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Engineering Education Concept in Modern Russia (Philosophic, Scientific and Pedagogical Aspects)

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The problems of engineering education are presented in terms of modern philosophy. The importance of creative thinking in innovative activities is emphasized. The ways to develop creative skills of future engineers are discussed.

Key words: *engineering education, creativity, reformation of education.*

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The logic of conceptual justification of innovative engineering training

The concept is regarded as true knowledge. The concept of innovative type of engineer should include three components.

The first is job description that determines specification of specialist's engineering activities.

The second – justification of content and forms of education process to train such specialists.

The third component is justification of means and kinds of scientific and practical activities of an innovative engineer in the frame of his/her job and civil relations to the society.

Innovative engineer's job description is characterized by four specifications – science, industry, business and power. Science and industry are fundamental. Business and power have applied relevance that characterizes an engineer in the frame of business and political infrastructure of his job.

We assume that the State Educational Standards formally contain a list of required sciences. But these sciences are not didactically adapted to the needs of innovative engineer professional training with respect to the job description mentioned above. We do not need sciences as they are but disciplines developed on their basis.

The discipline system of natural, technical and social character should ensure knowledge and skills necessary for an innovative engineer. It means that disciplines together should be sufficient to achieve the objectives and should be logically connected to meet didactic principles: from simple to complex, from parts to the whole, from reproductive to productive.

Thus, we need an accurate set of subjects that are systematically organized and aimed at producing innovative engineers.

The State Educational Standards have one more dimension that should be conceptually developed and filled with corresponding educational meanings and aims.

The question is that the standard comprises different levels: federal or

ministry, regional or university and disciplinary. The current standard is federal. The regional or university level is still being developed. The reform ideologists supposed that it should be the regional component that clarifies abstract ambiguity of the federal level and direct practical educational process to the implementation of the reform principles and ideas.

The federal standard has only some regulations on the limits of freedom and responsibilities of universities to interpret the standard as an educational law. (Standard. Official document.)

In comparison to the Ministry, universities turned out to be less competent for such work and tend more to the traditional didactics. In the frame of Ministry's standard interpretation traditionalism is more or less episodic and secondary feature but it becomes the basic feature of the university level. As a result, the innovative determination of the educational standard federal component is demolished by traditionalism of the reform perception at the university level.

The basic mission and sense of the university component is to specify the federal component in particular meanings and objectives of a definite engineering speciality.

The managerial rights and power are given to a university, didactical and methodical rights are given to faculties and departments, and thus, the federal standard idea is transformed into a certain educational form.

The final component of the standard takes shape of a discipline curriculum. It is a discipline, including its subject and object, objectives and methods, its didactical and methodical constituents, that reaches the focus of all educational driving forces and determines the final learning outcomes. According to the logic of standard it is the educational discipline that is to implement the idea of innovative education in its certain meanings and sense. But it is this level that is the least innovative nowadays.

The problem is that this level requires pedagogical professionalism and even mastery to put together all the meanings for one result: student's knowledge and skills required for personal development in the context of innovative professional and social relations. It is the level where lack of pedagogical professionalism and culture has the most effective negative influence on the learning outcomes. Besides, it is the disciplinary level that suffers most of all from bureaucratic pressure, which makes the situation more dramatic.

When studying the logic of the standard from federal to regional and then disciplinary levels, we observe the ideals and principles evolving from abstract and theoretical to concrete and practical ones. The disciplinary level is the quality and the aim of the reform.

On the basis of the disciplinary level profile departments or faculties develop educational complex for a particular engineering speciality. All the efforts of disciplinary level fill the reform ideals and principals with qualitative content that determines if the reform is successful or not, if it became an exception from a number of ineffective Russian reforms or just one of them.

The aim of every university is to elaborate the structure and content of the standard not only downwards but also upwards. That means that all didactical and methodical ideas on subject studying should be implemented on the disciplinary level.

