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Competence Approach and FSEP of the Third Generation

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The issues concerned with HPE FSES in the sphere of engineering training are considered in the article. The necessity in competencies revision and systematization, in particular, common cultural one is pointed out. It is specially noted that this process should be performed within an enlarged group of profile training. Particular attention is paid to decrease in Bachelors' training hours in the sphere of engineering and technology in physics in comparison with the standards of the second generation.

Key words: *Federal State Educational Standards of Higher Professional Education, competence-based approach, the training of engineers.*

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A specific feature of our time is the formation of global space covering nearly entire globe of educational space. Higher school is intensely integrating into transnational and global contexts. It serves as a specific retranslator of global impulses that via it act on the whole educational system focusing on its international standards and models of education. It is development of education in combination with high tech, including humanitarian that has become today a major component of innovative development [1].

At present university graduates' activity in the sphere of technology and engineering (including Bachelors) is of multifunctional nature. It includes, in particular, design of engineering processes and selection of engineering equipment, regulation of equipment operation, efficient coordination of interaction between personnel and technology, increase in its operational efficiency and etc. One more typical tendency that changes the requirement for a university graduate is merging practical and research spheres of graduates' activity: from the process of technical device operation to development of fundamentally new systems and technologies [2].

There is a paradigm shift in the Russian system of higher education mostly conditioned by the processes of its integration into international educational space. This results in the necessity of complex consideration of issues related to training graduates of engineering universities within the context of professional mobility and competitiveness as well as in the framework of a graduate's development as a social and humanistic personality.

In the framework of Bologna process it is suggested using modular-based system of education content based on competence approach. Such changes require review of curricula, mastering new teachers' competences, development of auxiliary students' supply, management, and tutorial systems, introduction of new methods and forms of academic and tutorial activity, modern concepts of learning outcome evaluation [3].

«Bachelor» Degree course involves acquisition of knowledge and skills within the chosen profile that are in demand at labour market. Besides, curricula of the first cycle, according to Lisbon Convention, are to provide access to those of the second cycle. According to Dublin (2002) descriptors – description of the things that a student is to know, understand, and/or be able to do after completing the curriculum, «Bachelor» Degree, meaning the finish of the first cycle, is awarded to the students who along with awareness of bases and history of corresponding course possess the abilities [4]:

- to present the attained competencies logically and consistently;
- to contextualize new information and give its interpretation;
- to understand the general structure of discipline;
- to use methods of critical analysis and theory development;
- to apply methods and techniques of the discipline correctly;
- to evaluate the quality of research in the given topical area;
- to comprehend the results of experimental tests of scientific theories.

It is supposed that in the course of the first training cycle there will be developed skills that are necessary for further training with higher degree of independence. In practice in the context of higher education European space introduction of «Bachelor» Degree has caused acute debates, particularly in view of eligibility to hold this or that position or career perspectives.

In the Bologna process documents Master Degree is considered as the second stage of university education. Master Degree course implies more focused and advanced specialization, a Master is often oriented at research and/or teaching profession. The degree of the second academic cycle gives an opportunity for further research to get scientific degree. According to the Dublin descriptors Master course graduates must:

- possess the latest research methods and techniques in their professional sphere;
- know latest theory and their interpretations;
- comprehend development of theory and practice critically;
- possess methods of independent research;
- be able to make contribution into discipline, for instance, within their qualification paper.

In the course of Bologna process a professional competence for labour market is regarded as the use of body of knowledge, skills, competencies, as well as personal features relevant for university graduates' successful career growth in the chosen profession and their perspective employment. Learning outcomes mean a set of competences including students' knowledge, understanding, and skills that are defined for both every curriculum module and curriculum in general [5]. Competence model of a university graduate describes a set of competences which he/she has to possess, for which functions he/she has to be ready and what should be the rate of his/her proficiency in definite professional responsibility performance.

The competence approach in engineering education is «a description of learning outcomes in the language of competences» of a future graduate. In methodical aids for development of HPE FSES projects a competence is referred to as a dynamic set of knowledge, skills, abilities, values necessary for efficient professional and social activity and personal development of graduates and which they are to master and use after finishing a part of or the whole curriculum. Competences are considered as a structural principle of contemporary higher education.

