

# ПЕДАГОГИКА

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# PEDAGOGY

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## ASPECTS OF PROFESSIONAL EDUCATION IN THE HIGHER SCHOOL IN THE INTERESTS OF THE TECHNO-SPHERE SAFETY

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*Purpose. The article considers the questions of formation of creative thinking of future engineers in terms of the educational process in technical University. Attempt understanding engineering creativity as socially significant and socially conditioned process aimed at achieving the objectives of techno sphere safety.*

*Methodology. The article presents the experience of leading national technical universities, for example, Bauman Moscow State Technical University (BMSTU, Bauman MSTU), State Technical University – MADI (STU-MADI), Kazan National Research Technical University named after A.N. Tupolev. The authors use as a methodological basis for designing the content of training of future engineers' systemic ecological approach in the interests of techno sphere safety.*

*Results. It is shown that the implementation of the axiological bases of engineering solutions to – the conditions of the paradigm of sustainable development requires the formation of creative thinking of future engineers. The authors point to the problem of the continuity of engineering personnel training in modern conditions of development of domestic system of education at different levels. The ability and willingness of engineers developing and operating facilities and modern techno sphere to the adoption of a creative and responsible decisions*

*in complex and unexpected the circumstances, is the imperative to preserve life and health of people and safety of environment.*

*Practical implications. The results of the study can be used in the design of the educational space of higher school for the training of engineers in the interest of techno sphere safety.*

**Keywords:** *engineering education; techno sphere safety; axiological approach; creativity; creative thinking of students.*

## **АСПЕКТЫ ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ В ВЫСШЕЙ ШКОЛЕ В ИНТЕРЕСАХ ТЕХНОСФЕРНОЙ БЕЗОПАСНОСТИ**

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*Цель. В статье рассматриваются вопросы формирования творческого мышления будущего инженера в условиях образовательного процесса в техническом университете. Делается попытка осмысления инженерного творчества как социально-значимого и социально-обусловленного процесса, направленного на реализацию задач техносферной безопасности.*

*Метод и методология проведения работы. В статье представлен опыт ведущих отечественных технических университетов, например, МГТУ им. Н.Э. Баумана, МАДИ, Казанского государственного университета им. А.Н. Туполева. Авторы используют в качестве методологической основы для проектирования содержания подготовки будущих инженеров системный экологический подход в интересах техносферной безопасности.*

*Результаты. В работе показано, что реализация аксиологических оснований инженерных решений – условия выполнения парадигмы устойчивого развития – требует формирования творческого мышления будущего инженера. Авторы указывают и на проблему непрерывности подготовки инженерных кадров в современных условиях развития отечественной системы образования на разных уровнях. Способность и готовность инженеров, создающих и экс-*

*плуатирующих объекты современной техносферы к принятию творческих и ответственных решений в сложных и неожиданно сложившихся условиях, является императивом сохранения жизни и здоровья людей и безопасности окружающей среды.*

*Область применения результатов. Результаты исследования могут быть использованы в области проектирования образовательного пространства высшей школы для подготовки инженерных кадров в интересах техносферной безопасности.*

**Ключевые слова:** инженерное образование; техносферная безопасность; аксиологический подход; творчество; творческое мышление студентов.

## Introduction

The problem of «origin» in the minds of creative engineers, leading technical decisions, has always been and remains relevant. Creativity is «...an activity generating new values, ideas of man himself as the creator» [9]. The need for innovative thinking in demand, especially to overcome unexpected challenges and obstacles in our opinion, should be in every technician. The reality is that everything is fundamentally possible situation it is impossible to foresee. There are cases when it is necessary to take quick and adequate problem solution that is first and foremost when we are talking about the provision of personal or public safety.

The ability and willingness of engineers developing and operating facilities and modern techno sphere to the adoption of a creative and responsible decisions in complex and unexpected the circumstances, is the imperative to preserve life and health of people and safety of environment [3]. Modern engineering education as a field of technical thinking and translating technical ideas into practice is, of course, a space of creativity. Question: «Can you teach a student at the technical University creativity, understanding it as a process of thinking and generating new ideas?». You need to understand that every future engineer can think creatively or is it the exclusive preserve of the elite? Is creative thinking an innate ability of individuals or it is possible to develop pedagogical tools?

