

Development of Personal and Professional Culture as the Basis for Engineer's Effective Activities

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Abstract: The article deals with the specific character of modern engineering education, its meaning seen by the authors as the development of a competent specialist, who is well aware of complex socio-cultural circumstances, responsible and able to act professionally in the rapidly changing environment of science and industry. Such specialist is the bearer of personal and professional culture, being a special type of mental activity arrangement, which manifests itself and finds realization in the professional functioning, which embodies various apprehended, adopted, reproduced and newly elaborated patterns of culture. The paper aims at specifying the concept of "personal and professional culture of an engineer" from the viewpoint of a qualitative characteristic of consciousness and vital activity and behavior. In this study, the authors for the first time structurally characterize this concept by its reasonable analysis in the unity of all such components as general culture, communicative culture, information-methodological culture, culture of personal improvement, professional competence, culture of thinking and creative qualities. The discussion substantiates the technology of effective social and natural interaction, contributing to the development of a cultural-like techno sphere, which encourages self-realization of an engineer in his activity as a special area of culture (to carry out his assignment), and therefore can be the equivalent of his social dignity. Personal and professional culture is studied as a special qualitative characteristic of human consciousness and life, reflecting the attained level and character of the development of professionally significant personal qualities of the specialist, representing the system of his values and emotional attitudes, which affect the efficiency of his engineering activities. The authors suggest its integrative model with invariant indicators.

Keywords: Personal and professional culture, engineering education, engineer's professional behavior, general culture, professional competence.

INTRODUCTION

Twenty-first century demands specialists being capable of effective performance in the probabilistic and uncertain conditions of a multi-vector society and a "mosaic" structure of culture. The modern type of economy imposes requirements on the results of the engineering education, expressed in the language of competencies, fixed today by the new educational standards at the national level (Zhurakovsky & Sazonova, 2010). Today's industry expects graduate engineers to have career-equipped skills such as problem solving, creativity, innovation, communication and project management (Chandrasekaran, Littlefair, Joordens, & Stojcevski, 2014; Caraka, Hafianti, Hidayati, Wilie and Muztahid 2019).

Preserving its fundamental nature, engineering education should be the guide to the world of new values, such as social mobility, most practical

orientation, realization of personal potential in profession and career (Enggartyasti and Caraka 2017). Social order changes the purpose of education—the main element of the didactic system. It gets particular drives: the development of active and creative personality, capable of continuous professional self-development. General cultural and professional competencies act as guides, determining the process (Baidenko, 2005; Caraka, Chen, Bakar, Tahmid, Toharudin, Pardamean and Huang 2020).

The scope of this article covers not only the task of universities to form the competence of future specialists, because the risk of repeating mistakes of past years is great. As a result, engineering activity, reinforcing a technocratic character, may lack a humanistic content, which will lead to serious violations of the human environment. Absolute priority given to the pragmatic role of professional competence in a human life, the idea of the results of education as a set of competencies that allow future specialists to find a well-paid job and, in some way, find his/her niche in the world, will affect the development of other human activities (Chen, Dewi, Huang and Caraka 2020).

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BACKGROUND

The specific nature of modern engineering education, its meaning lies in training of a competent specialist as the subject of his own activity (Cropley, 2015). As rightly noted by some authors (The Modern Educational Technology, 2016; *Sovremennoe inzhenernoe obrazovanie*, 2012), the space in which knowledge, skills and abilities are defined and then imparted by the teachers to students, is essentially different from the space, in which the necessary competencies are formalized.

The knowledge, skills, and abilities are units of culture, bearing the priority cultural values. In contrast, the competence is initially a unit of the market, and socially responsible economy. The very etymology of the concept of 'competence' originated not in pedagogy (and thus cannot be reduced to a certain amount of knowledge, skills and abilities only), but in the field of economics, management and training of personnel (Andreev, 2005; Caraka *et al.* 2020).

