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Development of Engineering Creativity in the System of Specialists' Training

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Abstract

The article discloses the issue of developing engineering creativity as an element of the qualified specialists' training. The researched forms and methods of organizing engineering creativity in Russia are analyzed in comparison with these activities in foreign countries. The author shares his experience in organization of classes aimed at development of creative abilities of students and provides the achieved results. The proposed conclusions underline an opportunity for transferring best practices to the practical activity of other educational institutions.

Key words: engineering creativity, simulation, design, self-improvement, social partnership, creative abilities.

"One involves in creative activity not at the age of 15-20, but when he/she is four..."

Modern society that is developing based on the accelerated progress ought to solve new tasks. Scientific and technological development requires creation of unique, exquisite technology, design and mechanisms in any field of economy, provided full-manned qualified staff, which possesses both skills of using advanced technical equipment and ability to develop creative skills.

A topical issue is the formation of future specialists able to solve tasks aimed at innovative development of production industry and at formation of deliberate professional choice for personal development. Possible solutions for developing engineering creativity are researched as elements of the system for training qualified specialists.

In the context of modern conditions the basis for innovative activities is the scientific and technical creativity. Mastering skills of engineering creativity implies development of ability to create new technical means, generation of modern and demanded innovative ideas, shaping them to their logical end, preparation of project documentation, experimental development prototypes, and serial production. Formation of an accomplished personality with the required level of education turns to become one of the most important tasks in future specialists' training at an HEI, becomes an essential part of the modern system of training. Development of scientific and technical creativity skills gives students, aiming to master a certain profession, an opportunity to enhance professional and social proactiveness, which, in its turn, is realized in deliberate professional self-identification, increased level of productiveness, progress in improving scientific and technical potential of the production.

The main aim of training young specialists the basics of engineering creativity can be seen as raising interest and, later on, forming and developing a system for fostering creative attitude towards professional activity, which would lead to fostering skills of scientific research work, to finding the

need for rationalization and innovation in their professions.

The process of formation and development of students' interest in technology and engineering creativity allows fostering their engineering thinking, spatial imagination, observation, visual and motor memory, technical proactiveness and skills. These features are necessary for understanding systems of constructional and technological requirements of the industry.

Researchers B.P. Esipov, V.A. Sukhomlinskyi, G.I. Bukina formed the main requirements for training creativity to youth, which is an essential component of personality development. Issues that come along the process of forming and developing engineering creativity skills of students have been analyzed in a number of studies by P.N. Andrianov, V.E. Alekseev, G.S. Altshuller, V.A. Gorskyi, S.K. Nikulin and many other scientists and practitioners. Educators I.P. Volkov and V.F. Shatalov showed on practice a convincing opportunity to turn the theory into everyday practical activity of students. However the process of developing students' disposition towards engineering creativity is a complex, multifaceted and multidimensional activity [1].

Development of the system for engineering creativity within specialists' training requires development of the system of education, integration of vocational, general and professional education into a comprehensive complex. Formation of students' abilities in engineering creativity requires implementation of certain technologies, specific for training teams consisting of mixed-age students. Particular attention to the methods of forming engineering creativity skills of students from various specialties has been paid by such scientists and practitioners as M.M. Zynovkina, A.E. Larin, V.V. Popov and others [1].

Besides the achieved positive results, the issue of training engineering creativity as an efficient instrument for improving the quality of education requires conduction of further research. Insufficient elaboration of theoretical and methodological foundations obstructs wide implementation of new methods for training engineering creativity at HEIs. It is essential to create a system to integrate the whole community of educational institutions, including preschool institutions.

Young kids are attracted by an opportunity to get involved in children's engineering creativity. A chance for creating a craft independently and for presenting it to relatives or friends is just a small visible tip of an iceberg of engineering creativity. The very first craft created by a child gives an understanding of his/her creative independence and an aspiration for cognition of the surrounding world by means of this craft. Creating any crafts, models sets requirements towards gaining knowledge in various scientific and technological areas. By creating any piece of work an author discovers his/her own strive for new knowledge and innovative character, which become the main features of the future creator. Youth show their interest in creative activity more distinctively than adults. Granted the encouragement from adults, they develop a constant need for creative activity, which results in their striving for self-improvement [4].

Many countries put great efforts for developing children's engineering creativity. Organization and development of engineering creativity in France, Germany, England, Finland, and USA is executed in a private manner. This creativity mostly has sports and technical trends. T.G. Kazakova [5] discloses the position of USA researchers, who dedicated their activity to learning issues of children's creativity. Scientists V. Lounfelda, U. Lambert give the main influential role to the new subjects that provide the environment for forming emotions and creative and logical thinking [2, 3, 10]. Russian and Soviet pedagogues, who devoted their research to children's engineering creativity, base their research on the theory proposed by such scientists as V.A. Gorskyi [6], V.N. Varaksin [7], and many others. Thus, V.A. Gorskyi considers common problems that exist in

the methodology of engineering training in general schools. In his works he underlines the specifics of system formation for engineering creativity training, uncovers logics of technical creation of models and devices, and describes main stages of education.

Implementation of the proposed forms and methods helps teachers to foster students' passion for engineering creativity, their self-identification.

The Education Development Federal Targeted Programme for 2016-2020 [8] approved by Directive No. 2765-r of December 29, 2014, issued by the Government of the Russian Federation, enacted the Concept for modernization of education [9]. The programme emphasizes a unique role of professional education in the development of dispositions and abilities, as well as professional self-identification of youth. Focus on creative activity in professional education is recognized as the basis for training young specialists. Students find interest in their work results. They develop a need for creative search, for application of the whole potential of an HEI available for students. The aspiration for finding ways for improvement and self-improvement increases. At the same time, by getting acquainted with the basics of engineering and scientific creativity, students foster their creative attitude towards the process and develop deliberate understanding of their activity, which encourages future specialists' professional development.