The basis of HPE FSES of the third generation is competence models of Bachelor and Master. Bachelor's competences consist of cross-cultural competencies, invariable for the professional sphere and professional competencies

(specific). Invariable for the professional sphere are social-personal, general-research, general-professional, economic and managerial competences. Specific competencies are developed with regard to the sphere of activity for definite qualifications and profiles. With respect to the professional sphere «Engineering and technology» such competences as production, project, research, operational ones etc. are described. Competences of higher rate in the sphere of solving production management problems in innovative project performance are to be possessed by master managing modern approaches in staff relations, methods of innovative team building. In addition, the basis for master training is to be awareness of fundamental methods of research organization and innovation activity management at all stages of production life-cycles.

However, degree of significance of this or that competence in the standard is not defined. As a result, such a cross-cultural competence as «ability to apply methods of physical training and health promotion independently and methodically correctly, to achieve a proper level of physical education to provide full value social and professional activity» is ranged along with «ability to apply basic laws of natural sciences in professional sphere, to use methods of mathematical analysis and modeling, theoretical and experimental research. The number and content of common cultural competencies for different qualifications of Bachelor Degree course are sure to be the same (that's why they are cross-cultural). In fact, they are intended for different qualifications of Bachelor Degree and vary from 13 to 23. Besides, the same competences in FSES of different profiles are formulated in different ways. Let us give examples of competence formulation related to the knowledge of basic natural laws. «Standardization and metrology» profile: ability to apply knowledge of processes and phenomena taking place in animated and inanimated nature, awareness of possibilities for contemporary research methods of nature perception and to possess them at the level necessary for problem solution of natural scientific content and appearing in professional performance (CC-12).

«Power engineering and mechanics» profile: ability to show basic knowledge in the sphere of natural sciences and commitment to apply the basic laws in professional activity (PC-2); commitment to reveal natural essence of problems in the course of professional activity and ability to apply corresponding physic-mathematical operations for their solution (PC-3).

«Radio engineering» profile: to apply basic natural scientific laws in the professional sphere, to use methods of mathematical analysis and modelling, theoretical and experimental research (GC).

«Applied Mechanics» profile: to be able to reveal the essence of scientific-engineering problems in the course of professional activity and apply corresponding physics-mathematical operations for their solution (PC); to apply physics-mathematical operations, theoretical, calculation and experimental research methods, methods of mathematical and computer modelling in the process of professional activity (PC).

It is difficult to explain the cause for great dispersion of competences that are to be possessed by Bachelor graduates included in one large group. For example, for different Bachelor's specialities of the large profile group «140000. Power and Electrical engineering» the number of professional competences varies from 17 to 51, for the large group «150000. Metallurgy, Engineering Technology and Material Processing» – from 17 to 55, but for the large group «190000. Transport» – from 16 to 40. The graduates with the same term of apprenticeship (4 years) and degree of professional qualification (Bachelor) will possess different number of professional competences that is likely to result in the problem of competitiveness in the labour market.

At the same time, competence approach to development of educational standards results in reduction of students' fundamental training that defines graduates' breadth of vision,

his ability to retrain and adopt quickly to new professional conditions, as it is good fundamental training that is typical feature of the Russian higher school. Using competence approach a young specialist with higher education is given a set of narrowly focused skills instead of systemic idea of the universe, that will give him/her opportunity to be guided in the current professional sphere, but deprive him/her of a chance to change this sphere [6].