Summing up the speculations on the standard, we can state that the analysis of the educational standards turned out to be critical. Actually the current standard needs conceptual improving. We can even say that it is necessary not to correct but to develop new standards resulted from the previous one but being different from it. If we really want to complete the reform

we have to change the standard radically.

If the standard development and improvement has such a radical character, the idea of the first, second etc. generation is quite reasonable. It is natural way of things. When the development goes from one stage to another, it needs structural and content development of a new program. Such renovation of the reform program guarantees its effective completeness. But when it has only a formal character, it is not the document development and improvement but illusion. Unfortunately, illusion is what we see when trying to understand the current changes of the standards.

What are the issues of state educational standard as a whole that are to be included in development and improvement program for this decision coordinating document? The list of issues being the subject to consider in the new generation standards contains some statements reflected in the existing generations.

1. State educational standard on this or that speciality is to include a detailed characteristic of professional specification. In the course of these specifications one should distinguish basic or fundamental and applied ones that compose social-economic and social-political infrastructure of contemporary engineer's professional activity.

2. Based on this meaningful job description it is also necessary to specify the list of the sciences study of which would condition the context of notions for engineer's professional specifications.

3. Standard must contain recommendations regarding the character, content, and forms of didactic adaptation of studied science to academic process of an engineer of innovative type.

4. Every studied discipline is to be presented as a model of studying actual science from the standpoint of a subject and an object, methods of this science as well as in terms of transformation of these characteristics into the content of discipline.

5. Didactics and methods of every discipline are to be focused on not only its content area but also content area of other disciplines specified in engineer's curriculum of the given profile. They could be accepted for the future generations.

We suggest a list of issues for development of next generation standards that, in our opinion, are of innovative nature.

1. Standard is to include recommendations concerning the process of how teaching didactics is added by learning didactics.

2. Learning process is to be simultaneous with that of self-learning, self-performance, and self-realization of student's personality.

3. Academic process is not to be based on the subject-object relation model, since a teacher and a student are two subjects or two co-subjects in academic activity.

4. Student is an initial criterion of mode, content, and forms of academic process.

5. Teacher's function is organization of academic process, i.e., expert, tutorial supervision, etc.

6. Learning process is transformed into self-learning process as a student is able to define and perform the main parameters of his/her educational activity autonomously or under teacher's supervision.

7. Learning process does not evolve into the true scientific-practical activity when a student graduates from university, but it does in the process of student's acquiring the necessary professional knowledge, skills and competencies by himself.

Hence, a standard is not only presentation of issues in academic process ontology, but also its epistemology, axiology and praxiology. Standard is, in fact, a detailed program with concrete indication of which func-

tions and commission of the Ministry in its realization, which are University's, which are faculty's, which are those of department, which are student's. System and integrity of the functions and commissions taken vertically and horizontally are the major condition for success in engineering education.

Creativity as a system-forming problem of didactics, methodology in contemporary engineer's training

Technical issues in engineering education are, in any case, solved on the basis of rational following the concept requirements. It is enough for all representatives of academic process to interact correctly and consistently with other representatives, then the program of engineering education improvement would be successful.

In view of ideals of professional education reform we deal with not only and not so much the rationally developed program, techniques and technology of education, model of academic process, we are dealing with innovation trend in academic process, the goal of which is formation of creative personality's abilities and demands. Such a task, on such a scale has not been set before. This circumstance makes reform and the standard on which it is based innovative. Without focusing on creativity no tradition or modernization can guarantee the innovative outcomes.

One cannot state unambiguously that didactics in creative training is an absolute blind spot or terra incognita. Since the beginning of time there have been some creative jobs in the sphere of literature and arts. Creative skills can characterize proficiency in economics and politics, science and culture, etc.

This concept is used to characterize human abilities at the level of talent and genius, but what creativity is as a spiritual phenomenon and how to formalize it if at all we do not know. In fact, speaking about creativity, we, as a rule, mean not creativity itself, but craft. As for craft, it can be taught! Can one be taught to be creative? This is the question.