Analyzing the difference between competence and knowledge, skills, and abilities, A. L. Andreev (2005) often cites J. Raven's (2012) thesis, that in contrast to the usual knowledge, skills and abilities, competence can be measured only in terms of motivation for the due achievement. New notion of knowledge, new types of competencies and skills, the students' learning process and motivation, new type of curriculum structure and content, new roles for academic staff, institutional change have been among research issues, indicating both conceptual and empirical studies as part of methodologies used for the study of learning, competence and education (Du, Graaff, & Kolmos, 2009, p. 11). Competence is based on knowledge and skills generated in the course of training at higher school, but is not limited to them. Adoption of the language of competence by pedagogy makes it clear that education has recognized the importance of the existence of economic reality and key markets, and in particular, the labour market (Andreev, 2005).

In this situation, it is necessary to be extremely careful in one's approach to the strategy of education development, trying to build up the holistic educational system, which is capable of solving in parallel the problems of different types and levels (Susimenko & Litvinenko, 2015). That means, on the one hand, to fulfil quickly and effectively the order for formation of the abilities and operational competencies demanded by the labor market at that moment, on the other hand, irrespective of this to develop complete and at the

same time multidimensional view of the system qualities of socio-historical reality as an "existential world" of the personality (Caraka *et al.* 2019).

In addition, for higher school it is essential not just to form particular competencies, as their set will constantly change but to develop the students' ability to form the competence (Newell & Nelson-Gardell, 2014). That is the result of education should be not so much the competence as the ability to its "self-cultivation", and self-correction, if needed. This will be possible if the professional competencies dictated by the market are based on the solid "cultural core" formed and developed in higher school. And this core, in our opinion, may be the personal and professional culture of the specialist, in this case, of the engineer.

The need for such a core is defined by modern realities. Professional competence of the engineer should be based upon his personal and professional culture, or rather be one of its components. To comprehend this category, we turn to modern understanding of the essence of an engineer (Galanina, 2015; Parkhomenko, 2008). The view of him as a narrowly focused specialist has proved its inconsistency. The modern engineer must possess not only professional knowledge, but also a wide range of personal qualities.

Being a representative of a special cultural layer associated with engineering and technology, today he is obliged to assume full responsibility for his actions. And education should provide him with this opportunity. Suffice it to recall that in pre-revolutionary Russia engineers made part of the most educated and well-rounded social class.

Given the fact that the notion of an engineer is closely related to the concept of the intelligentsia (intellectuals), it can be assumed that the image of the intellectual can act as such ideal.

The intellectual is a peculiar kind of educational ideal. P. F. Kapterev (1982) characterized a truly educated person as a man who

... feels a lively and active member of the contemporary cultural society and understands close relationship of his personality with the humanity, with his own people. He is moving human culture forward to the best of his power... (p. 436).

It is hard to agree with the thesis that "in modern world knowledge in itself ceases to be valuable". Knowledge was, is and will be the elements of culture, which should be learnt, they are the absolute basis of education. But at the same time it is hardly possible to train the specialist "in general", to develop personal qualities of the man, without being guided by requirements of modern production and management, as the person won't be able to find a "niche" for himself, where he belongs in the greater scheme of things. To avoid this, it is necessary to harmoniously combine two spaces in education: of knowledge and competence, social order and cultural values. In fact, we exist in a situation of historical uncertainty, the development of which is difficult to predict in details. Therefore, for today it is hardly possible to fix the standard set of social competencies conforming to "requirements of the present" and furthermore to distinguish unambiguously the key ones from them.

This phenomenon, interpreted on an individual-personal level, is a contribution to the global science, substantiating a measure of the professional activity of the engineer, an indicator of the completeness of abilities and personality traits and their integrative functioning. Personal and professional engineering culture represents a complicated organized system, which elements are not only plural, but are intertwined and interrelated.

The above considerations suggest that the primary qualities and characteristics of a person expressed by the concept "personal professional culture of an engineer" are fully concentrated in it. Its education is possible only in such a form in which the learning process is embodied in culture-syntonic, scientifically organized educational environment. Without having exact scientific concept of this category, we confine ourselves to identification of the key indicators that determine its quality.