Let us compare standards of the second and third generations in that part where graduates' fundamental training is defined – a cycle of mathematical and natural sciences. A number of Bachelors' profiles have this cycle in a more reduced form than it is in similar profiles in terms of the standards of the second generation. Let us give examples. There is 16% decrease of Bachelor's profile «Electronics and nanoelectronics» in comparison with that of «Industrial electronics». The Bachelor's profile «Design engineering of machine tool industry» has got 13% decrease in comparison with speciality «Machine tool engineering». At the same time there is some increase in volume of mathematical and natural sciences in some specialities. For example, in «Standardization and metrology» profile –55% increase, in «Quality management» profile – 46% increase. In the Bachelor's profile «Software engineering» physics is excluded from the basic part of the cycle. In the educational standards of the third generation in the profiles «Economics» and «Management» there are not any courses expanding the idea of modern natural scientific world view. In the previous standards of economic specialities there was some integrated course of worldview and methodological focus «Concepts of modern natural sciences», factual and methodological basis of which is experience of fundamental sciences. Participating in production organization and management supplied with high technologies, in development of social relations, regulation of financial flows, graduates of economic specialities and profiles are in need of definite background of natural sciences knowledge permitting them to influence the innovation process directly, evaluate this or that proposals for improvement of modern technologies quickly and adequately, foresee a breakthrough in scientific progress. On the contrary, absence of basic natural science knowledge can result in serious errors in professional performance. Let us compare the total time (in hours) for «Physics» for specialities in accordance with the standards of the 2-nd generation and corresponding Bachelor's profiles.

Specialities	Hours	Bachelor's profiles	Hours
Material science in mechanical engineering	425	Material science and material technology	396
Mechanical engineering	505	Design engineering of machine tool industry	288
Микроэлектроника и твердотельная электроника. Промышленная электроника	700	Electronics and nanoelectronics	468
Radio electronic systems	500	Radio engineering	324
Standardization and certification	425	Standardization and metrology	324
Industrial thermal engineering	550	Thermal engineering and technology	288
Gas-turbine, steam-turbine units and engines	476	Machine tool engineering	396
Software engineering	402	Information and computer science	324

One could give some other similar examples. To tell the truth, nearly half of the cycle consists of variable-based part developed by a university, but there is no guarantee that turning-out departments would intensify the natural science component in designing curricula. It is greatly to be feared that transition to the third generation of FSES could lead to aggravation of graduates' fundamental training, namely, profound fundamental training was a typical feature of Russian higher school [7].

It should be paid special attention to one of the circumstances under which the transition to HPE FSES of the third generation takes place. At the beginning of the 90's of the previous century in Russia there was the beginning of extensive growth of demand for higher education. The number of universities grew sharply as well as their students. There was particular increase in the number of fee-paying students in both non-state and state universities. In Russia the demand for higher education is explained by not only conditions at labour market and forecasts for its changes, but also social stereotypes, including prestige value of higher education, school-leavers' and their parents' ambitions. It is accompanied by a sharp decrease in demand for elementary and secondary vocational education.

Focusing on market demands universities including state ones, increase the enrollment by agreements with natural and legal persons as it contributes significantly to the budget and university material base as well as staff welfare. It should be noted that growth of fee-paying students' share was due to, first of all, a number of specialities, training in which require less financial expenses (humanitarian, economic, juridical). In fact, none of the non-state universities train students in engineering specialities.

The process of school leavers' demand growth for higher education is accompanied by decrease in the number of secondary school-leavers making up the basic group of enrollees. Most universities, especially engineering ones, have noted the level decrease in school-leavers' training. Of particular concern of engineering university teachers is training in mathematics and physics. According to the results of enrollment in 98 metropolitan universities the half of government-subsidized enrolled students in 2009, as is known, had a «weak» three in USE (Uniform state exam) of profile subjects – mathematics and physics. Similar situation was observed in regional universities. The picture has not changed in the following years. Submission of documents in several universities and for several specialities and profiles testifies the fact that school-leavers are badly professionally oriented and, perhaps, do not need it.

Focusing on low level of enrollees' training, junior course lecturers have to spend a part of academic time to close the gaps in knowledge in mathematics and physics not acquired at school, because it is impossible to continue study in engineering university without it. One has to simplify the academic process, lower the requirements that, in the long run, affect the university graduates' training quality.

In our opinion, the introduced FSES of the third generation need to be revised rapidly. It is necessary to systematize, at least within the large profile group, cross-cultural competences. Special attention should be paid to the content of mathematical and natural sciences cycle. Natural science and mathematical training for the large profile group is likely to be the same. One cannot allow the decrease in Engineering and Technology Bachelors' training hours in physics in comparison with the standards of the second generation since all new technologies are based on physical phenomena.

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