed in the process of studying mathematical, natural-sciences and general-professional disciplines (ability to analyze, synthesize, availability of initial knowledge on reading, compiling, execution of textual and graphical documentation, etc.).

Figure 2 demonstrates a structural model of competences of a future constructions engineer, which comprises 8 sections, as may be seen in the diagram. The scope of this article does not allow for an in-depth consideration of each section of this structural model. There is no doubt, though, that the forming of the theoretical base of in-depth knowledge in the field of construction for the purpose of mastering this industry’s professional competences, as well as the development of the skills of using the obtained knowledge for solving the professional tasks are the guarantee that a future specialist will receive the professional qualification. Such competences comprise the knowledge and skills, which are directly related to the profession and specialization (structural design, equipment operation principles, rules of operation and maintenance, etc.) [21].
An important aspect is the preparedness of teaching staff to work in a new informational space and their progressive attitude, which are a necessary condition for developing and implementing the new forms and technologies of training. Independent work with electronic materials, using a personal computer, a smartphone and other modern gadgets, allows a future specialist to shape and improve the level of informational culture, and master modern information technologies.

3. Conclusions
The social and professional competences acquired during studies turn out to be a crucial condition for labor socialization of university graduates. The absence of those competences makes it impossible for a neophyte specialist to start the process of efficiently adopting social experience, mastering the skills of practical, individual and team work. It is important, already at the stage of university studies, to form a consistent system of universal knowledge and skills in students, as well as help them gain the experience of independent professional activity, that is, acquire professional competences.

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