REFERENCES

1. Pirumov A.R. High quality engineering education as a basis for technological and economic security of Russia // Vlast. – 2015. – Iss. 2. – p. 67-71.
2. Akatiev V.A. Engineering education in postindustrial Russia [Electronic resource] / V.A. Akatiev, L.V. Volkova // Sovremennyie problemyi nauki i obrazovaniya. – 2014. – Iss. 5. – URL: www.science-education.ru/119-14671, free. – Title from the screen (reference date: 09.11.2015).
3. Shatalova N. Mission – Perfection. Association for Engineering Education will help to train new specialists // Poisk. – 2015. – April 17 (Iss. 16). – p. 12
4. Meeting of the Presidential Council for Science and Education [Electronic resource]: verbatim record of the Meeting of the Presidential Council for Science and Education, Moscow, Kremlin, June 23, 2014 // Official website of the President of Russia. – M., 1998-2015. – URL: http://www.kremlin.ru/news/45962, free. – Title from the screen (reference date: 11.11.2015).
5. Forming of engineering thinking during the specialists training process: traditional approach and modern challenges / Lysak V.I., Gonik I.L., Fetisov A.V., Yurova O.V., Tekin A.V. // Engineering Education . – 2014. – Iss. 15. – p. 216-223.
6. On-line Quality Assurance of Study Programmes [Electronic resource]: project № 543727-TEMPUS-1-2013-1-IT-TEMPUS-SMGR // Volgograd State Technical University (VSTU) : official website. - Volgograd, 1997-2015. – URL: http://vstu.ru/mezhdunarodnoe-sotrudnichestvo/proekt-543727-tempus-1-2013-1-it.html, free. – Title from the screen (reference date: 17.11.2015).
7. Important meeting at VSTU [Electronic resource] // Volgograd State Technical University (VSTU): official website. – Volgograd, 1997-2015. – URL: http://vstu.ru/news/2015/11/30/vazhnaya-vstrecha-v-volggtu.html, free. – Title from the screen (reference date: 30.11.2015).
8. VSTU in mass media [Electronic resource] // Volgograd State Technical University (VSTU): official website. – Volgograd, 1997-2015. – URL: http://vstu.ru/news/2015/12/01/volggtu-v-smi.html, free. – Title from the screen (reference date: 01.12.2015).

UDC 37.022:37.032:378.1

The Level Structure of Creative Class

Siberian Federal University,
School № 82, School № 10 of Krasnoyarsk city
A.V. Kozlov, O.V. Sidorkina, T.V. Pogrebnaya

The article deals with the description of essential characteristics of creative class developed within technological creativity based on the modern engineering creativity methods – applied dialectics, or the theory of invention problem solution (TIPS). Evaluation criteria of creativity levels are suggested. The ways of increasing students' creativity level in the engineering education are studied.

Key words: creative class, creativity levels, creativity structure, TIPS, applied dialectics, TIPS-pedagogics, knowledge invention, innovative projects, CAI programs.

The term "creative class" was introduced by American economist Richard Florida, the head of "think tank" of "The Richard Florida Creativity Group". His famous book [1] not only reveals the fact of appearance of a new social group having new specific relation to the means of production but also is itself a means of intellectual production in different countries. The book details different social qualities of creative class, its subculture development, aspects of its interaction with the society in general, influence on the society.

R. Florida's investigations are of mostly social-economic, psychological, and philosophical character. In authors' opinion, the most essential idea of the book consists in the necessity of creative class for the modern society as a basis for social and economic advance, the role of creative class as a competitive advantage of those countries and areas where it has been sufficiently developed.

Following R. Florida's book, there was a number of other articles and books to some extent devoted to creative class, for example, [2–4] describing mainly its social-economic aspects. At the same time, though in [1] there is no reference to American philosopher and futurologist Alvin Toffler, the first chapter "Creative epoch" correlates sufficiently with the description of the Third wave in [5].