The paper aims at specifying the concept of "personal and professional culture of an engineer" from the viewpoint of a qualitative characteristic of consciousness and vital activity and behavior. The task is to develop an integrative model and specify its invariant indicators.

MATERIALS AND METHODS

A complex of mutually complementary methods, adequate to the nature of the phenomenon under study were used, such as the method of theoretical analysis

(historical, comparative, logical), pedagogical supervision, study and generalization of pedagogical experience, study and analysis of documents, theoretical modeling, the method of semiotic analysis and modeling of educational processes, forecasting. In this study, for the first time, the concept of "personal and professional culture of an engineer" has been analyzed in the unity of all such components as general culture, communicative culture, information-methodological culture, culture of personal improvement, professional competence, culture of thinking and creative qualities

RESULTS

As a research finding, the main goal of engineering education was specified, which meaning lies in training of competent professionals, based on personal and professional development.

Indicators of Competence

The competence formed at higher school has to provide personal and professional development of the future specialist rather than serve as a means of "smoothing" of the relations between education and the labor market (Korenyugina, Revin, Susimenko, Shemet, & Scherbakova, 2015). To the future professional it will allow quick generation of the necessary skills and operational competencies demanded at that moment by the labor market.

So that not to overlook the problems associated with the interpretation of engineering activity in terms of cultural and historical process, it is necessary that the competence was not the goal of educational process at higher school, but played the role of a product obtained in the course of personal and professional development of the future specialist.

The competent person has characteristic valuable attitude to his activities, therefore competence cannot be reduced narrowly to the social order for it.

Overcoming a gap between education and social practice is not possible only due to inclusion of the educational system in the market relations. If the higher school focuses on the idea of the open order for education too much, we will program a mass shift of personal motivations from true values to an abstract demand.

Ultimately, in that case we will get a society in which, in the figurative expression of a well-known

mathematician, everyone will only sell, vote and communicate (but in foreign languages). It is just unclear, who will make discoveries, invent, teach and build in such a society. (Andreev, 2005, p. 21)

Cultural and Educational Ideal of the Graduate of Engineering Higher School

To understand the nature of engineering education of the twenty-first century it is important to present a cultural and educational ideal of the university graduate, on whom it will focus.

Modern idea of an intelligent person closely associated with understanding of the phenomenon of culture may be expressed in D. S. Likhachev's (1983) words:

...an intelligent person is the one who retains sensitivity to cultural values, aesthetic sense, able to understand the character and personality of the other person..., to show understanding for his position, and, having understood the other person, to help him... Intelligence is the ability to understand, to perceive, it is an attitude to the world and to the people (p. 19-20).

Intelligence, according to the formula of the known Russian ophthalmologist Professor S. Fyodorov, is the intelligence multiplied by morality. The phenomenon of "intelligence" involves a certain historically developed level and type of socio-cultural erudition of a person, which may be called his cultural competence. "The personality is the embodied intelligentsia—as a myth, as the meaning, as the face of the personality itself" (Viktorova, 1999, p. 13). The concept of the intelligentsia that has gained worldwide recognition owes its origin to the corps of Engineers.

For this purpose we have to define clearly, what the essence of training of the engineer actually consists in, which qualities are to be developed in the young man who has entered the engineering university.

The novelty of the approach lies in specifying the integrative indicator of the engineer's culture in the personal and professional culture, the development of the model and the identified indicators, such as humanity, spirituality, sense of commitment, responsibility, valuable attitude towards people and environment, moral and ethical ideals. In this regard, at present, the dominating place in vocational training

must belong to the development of personal qualities (Sosnin & Pochekutov, 2007).