Based on the example of a number of professional educational institutions, such as Novosibirsk College for Car Service and Road Industry, Novosibirsk Industrial and Energy College, Berdsk Polytechnic College, Novosibirsk Radio Engineering College, activity of pedagogical teams, aimed at solving the issues of engineering creativity development as an element of training system for qualified specialists, can be noted. With an aim to increase students' motivation towards studying elements of creativity a number of creative projects is executed. Teachers conduct workshop on automotive services, creation of light motor vehicles, automotive model design, aeromodelling, design of radio communicating devices and other. In the past years, professional educational institutions organize recreation day-camps for increasing children's motivation for engineering creative activities.

A system for industry-specific education is created. When a student sees that a model of a real machine unit of a car can be created in 45 minutes, when his/her classmate rides a vehicle created on the basis of a typical jig-saw, the prospect of his/her attraction to creative activities increases multiply.

In spite of complex and, typically, dependent on external influence economic problems existing in Russia and its regions, material and equipment support of professional educational institutions strengthens.

Teams of regional HEIs, when researching the topic "Development of engineering creativity as an element of qualified specialists' training system", have analyzed possible problems that significantly influence the formation of an efficient educational model for training engineering creativity skills that effect qualified specialists' training. Out of a number of problems the following ones have been underlined as the most significant ones for HEIs:

- Prevalence of individual situational problems over the problems of professional education organization as a whole, continuity of its contents, development of required competences within the individual work plans.
- Inefficient arrangement of solving problems concerning educational quality improvement, based on the need for improvement of teachers' qualification level; lack of pedagogic community differentiation according to their level of motivation for studying.

Distinctness of the requirement proposed by authors to construct a structured scheme of the system for engineering creativity training lieы at the root of the importance of the following features:

- Novelty and uniqueness of the contextual matter of the methodological work, of the methods for strengthening the importance of advanced professional activity of teachers.
- Need for organization of research, scientific and methodological components of teachers' work in teams, when developing and executing educational, methodological, research and scientific projects.
- Efficient creative activity within the laboratories (in line with WS standards), interregional specialized competence centers (WSR-Siberia) created in colleges.
- Participation in professional management of educational institutions' project activity.
- Participation in Priority National Project "Education".
- Participation in the work of experimental platforms created in educational institutions.
- Assessment of pedagogical work efficiency based on its final result.
- Formation of new, in-demand competences of teachers as a basis for their professional mastership.
- Expansion of the range of questions for development of creativity that promotes continuous advanced education of teachers.

In the framework of creating a system for pedagogical team's activity, the following milestone ideas have been identified:

- Motivation of pedagogic staff for studying professional management of educational institution's project activity.
- Motivation of pedagogic staff for their successfulness.
- Informational presentation of the positive results of particular teachers.
- Long-term prospective planning of key achievements.
- Monitoring of educational services' quality, which is based on analytical, directive and diagnostic principles.
- Organization of optimum forms of interaction between educational institutions in the framework of network communication and the created educational cluster.

The importance of the chosen development route of an educational institution's scientific and methodological work lies at the root of training specialists with modern level of thinking able to realize his/her creative potential.

The result of such training positively affects students' academic progress, which is proved by their achievements at regional and all-Russian competitions. Thus, Novosibirsk College for Car Service and Road Industry student won the 1st prize on a regional competition for "Automotive Mechanic" profession. Another student won the 1st prize in the selection round of WorldSkills Russia (Siberian Federal Region) in 2015. Another student of the college won 2nd prize on the III National WorldSkills Championship in 2015 in Kazan.

Among other achievements, college students:

- won the Finals of the Siberian Federal Region Championship on work professional according to the WorldSkills Russia standards, that was held on the premises of the International ExpoCenter "Siberia", based in the administrative business center of Krasnoyarsk on March 23-27, 2016;
- were among awardees of the 11th Regional Students Olympiad on professional education (Novosibirsk);
- participated in International Conference "Policy and Educational Development in a Global Context" organized by the Comparative Education Society of Hong Kong (CESHK) in the University of Hong Kong in March 2014;
- won All-Russian Competition "Engineer of the Year, 2014" in Moscow, February 2014;
- were among awardees of the Annual Regional Review Competition "Master of the Year";
- were among awardees of the All-Russian Competition of scientific and technical creative works of students studying at vocational programs, 2014-2015.

For the further realization of the engineering creativity training system the authors propose:

- to enlarge the network of locational platforms;
- open platforms for interaction with social partners and industrial enterprises;
- conduct expert assessment of the quality and efficiency of the realization of extracurricular educational programs for children in the capstone educational institutions;
- conduct regional competitions on robotics and children's innovative engineering creativity with attraction of engineering staff of the interested industrial enterprises;
- provide training and send delegations of students of the regional educational institutions for participation in events for gifted children on Russian and international levels.

The main aim of solving problems for the development of engineering creativity as an efficient instrument for improving professional mastership of students is the task for creating conditions for maximum self-expression of students [7].

Declaring the fact that the country needs trained workforce is unsound unless a sustainable interest for engineering creativity is expressed. For that, it is necessary to create a specific comprehensive educational system and to advertise widely the attraction of children and teenagers to youth's engineering creativity. It is the engineering creativity of children and teenagers that is the basis, the required foundation for training of qualified specialists.

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