On the whole, all the mentioned and other works on phenomenon of creative class just state its fact, as the authors are mostly "observers" of its formation and development. A specified and managed character of this process as well as investments to be made is discussed about like a problem to be solved: "…creativity does not appear and exist by itself; it is to be cultivated. If we don't find a reliable technique, someone else will do it" [1, p. 345].

The crucial role of creative class for social-economic development in the modern epoch of global innovative society conditions the importance of its transition process from spontaneous to consciously governing one. In particular, it deals with technological creativity. At the meeting of the Presidential Council for Science and Education of the Russian Federation in Kremlin of 23 June 2014 the rector of Saint-Petersburg State Polytechnic University A.I. Rudskoy noted: «We are to develop engineering training of qualitatively new and complementary types … – so called engineering-technological special forces, I would say, modern, possessing the technologies of international level, … engineers-researchers capable of solving seemingly unsolvable problems and providing innovative breakthroughs in the high-tech industries" [6].

A.V. Kozlov

O.V. Sidorkina

T.V. Pogrebnaya

Thus, it is necessary to find that "reliable way", which was mentioned by R. Florida. For this reason, especially taking into account the necessity of technological creativity development and engineering approach to creative class formation, improvement of its qualitative indicators is also important along with social-economic one.

As a result of the analysis of some publications in the domestic and foreign journals on the issues of technological creativity, its development in the engineering education, the authors of the article noticed that specialists, often setting the task to develop creativity including that in engineering education, are not sufficiently aware of modern efficient tools and methods of creative thinking, though such methods have been developed and improved since ancient times, most intensively since the 20th century: maieutics (Socrates, the 5-6th centuries AD), heuristics (Pappus of Alexandria, the 3d century AD), "Lullian Circle" (Ramon Llull, the 13-14th century AD), in the 20-th century: the method of focal objects (MFO, E. Kuntze, Germany, 1926 improved by Ch. Whiting, USA, 1953), "Brainstorming" (A. Osborn, USA, the 30's), morphological analysis (F. Zwicky, Switzerland, the 30's of the 20th century – development of "Lullian Circle" idea), synectics (W. Gordon, USA, the 50's of the 20th century) and others. In the middle of the 20th century in the former USSR G. S. Altshuller developed the theory of invention problem solution (TIPS) [7 – 9], improved and expanded up to applied dialectics by the present [10].

Simultaneously, independently of the problem to develop creative class based on pragmatic consideration, design departments of the largest transnational corporations in electronics, mechanical engineering, aircraft engineering, power engineering etc. widely use the methods of creative thinking when solving problems, developing innovative solutions, at the same time, replacing such methods as morphological analysis, synectics etc. by TIPS. According to the growing demand for engineers possessing TIPS, this discipline is widely taught in the leading world universities including Massachusetts Institute of Technology, Stanford University, Oxford University, Strasburg University, universities of Japan, South Korea, India, China, Taiwan, Malaysia, Australia and others. Changing "think tank" of the previous generation: "RAND Corporation", "The Richard Florida Creativity Group", "The Adam Smith Institute" etc., which are mostly based on the Delphi method (combination of expert opinions) and solving problems by means of involving large number of highly-paid experts [11], there come "think tanks" of new generation solving problems by much less number of specialists and with much less expenditure due to TIPS application: "Oxford Creativity", "Gen 3 Partners", "Ideation International Inc", "Inventioneering Company", "Systematic Inventive Thinking Center" etc. There is also a growing interest at "Silicon Valley". In addition to Silicon Valley in California, USA, the conferences on TIPS with participation of leading world experts (many of which are Russian-speaking participants) are regularly held in "Silicon Valley" of Taiwan, in Hsinchu, in "Silicon Valley" of India, in Bangalore etc. [12]. The software of new type CAI (Computer Aided Invention) assisting users to apply TIPS is designed and widely used.

All described processes have not been noticed by the researchers of creative class up until now, but they are certain to enable its formation, though initiators of the processes do not set such a goal. Nevertheless, according to the information available to the authors, education and science authorities in some countries show their interest in techniques of creative thinking, particularly in TIPS.