Personal and Professional Culture of an Engineer

A modern engineer must possess the ability of humanitarian vision of any, even a strictly professional engineering task. It will allow him to enter his activity into a culture context, which integral part is technosphere. This statement gives a reason to believe that an engineer according to a modern understanding as a creator of technosphere, is first of all a cultural, well-informed personality, socially and personally demanded in modern society. In their interpenetration, these characteristics give opportunity to carry on discussion on existence of a phenomenon of personal and professional culture of the engineer. The level of its development determines the degree of the higher school graduate's competence in the chosen profession.

The personal and professional culture of an engineer is a special qualitative characteristic of his consciousness and life-sustaining activity expressing the reached level and character of development of his professional competence as a specialist, representing the system of his values and emotional attitudes, influencing the efficiency of engineering activity. It manifests itself and finds realization in the professional functioning, which embodies various apprehended, adopted, reproduced and newly elaborated patterns of culture. We suppose that the professional behavior of an engineer is a practical embodiment of his personal and professional culture. This phenomenon is characterized as a difficult multidimensional concept. Its integrative model includes such invariant indicators as a) general culture, b) communicative culture, c) informational and methodological culture, d) culture of personal development, e) professional competence, f) culture of thinking, g) creative qualities (Shemet, 2010).

Let us give a short characteristic of components of this model. Professional competence enables its bearer to carry out main types of engineering activity taking into account all interconnections existing in nature, in the context of complete development of technosphere as an integral part of culture (Chuchalin, Boev, & Kriushova, 2006). Being a complex resource of the personality, providing the possibility of effective interaction with the world of engineering culture, professional competence is revealed through the prism of the mastered general and professional competences. It determines the level of the engineer's

functional literacy and at the same time serves as one of the forms of his social protection. In fact, it is potential, as being a product of training it does not follow it directly, but results from individual development and self-development, his not so much technological, but personal growth, due to his self-organization and synthesis of the activity and personal experience. In this context, technical knowledge acquires special valuable and semantic meaning, and professional competence is treated here as the powerful individual capital.

This component of personal and professional culture of an engineer promotes his self-realization, finding a niche for himself. Professional competence provides a holistic view of the nature of engineering activity not only in technical, but also in social, ecological and economic spheres that allows its bearer to interpret, design and use technologies of effective social and natural interaction. It also promotes the development of a culture-syntonic technosphere. It is the competence, that allows the engineer to engage in self-realization in his activity as a special area of culture (to carry out his assignment), and to carry out his mission, and therefore it can serve an equivalent of his social dignity.

Competence of an engineer also manifests itself in his free operation by concepts and involves developed and professional speech, organizational skills, management and communication skills, being an important factor of personal socialization. In compliance with these requirements, an engineer's behavior is considered as the formation of his communicative culture elements. Communicative culture is based on the knowledge of languages and communication laws, the interpersonal interaction psychology, the speech skills possession and the professional speech technique (Flyvbjerg, 2006).

With the development of science, technology, economy and the society in general the specialist's functions are also changing. New challenges and especially new opportunities for their solution are changing not only the nature of man's activity, but also his identity, forming his personality in a new way (Wisnioski, 2015). A distinctive feature of an expert, the hallmark of the professional is the ability to solve professional problems competently and responsibly, to integrate and develop the scientific knowledge in the process of solving problems. Thus, the individual must possess the qualities, which will enable him to adapt successfully, to live and work in the conditions of a new

century. Among these qualities are scientific theoretical thinking, ecological culture, information culture, creativity, tolerance, high morality.

Engineering activity comprises regular application of scientific knowledge for creation of artificial, technical systems—constructions, devices, mechanisms, machines and so on. That is its difference from purely technical activity, which is based more on experience, practical skills. The engineer is a specialist, solving problems of design engineering, construction, functioning of equipment and science-based technologies. It is a scientifically prepared agent, whose efforts are directed at creation and development of the post-industrial civilization. It is extremely important not only to increase the level of his education, but also to form a new type of intelligence, other mode of thinking determining the attitude of the person towards quickly changing economic, technological, social and informational realities (Alves, Restivo, & da Silva, 2015). And it means, besides technological preparation, a variety of the components, having generally soft skills character, but at the same time absolutely necessary for each specialist today. First of all these are such personal qualities as an ability to make responsible decisions, creative approach to any task, a skill to follow it through, self-starting, self-discipline, love of a profession, etc. Above essentially vocational and technological training, there is a huge extra vocational superstructure of requirements to the specialist. Among the high-priority values there are the ones providing human survival.

