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Creativity in engineering education

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Abstract

The paper examines the creativity in engineering education. The authors substantiate the topicality of the training of creative professionals in Russia and abroad and present training of creative professionals experience at the Department of Engineering Entrepreneurship of NR TPU. The empirical basis of the paper is the definition of the algorithm and conditions of the training of creative professionals.

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1. Introduction

Both Russian and Western researches reckoned that “the main purpose of education is to shape a personality that is able not only to copy the work of previous creative and ingenious generations, but to create. The shaping of self-reliant mind able to make decisions, check information and think critically is the objective of education” (Zhurakovsky V.M., 2013; Sauthwik F., 2013; Alexandrov A.A., 2012; Hadzigeorgiou Y. 2012).

2. Literature review

Philosophers contributed greatly to the development of this idea. V.S. Bibler and V.M. Rosin considered cognition as an act of creativity, N.M. Berdyaev mentioned that creativity is mainly freedom, and G.S. Batishchev emphasized that creativity is an intersubjective relation, and creation is not the purpose itself, but the side effect. It is mentioned in modern papers on the creativity issue that “the power of creativity is its orientation on new, more effective than prescribed solutions.” Development and retention of the current state of society with its complex social technological relations are unfeasible without the definition of the algorithms of creativity inspiration and its results implementation processes. Creativity develops into a new approach to the existence of

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human and humanity. Therefore, creativity should be addressed not as a distinction, but as an essential socio-technological element of modern civilization (Blokhohtseva G., 2011)

Hence, we might consider a creative graduating student as a creatively thinking individual able to apply different kinds of information in fast-changing environment, and able to create something qualitatively new for the benefit of mankind. Could such a specialist be cultivated under current circumstances? Ken Robinson, an expert in education, writer and doctor of University of London, mentioned in his book “Out of Our Minds: Learning to be Creative” that modern education systems of nearly all European and American countries are directed against creativity development. Instead of creative educational approaches, standards and tests are used. The quantity of graduates is more important than the quality of their training. The author reckoned that today there is an unnecessary abundance of graduates, and what world actually requires is a new type of creative specialists. Robinson is also convinced that that “traditional forms of education typically fail to identify and develop creative and innovative potential that every individual possesses” (Robinson K., 2013).

In our opinion, in the concept of specialists’ cultivation, creativity should be considered as a key category. Moreover, promoting students’ aspiration for self-development into a creative leader should be the main aim of this concept. On the basis the leading institutions’ researches, we might notice that today most of the countries’ educational practices aim to the students’ creative potential development.

Robina Shaheen, professor of The University of Birmingham in The United Kingdom, mentioned in her article “Creativity and Education” that modern institutes of learning are considered to be encouraging creativity, because universities allow to master analytical and creative skills of students more effectively, than small selected groups. Considering different countries’ experience, she provided examples of this practice (Robina S., 2010).

There are various projects on implementation of students’ creative potential development programs in Russia and abroad. For instance, a group of professors of University of La Laguna in Spain implemented an innovative training project on entrepreneurship. This project consisted in the development of business plan by multidisciplinary student groups. Students from various departments took part in this project: chemical engineering, computer science and business department. Multidisciplinary groups were formed from two sets of students: engineering students and business administration students (but one student from one department maximum). The purpose of the project was the cooperation of students with different mindsets in order to develop a business idea and elaborate a business plan. Engineering students were responsible for technical and operational execution, while business administration students carried out forecasting, market development and research and financial and economic analyses. Business administration students acted as business consultants, helping engineering students to elaborate business plan. Out of 217 participants of four years of education almost a half (109 students) studied engineering, others studied business administration. 12 multidisciplinary teams of 11-20 participants were created during the project. On the basis of project evaluation, authors concluded that the results of multidisciplinary business plan elaboration could serve as a great tool in educational economics, business and scientific education for solving creative graduate cultivation issue of the day in Europe and in the world. As another result of this project, participated students are more willing to start their own business than average Spanish citizen (Francisco J. García-Rodríguez, 2012).