Obviously, we have right to, as the things stand now, consider creative learning not as a fact of didactics and methodology, but an original approach, way or tool of creativity propedeutics. At present we have at our disposal sufficient philosopho-scientific and philosopho-pedagogical bases for considering the problem of creative thinking as a problem of engineering didactics of innovative type.

We could conclude that reproductive and productive, formal and informal aspects in creative mental activity are by no means always and for everybody apprehensible, subject to interpretation, comprehension, and awareness. It is a common standpoint about the fact that creativity is a heaven-born gift. Creative thinking is somewhat mysterious, enigmatical, mythical, and incredible – that is a result of mythologizing this phenomenon, but not an adequate presentation of its idea. Moreover, for instance, the abduction method speaks straight out the fact that, at least, in scientific cognition heuristic or creative element is just connected with the process of how hypothesis come to mind of talented and genius people: intuition, talent, genius. But method of hypothesis processing that is prescribed by abduction procedures are, so to say, matter of techniques and technologies. Therefore, taking the challenge in comprehension of creativity mechanism we, in the long run, come to the situation when it is necessary to put both didactic questions concerning possibility of training in intuition, insight, anticipation, supposition etc. But even in this case, standing on accepting the fact that it is necessary to develop, improve the physical and mental abilities of different individuals given from the nature that is performed, in fact, by the system of education, training and bringing-up.

We are holding a view that an engineer can and must be taught to think creatively. Those who have capabilities for this, would have the scope for their implementation. Those who are not endowed, would size-up their limits in abilities, level in creativity by themselves. If one takes into account that there are not any untalented, uncreative persons in the world, and everyone has to search for creative activity relevant for himself/herself, then it comes out that the question on creative thinking training didactics is far from being idle. The fact is that we are not ready to set all records straight today. But it does not mean that the problem cannot be effectively solved for education. Possibly, the best that can be done in the process of an engineer's formation is to help him/her in finding out the abilities, but, on the other hand, to create the conditions for eliciting his/her potential.

It means that creativity from the didactic point of view is not only ontology but also epistemology, axiology and praxiology. For the process of creativity training to be presented as a system in general terms, it is relevant to consider creativity dialectics, but before it – social-epistemological conditions of a person's creative mental activity.

Social conditions of autonomous creative personality in engineering profession

Take as a premise that a human being is a unity of generic and individual features. Within every formation society develops a personality in its own image. Personality is a set of socially significant properties and abilities of an individual at a definite stage of society development.

In definite historical view society is a unity of economics, social structure, politics and culture. Individual personality is what its position in the society.

We assume that mankind has reached the stage of its development when it can admit that such an ideal personality as creative one can become not only a far-off possibility but a real necessity. Therefore, a creative personality that also implies many-sided and well-balanced personality is one of the conditions of human progress.

For clarity, it is essential to introduce the following metaphor: personality is a contracted society, while society is an expanded personality. The processes of society contraction and personality expansion take place in the light of such phenomenon of human life as activity. Any personality including specific features, capabilities and needs is formed during each stage of his/her activity. This also holds true for the influence of personality on the society, which depends strongly on the character, content and types of personality activity. Activity is always performed together with other people and that's why it is social in itself.

Assuming that the idea of society contraction up to personality reflects basically a real mechanism, society definitely creates personality in its own image. Personality is an object with respect to society. However, society itself, in strict sense, is not a subject. Being dominant in interaction with personality, society is represented by many structures, such as government, political parties, trade unions, Church and etc. Under close examination it is not society that takes part as a subject in personality formation but state officials, party workers, churchmen and etc. Thus, society as a subject of personality formation in its own image is a conventional category. Its unity as a subject is more than problematic. However, society with all its superstructural elements, bodies and organizations and etc. has dominant influence on personality.