A modern engineer is not only an intellectual of a new breed and a bearer of the most advanced knowledge and process technologies. He is also capable of introducing drastic changes into engineering activity, possessing high intelligence, professional mobility, responsibility for consequences of one's own activity, aspiration to self-development, creative intuition, eco-friendly attitude, sense of commitment to the people and mankind, introducing humanity, democracy, high morality and advanced culture of the human relations in it.

DISCUSSION

At present, not only domestic, but also foreign higher school pays primary focus to cultural skills in the professional development of an engineer, humanitarian character of his professional identity. Thus, in the documents of European Federation of National Engineering Associations in section "The Potential of

Competence”, it is pointed out that the European engineer must “understand the essence of an engineering profession the same way as the responsibility in relation to the colleagues, working nearby and in relation to society and environment” (Shemet, 2010, p. 106-107). The specialists, deprived of humanitarian guiding lines, lose sight of the person, and that is actually technocratism. The absolute priority given to the technical progress, so typical of engineering institution of higher learning, is its “occupational disease”, the remedy for which is high general culture of an engineer allowing to overcome rationalistic directions of technical thought and to renounce pragmatism of technical activity.

The realities of today are that an engineer must be guided not simply by material production, but by “technology of the mind”. Therefore, an important point in the course of formation of the competent specialist is the development of general culture of the personality, that is, culture, which, according to a popular aphorism, is understood as what remains when all learned is forgotten.

In perspective, an engineer must be able to interact with specialists of related fields—to pose problems for them and be critical to the proposed solutions. To solve the problems, it is necessary to show an individual approach to each problem, be able to use physical phenomena, processes and mathematical tools, and broad erudition in related fields.

A special role in the structure of personal-professional culture of the engineer plays culture of personal development. It not only provides the feedback, but also is a powerful mechanism that orients the engineer to the continuous self-development and improvement of his skills. Focused on mastering the methods of physical, moral, emotional development and self-regulation activities, it promotes creativity and self-improvement.

A new challenge higher school educators are facing is the necessity to direct the process of student’s self-learning activity formation (Splitt, 2003). The responsibility of university staff is to continuously analyze student learning and teaching practice, formulate and correct goals to strengthen efficient teaching practice, pushing students’ personal development, peer to peer learning and promote their work integrity (Chandrasekaran, et. al., 2014). Culture of personal development is based on reflection, that is, on the ability to provide an adequate self-evaluation

and analyze professional activities, thus developing professional skills.

In modern science, reflection is considered as a fundamental ability of a conscious being to be in relation with his own consciousness, as a form of theoretical thinking activity aimed at the comparison of its results with the original objectives (Makienko, Kurkan, & Strelcowa, 2015; Sidelnik, Melnik, & Burenko, 2016; *Sovremennoe inzhenernoe obrazovanie*, 2012). Reflection includes the ability to monitor oneself and the effectiveness of the targets implementation.

In the context of our model, we are talking about “professional reflection that contains the unity of the human (the ability to Self-study, causality analyses, the doubts, the implementation of value criteria, work on oneself) and professional, that is, the use of this ability in difficult conditions and circumstances of professional life” (Bondarevskaya & Kulnevich, 1999). Awareness and understanding of the personal and professional culture formed, and its manifestation in engineering activities, give the engineer a greater freedom in its improvement.

Moreover, engineering activity requires creativity that is necessary for the new knowledge production, new technology development, the technosphere increase.