The mentioned methods, particularly TIPS are based on fundamental laws of development studied by dialectics and specify those laws that allow solving not only problems of innovation solution generation, i.e. synthesis, but also

problems of different system analysis, which is often required for the subsequent efficient synthesis. The authors of the article also apply those methods not only as a recommendation for creative class development, but also as a base for analysis of contemporary creative class conditions.

First of all, it should be noted that R. Florida's understanding of creativity is different from that of, for example, developer of intellect model structure J. Guilford, who distinguished two types of thinking – convergent and divergent – in the intellect structure. Besides, he believed the divergent thinking to be creative one, that is "going simultaneously in many directions", focused on generation of multiple solutions to a problem [13]. Divergent (i.e. "different") thinking, according to J. Guilford, is applicable for the problem solution suggesting several correct answers to one and the same question. Convergent (i.e. "similar") thinking, according to J. Guilford, is focused on finding the only correct answer to the question, i.e. it is efficient for the problem solution having the only correct option.

As summarized in R. Florida's book, a crucial feature of creative class is an ability to develop efficient solutions of problems including those of technology and engineering spheres. Hence, R. Florida, in fact, gives a functional definition for creativity. Though R. Florida does not use the terms of "convergent thinking" and "divergent thinking", nonetheless, it follows from the content of his book that his understanding of creativity corresponds to combination of those types of thinking. Indeed, actual engineering practice studied in detail by Russian TIPS developer G. S. Altshuller shows that engineering thinking always contains both divergent and convergent elements in different proportion.

Historically, solution of inventive problems is the initial and up to now widely used trial and error method mostly based on divergent thinking, and convergent thinking is involved only at the stage of efficient idea selection among all generated ideas. Such methods as "brainstorming", method of focal objects (MFO), morphological analysis etc. just accelerate the process of arbitrary idea generation, i.e. the process of divergent thinking still leaves convergent thinking for the final stage. To some extent synectics contributes to the convergent thinking using different types of analogies. But TIPS shows the most efficient combination of divergent and convergent thinking.

Intellectual efficiency, ability to generate innovative solutions sufficiently depends on the combination of divergent and convergent thinking. It is this base on which the authors suggest their creativity classification in terms of levels.

R. Florida notes that the structure of creative class includes the two elements: supercreative core (intellectual elite fully engaged in creative process) and creative experts (capable of creatively and independently combine the standard approaches in various definite cases). The classification is made on the bases of goals and results. The classification in terms of levels complements it.

The authors distinguish the following creativity levels (keeping in mind that this classification can be improved over time):

1. An expert's creativity using the trial and error method and generating innovative solutions as a result of spontaneously occurring "flashes".

2. An expert's creativity capable of rapid generating spontaneous ideas different from typical ones: either as a result of natural aptitude or due to the study of before-TIPS methods of acceleration of idea generation.

3. An expert's creativity capable of regularly finding innovative problem solutions: either as a result of natural aptitude or due to application of TIPS methods.

It is necessary to underline that application of TIPS methods fundamentally means development of intellectual talent [14], or, using the formulation of "Working concept of talent" [15], tapping (realization)

potential talents.

Obviously, for innovative development of any country it is not enough just to increase the number of creative classes (which is limited by demands for working staff, service employees etc.), one should also enhance it structurally increasing the share of higher levels in its structure.

It is important to consider the issue on the methods of such structural improvement. Obviously, it is to be introduced in education and taking into a special demand for technological creativity – in engineering education. Besides, bearing in mind the psychological data on the highest efficiency in development of creative abilities from the school (or even before school) age, it is important to start applying the third level of creativity in the system of pre-university training for engineering specialization, at the same time continuing to develop it in university and post-graduate education. At present, in some schools there is experience of pre-university training in engineering specialties even in primary secondary school. But both in primary and upper school such training consists basically in acquiring additional knowledge on the existing engineering specialties. Pupils' creativity is motivated by competitions of ideas the number of which is growing. The third element should be added to this system – teaching the methods of TIPS thinking. In some schools it is performed even now, but does not become a widespread phenomenon. It is mostly explained by the demand for additional academic hours not only at school but also universities.