### **Applied aspects of formation of creative thinking students in the educational process**

Pedagogical science and practice testify that the creativity in any person can and should develop, especially for creating that «space development» [6] personality. Supporting this view, L.I. Gurie (2005) uses the term «innovative education» in relation to the development of engineering education in higher school education, aiming at «...the preservation and development of creative potential of personality» [8, p. 45]. What are the psychological and pedagogical conditions of development of creative personality? Practice shows that for the learner it is essential that the presence of psychological comfort in the study group. In this regard, note that one of the basic tenets established by bishop Jan Amos Comenius (1592–1570) theoretical foundations of pedagogy – didactics reads: «Education should be pleasant».

The student must be motivated to be creative, and possess the methodology of creativity. Experience of leading technical universities, for example, Bauman Moscow State Technical University (BMSTU, Bauman MSTU), State Technical University-MADI (STU-MADI), Kazan National Research Technical University named after A. N. Tupolev shows that the discipline and training modules, whose study is focused on formation of system of technical thinking of students, are most in demand in the implementation of educational programs.

V.V. Bushueva (2010) in the article «The Value of philosophy in the training of future engineers to innovate» describes the experience of teaching the course «Modern problems of technical creativity in domestic and foreign practice» in the Bauman MSTU. It is interesting to note the following fact. For learners of philosophy students on a particular material illustrated position, the essence of which is that the methodological basis for the development of the principles of technical creativity is a philosophical analysis of the history of the development of technology. In this case convincingly proved that the system of principles of technical creativity in their totality express the general course of the development of technology. By studying the discipline students get acquainted with the methods of technical creativity, successfully

applied both in foreign and in domestic practice. Students shows the effectiveness of the application of the methodology of technical creativity, which in the following they use in the development of professionally oriented technical disciplines. In the study of the theoretical aspects of the discipline analyze not only technological creativity but also scientific, social, artistic, discussed their characteristics, psychological qualities of the creative personality, the social conditions of a particular type of creativity [1]. Gabdreev R.V. and Nadrshina M.N. (2010), employees of Kazan National Research Technical University named after A.N. Tupolev general objectives of teaching technical work include the formation of:

- 1) knowledge of the laws and stages of technology development;
- 2) the scientific worldview on the basis of an interdisciplinary approach;
- 3) scientifically based belief that creativity is the core of the innovative engineering activities;
- 4) understanding that each person can be taught to think creatively and to solve professional problems at the level of inventions;
- 5) knowledge about the basic methods of solving inventive problems;
- 6) knowledge of the unified system of development of creative potential and inventive problem solving;
- 7) skills and abilities of inventive and professional challenges in innovative engineering activities;
- 8) the creative potential of students, is the core of innovative engineering activity [2, p. 83].

The study of the history of science and technology is intended to shape future engineers an understanding of the evolution of industry technology, professional involvement and commitment, nurture the spirit of corporatism. In preparing engineers for the needs of road transport is used throughout the textbook [10] written by the candidate of economic sciences, associate professor A.D. Rubec and officially recommended by the Ministry of education and science of the Russian Federation to use in educational process. This study guide has been

reprinted, which indicates its usefulness for readers. Surveys of teachers and students showed that the study of the history of road transport unanimously recognized the essential link in the training of engineers and transport workers.

A characteristic feature of the modern educational process, the interdisciplinary approach to the formation of competencies of future specialist. The interdisciplinary competence of the engineer based on the study of the relationship of engineering and closely offsetting it with other educational disciplines, primarily in the areas of applied mathematics, economics and management, information technology, sociology, law, foreign languages for business communication, history of science and technology, etc.

Training a corps of teachers to work in the Bologna process should also include the improvement of their skills, including towards the development of multidisciplinary competencies.

Priority development of concepts of development of creative personality of the future engineer and the corresponding theoretical model of creative pedagogical system of continuous formation of the future engineers of the system of creative thinking belongs to doctor of pedagogical sciences candidate of technical sciences, professor M.M. Zinovkina and her colleagues, who worked together last 20 years at interuniversity scientific-educational center of engineering creativity, in Moscow State Industrial University (MSIU).

Of particular importance in the theoretical training of the future engineer has to study physics, which is a platform for building new and operation of existing technologies. The study of physics-based understanding of the essence characteristic of the science of the effects, phenomena and processes, as well as the knowledge of its laws, and the ability to their wise use, is the basic stage of engineering education. Engineer competence in the field of general physics can and should serve as one of the most important means of creative professional activity. The study of physics provides the future engineer the formation of intellectual potential is highly demanded in the implementation of the structural-functional and streaming functional anal-

ysis of technical objects (TO). It is necessary to identify the physical principles of operation of already existing, but, more importantly, it is necessary for the generation of new ideas and extensions of reasonable proposals concerning the use of fundamentally new physical principles, namely those that can be the basis for the creation of innovative new generation.