Creative qualities are expressed in the individual’s ability to create new knowledge, concepts, and the formation of new skills. They allow setting the activities on the experience reorganization and the formation of new knowledge and skills combinations to create new material and spiritual values of social significance. The creative nature of the engineering profession involves implementation of creative activity. Creativity is a process that contains the elements of novelty, surprise and originality associated with the expression of personality and different personal abilities. The ability to think, to develop, to self-improve arises in education, in a complex system of relations, in the course of individual education in human culture that is the defining concept for a person to display the scope of his activity in a variety of ways and forms. An important aspect of engineering activity is the ability to acquire knowledge, to compare the acquired knowledge with the reality, and to know methods of its classification. All these determines the success of the engineer’s self-realization in the world. Therefore, the information-methodological component is the link in the integrative model of personal-professional culture of the engineer.

Information and methodological culture is shown in the ability to search and find the required information using various systems of information processing and classification, as well as modern computer technologies; in determining the value of acquired knowledge and the ability to use it for personal, professional and research purposes, as well as the ability to store information for future generations. The lack of information and methodological culture does not allow forming a holistic professional worldview of the engineer, without which a university graduate cannot have the appropriate ability to adapt to a rapidly changing life. Regarding this, the engineering education should be focused on the methodological students' training in each discipline, and, moreover, in the fundamental ones. At the same time, not only strength and depth, but also relevance of the foundation gain special significance on which the professional training is built. The similarity of fundamental training creates opportunities for the "lifelong learning", promotes creative development and personal fulfillment.

Culture of thinking presupposes that its bearer has a developed theoretical, systematic, logical, critical and humanitarian thinking. The ability to think, to develop, to improve oneself arises during its initiation to knowledge, to a complex system of relations. Improving thinking abilities, the student develops the culture of thinking.

A person with the culture of thinking tends to weigh "pros" and "cons", see the perspective, and try to find an original way to problem solving. He does not stop at the fact statement, but tries to see the phenomenon in all its connections, relations in the development process at a higher theoretical level. However, to form the mind only is simply dangerous, as technocratic origin lies not only in the phenomenon of ever-expanding technosphere, but also in rationalism and scientism as a way of the world exploration through science at the expense of the emotional and moral side of the psyche. Regarding this point of view, the target of overall University environment is its effect on the student, serving the development of the general personal culture.

Culture is tradition and technology. It is the language, cult, community, sociality, a system of values. Thus, an educated person is not only a person, prompted to the historical and cultural traditions, educated and brought up, who mastered speech and languages, joined to a cult (a particular faith, religion,

spiritual movement), but also a person belonging to a certain community, nation, with formed cultural values, and fully engaged in the life of his time. A modern engineer is, above all, cultural, highly educated person, but not just a specialist.

CONCLUSION

The concept of "personal and professional culture of an engineer" specified in the study is an essential methodological prerequisite for the further development of the problem of the cultural and educational ideal of an engineer, due to the peculiarities of his activities at the present stage of the society development. Based on the adequacy requirements of engineering training to the socio-economic conditions, he has to be a bearer of a certain level of personal and professional culture that should be considered as a form of intellectual culture, in which the meanings of things surrounding a human, like himself, are placed in the center of his life focus.

The strategy of its formation involves natural development of personal and professional qualities. These concepts are closely interrelated, but only personal qualities are a system-forming component that determines its existence. Therefore, the main strategic goal of engineering education, the meaning of which is the education of a competent specialist, is personal-professional self-development.

General culture assumes that the engineer has life values that he guides in the choice of working activity, while the perceived spiritual sense has a universal human, humanistic, moral character. It is personally and socially relevant, and determines the content of professional activity. Therefore, discreet, indirect prompting of a growing up person to the vision of higher values and orientation to them in life should be admitted as an important task of engineering education.

An important condition for the realization of this process is the transformation of a technical University from educational and research one, to a cultural center, and changing all directions and approaches in the activities organization.

This approach will allow solving the contradiction between the necessity to preserve the natural resources potential of the country and the constant development of the technosphere based on application of latest knowledge-intensive technologies in training qualified engineers.

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