As for personality expansion up to society, everything depends on socioeconomic status of an individual, which he/she takes in politics, religion,

culture, arts, literature and etc. In simple terms, the influence of a personality on society can take place in different way. In other words, quod licet Iovi, non lizet bovi.

From this it follows that somebody can have influence on society, while somebody cannot. Some individuals are capable of expanding their personalities in terms of social relations, ideals, values and etc., while other people, due to their reversed personalities, stand apart from these processes. In any case, the processes of society contraction and personality expansion are accompanied by various circumstances, which are beyond the needs and capabilities of a personality, but pertain to the sphere of ownership, social classes, politics and etc.

However, against this background of interconnection and interdependence of personality and society, there appeared such people who due to their intellective power, talent and genius left significant mark in history. These people, governed not only by ownership and authority but rather contrary to any governance, were able to develop themselves to the best of their capabilities and requirements. Such people were and are in literature, arts, science and industry. They are inventors, designers, pioneers, and etc. Scholars working on the phenomenon of these personalities proposed an idea that these people are not just the result of spontaneous deflection in individual and ancestorial development or the processes of contraction and expansion which were discussed above. They represent so-called autonomous personality, i.e. personality capable of converting his/her individual potential and skills, physical vigor and spiritual power to the basis of further self-development both under the conditions of social paternalism and contrary to it. At all times, autonomous personality being a phenomenon of social life was an exceptional case both with regard to statistics and the role these people played. These people existed in the past, they also exist now. These people who are gifted by nature with unique capabilities and requirements can achieve the peak of human spirits due to their genius as Mozart or due to their diligence and determination as Saliery.

However, it is a common place when a person who is born to be talented and genius is not able to reach his/her potential in virtue of social conditions. It is impossible for the society to provide such conditions which would correspond to all people peculiarities and contribute to their development. Besides, a person himself/herself is not always capable to understand the level of his aptitude, his genius and talent. There is an opinion that genius will approve itself as genius at any case. However, we know so many historical examples when such genius turned to personal tragedy.

Today, we can observe such turning points of the history when autonomous personality is becoming not just a possibility but also a necessity of society. It means that each person can and must assay his/her capabilities, genius and talent in terms of his/her autonomous existence. Society guided by not only the interests of a talented and genius person but its own motives can and must provide required conditions so that this genius person can reach his/her potential.

It is not utopia, it is a sign of present times. In general, we can make a reality of this idea, however, only if we reorganize ourselves, change our attitudes to each other and themselves, be ready to disclose ourselves and assume responsibility for these processes.

It means that not every personality is developing as creative one. Only autonomous personality characterized by his/her capabilities and requirements, nature and will, principles and views can develop as creative one. This kind of personality can recognize and assume his/her responsibility both to himself/herself and the society where

this personality reaches his/her potential.

In the century of innovation, mankind possesses a wide range of various advancements: science and technology, literature and arts, education and public health service and etc. However, one of the main advancements is personal creative potential. And, if we happen to be able to reach this potential, mankind will be bound to make a quantum leap in labor efficiency which can be hardly achieved due to any other resources.

Thus, there have always been two mechanisms of individual socialization. The first one is so-called general, i.e. the processes of society contraction up to personality and personality expansion up to society. Based on nature and logic of social development, personality must correspond to the social requirements from a society's standpoint. Personality is just a small screw or pinion in a large mechanism which is called society. Personality is an object but not a subject of his/her social relations. On the other hand, the process of personality expansion up to society in the frame of the first mechanism is mainly conditioned by external factors.

The analysis of cognitive methods in the studied discipline, i.e. its cognitive toolbox as a number of cognitive procedures and technologies, is a required stage in the development towards creativity. This stage is essential for a scientist to acquire relevant knowledge, skills and competencies during learning period. The second stage of the development is concerned with the transition from standard to nonstandard way of thinking, from reproductive to productive, from reviewing-subordinate to creative forms.

The concept of engineering education can and must become a good example of such reform in Russia, which unlike other can be followed to its logical end.

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