For targeted search for rational solutions to any actual engineering problems the existence of special knowledge in physics is necessary, but it is not sufficient. An important moment in the process of professional training of future engineers is to create conditions necessary to:

- to acquire experience of application of system approach in solving not only engineering, but also any other problems in life;
- to focus on the purposeful development of «multi-screen» thinking. It is a unique tool for visualization of dynamics of development «focus of attention» of the system (technology or process), observed in the context of similar processes taking place in the relevant «subsystem» and «super system».

The study of physics without understanding its role in engineering activities, ensure proper training of the future engineer. The situation changes dramatically in the case when students study the known from the position analysis system all realized in it of physical processes and arises as a result of the effects of those particular phenomena that interact with the environment.

Another topical problem in the training of engineers is the organic continuity of education. Analysis of the work of engineers shows that the greatest stability of personnel is ensured by the informed choice of their future profession. According to our estimates in the organizations of automobile transport after graduation continue to work no more than 25–35% of engineers (the criterion of fixation is obtained of a degree 10 years or more after graduation). One of the main factors influencing the departure of young engineers from professional fields relevant to their education, is the lack of professional orientation at the stage of choosing a future profession [11, p. 53], [4].

For the purpose of professional orientation of young people developed training manuals and educational literature used successfully in a secondary school in Russia in the study of the discipline «Technology». The use of textbooks [12], [13] and other similar publications have shown their relevance among high school students. For reviews of practitioners, vocational guidance manuals demanded in the educational process. Appreciated these tutorials persons enrolled in universities in core areas of training.

Reflecting on the value of learning creativity future engineers, we must, in our opinion, to consider this problem from the standpoint of its social value and, simultaneously, the social aspects. «Modern engineering is characterized by a systematic approach to solving complex scientific and engineering problems, using the complex of natural, technical, social Sciences and Humanities. Social and humanitarian aspects are linked, primarily, with the purposes and criteria of assessment of results of engineering activities, which are increasingly regarded as socially-determined activity» [8, p. 44]. The social importance of the engineering work is due, above all, the needs of companies in innovative technical solutions for the development of scientific and technical progress, in its cultural (socio-humanitarian, value) value to society. At the same time, social conditioning reveals the pragmatic aspect of technological creativity aimed at solving problems of effective use of natural resources. To solve this dual problem, from our point of view, should be used the aforementioned interdisciplinary approach, implemented with attraction of potential of the Humanities (philosophy, history, cultural studies, etc.). Note that ecological knowledge, from our point of view, in essence, genetically, is a humanitarian foundation [5], [7]. However, the axiological problem as a problem of value of human self-determination in relation to nature (natural ecosystems) in conditions of rapid and poorly uncontrolled development has become a topical issue in modern society and business practices. Understanding of the problem formed to present a new direction of research and development, received the name of sustainable development.



To the problems of sustainable development can be related and economically sustainable activities of the organizations. An important task at present is the ability to assess the effectiveness of innovative technical solutions. Based on this, one of the related disciplines on which to pay attention to the training of engineers in MADi, is the economy. The knowledge economy will allow to calculate the necessary financial resources for the implementation of each of the new engineering projects, to assess the future economic efficiency of the proposed to implement innovative solutions. Special attention in the process of learning students of Economics teachers need to address the applied nature of the acquired knowledge [14].

Future engineers studying at present MADi must be able not only to create new production technology, but also to organize the production so that the company acted economically stable, but also comply with the requirements of environmental safety [15].

### **Conclusion**

The problem of purposeful development of creative thinking and the creative act – the ability of students mastering engineer in educational space of technical institutes and universities, has always been among the crucially important, but previously not resolved comprehensively and systematically. Unfortunately, it remains unresolved at present despite the fact that its decision has a strategic importance in the formation of economy based on knowledge.

The future engineer as the creator of the techno sphere, of course, must have a high level of moral and spiritual culture. Therefore, the problem of the methodology of creative activities in the curriculum of a technical University student should obviously be related to the problem of development of his personality in a broad sense.

Methodological culture of the future engineer should include the individual and collective creative activities have a value vector, aiming at «creation», and this corresponds to its accurate translation from English into Russian language – «creation».

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