3. Learning to be Creative

This article presents 20 years of hand-on experience in cultivating creative engineers enabled to carry out responsibilities, generate inspiring ideas and form an environment providing opportunities and freedom necessary for results achievement. The generation of methodological culture that allows shaping independently the ideal model of creative specialist is considered to be the basis of this cultivation process. The simple request to students to apply creative approach is never enough; in order to reveal creativity, special skills and techniques are required. The academic staff might play significant role in this process, fits actions are aimed to the creative thinking promotion and encouragement of students’ innovative ideas. The staff should keep an open mind to

ingenious problem-solving approaches and search for creative solutions together with students. To achieve this goal, project and problem-oriented education techniques are used. Its aim is not only the results of the learning, but also the process itself. The knowledge acquired through project and research work should be applied for new exercises and problem solving (Dulzon A., 2013). Analytical, critical and creative thinking could be developed during the educational process by means of such teaching tools as case-study, debates, round tables, business and role games, trainings, interactive (problem oriented) lectures. These methods form cognitive interest, promote students' self-dependence and fulfill multidisciplinary approach (problem solving process during one class requires supplementary knowledge on various subjects) (Gutkevitch A., 2010). Basically, higher efficiency of innovative teaching methods comparing to traditional methods is achieved not only due to the imitation of the real professional life environment, but also due to the more active involvement of a student in a game situation, the more intense interpersonal communication and a brighter emotional experience of victory or failure. Thereby, innovative education techniques aimed to both professional attainments acquisition and personal development could be said to shape creative thinking.

In 2010 graduates of the Department of Engineering Entrepreneurship established the Lab called "Polygon of Engineering Entrepreneurship". The main objective of the polygon is involvement of bachelor, master and PhD students in innovative and entrepreneurship activities. The lab has two areas of activities: promotion of innovative activities among TPU students and education on the topics of innovations. There are several training programs like: "The theory of inventive problem solving" (Russian: TRIZ), "Project Management", "Engineering Entrepreneurship" and the training on the development of an individual innovative project that has a commercial potential. New form of activities is "Café with Entrepreneurs" that allows former students and nowadays successful entrepreneurs to share their experience of new business establishment and to recruit talented graduates. One more recreated polygon's activity is innovative business conveyor will empower its staff to educate, create project teams and provide them with different services (Kizeev V., 2013).

So called "Ladder to success", the departments' co-curricular activity program, is another form of students' inclusion in collective self-organization. It is a compulsory extension of the formal learning experience. Participation in such projects as "School of applied management", "Students in free entrepreneurship", annual international theoretical and practical conference "Impulse", "Welcome party for newcomers", "Knowledge day", student magazine issuing, various themed parties, competitions, festivals and events as "Shakespeare party", karaoke-bar "Broadway" and other events that are held in English enables students to be active and reliable participants of creative process since their freshman year (Allayarova Z., 2011). In creative and collaborative circumstances, every student and teacher is assigned a specific role: organizer, host, journalist, singer, dancer, director, photograph and etc. This socio-cultural environment enables everyone to develop creative potential; the emphasis is made on creativity, dignity, respect and approval that are of particular importance, because the wrong timing for critics could kill a creative idea. This students' and teachers' collaborative process of creativity is complex, but joyful. Ken Robinson said that helping people to reveal their creative potential is the best way to unleash all the best people could bring in the world. This statement is a burden of our creative cooperation.

3. Conclusion

Summarizing the article, one should mention that in order to survive and develop in our fast-changing world graduates should be capable to solve arising complex problems. We believe that modern professional environment requires multidisciplinary knowledge and creative thinking synthesis. Thereby traditional education techniques are not sufficient to cultivate new generation of creative specialists with high potential, flexible and associative thinking.

From our experience, following conditions are required for creative engineers' cultivation:

- systematic approach to creativity process organization; *creativity reaches its golden age* when there is multidisciplinary collaboration on every level of educational process;
- creative environment permeate through every level and step of organizational hierarchy (from the head of department to students);
- personality oriented approach to education, when the student is in the center of the picture, develops in cooperation with creative academic staff;
- innovative education techniques are aimed to the development of self-dependent personalities of students and teachers;
- competence-building and multidisciplinary approach allows to creates new, sometimes even paradoxical relationships;

If the conditions are followed, on the output strong, creative, confident and authoritative personalities of graduates that adhere to self-creation and self-realization path would be cultivated. Transitions from standard to non-standard, from reproductive to productive knowledge replication, from report-performing mindset to creative thinking underlie this process. On the modern development stage, the main objectives of educational institutions are to reveal and develop students' creative potentials. Creativity is said to be possible in any branch of science, and educational system should encourage its promotion.

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