Solution of the problem with additional academic hours in both schools and universities includes innovative didactic TIPS-pedagogics technology of new generation [16–18] different from innovative education technologies of the previous generation in the fact that qualities of innovators are developed in students as a result of teaching innovations. It consists in integration of studying different (engineering, natural, and even humanitarian) subjects and disciplines with TIPS. Such an integrated training does not require additional hours, as TIPS concepts are included in common content of subjects and disciplines replacing the logical connections among their concepts by those of dialectic-logical. Following the method of creative problems [17] applicable for the stage of academic process dealing with problem solutions, the methods of knowledge invention and innovative projects have been developed [18] distributing the TIPS-pedagogics in all stages of academic process and project activity. The methods mentioned above have been repeatedly tested, the method of innovative project resulted in Krasnoyarsk schoolchildren's and students' inventions and a number of awards and prizes at the scientific conferences. The program based on these methods for teachers' upgrade course of different types and stages of education was developed and repeatedly implemented.

Considering the challenges of modern world social-economic development: depletion of natural resources, climate change etc., the necessity of the adequate answer to which is formulated by the United Nations Organization in the form of principals of sustainable development, by the authors according to the goals and objectives of the United Nations Decade of Education for Sustainable Development (DESD), 2005 – 2014, and continuing Decade of UNESCO Global Action Plan for ESD, the concept of TIPS was developed as a science of sustainable development, understanding of sustainable development and didactics of sustainable development based on TIPS-pedagogics (i.e. creativity) was accepted as a highest form of innovative thinking [19, 20]. Hence, the authors offer the 4-th creativity level as creativity of specialist capable of regularly finding innovative solution of sustainable development problems.

REFERENCES

1. Florida, R. Creative Class: People Who Change the Future / R. Florida. – Moscow: Classika-XXI, 2005. – 430 p.
2. Mokir, D. A Lever of Wealth. Technological Creativity and Economic Progress / D. Mokir. – Moscow: Gaidar Institute Press, 2014. – 504 p.
3. Sukhovskaya, D.N. The Concept of Creative Class in the Global Society / D.N. Sukhovskaya [Electronic resource] // Scientific World: [site]. – [Kiev], 2010. – http://www.sworld.com.ua/index.php/uk/philosophy-and-philology-213/social-philosophy-213/17726-213-562, free. – Title from the screen (date of reference: 22.12.2015).
4. Volkov, Yu.G. Creative Class and Russian Government: Perspectives of Interaction / Yu.G. Volkov // Vlast'. – 2014. – № 3. – P. 12-17.
5. Toffler, A. The Third Wave / Alvin Toffler. – N.Y.: Bantam Books, 1981. – 537 p.
6. Meeting of Science and Education Council [Electronic resource]: the Record on the Meeting of the President Science and Education Council, Moscow, Kremlin, 23 июня 2014 // Official site of the President of Russia. – Moscow, 1998–2015. – URL: http://www.kremlin.ru/news/45962, free. – Title from the screen (date of reference: 21.12.2015).
7. Altshuller, G.S. To find an Idea / G.S. Altshuller. – Moscow: Al'pina Business Books, 2007. – 400 p.
8. Altshuller G.S. Creativity as an Exact Science : the Theory of the Solution of Inventive Problems / G.S. Altshuller. – N.Y. [etc.]: Gordon and Breach Science Publishers, 1984. – 330 p.
9. Altshuller, G.S. Creativity as an Exact Science / G. S. Altshuller. – 2nd edition. – Petrozavodsk: Skandinaviya, 2004. – 208 p.
10. Pogrebnaya, T.V. TIPS and Applied Dialectics [Electronic resource] / T.V. Pogrebnaya, A.V. Kozlov, O.V. Sidorkina // Metodolog: site. – 2003–2015. – URL: http://www.metodolog.ru/01108/01108.html, free. – Title from the screen (date of reference: 22.12.2015).
11. Dixon, P. Think Tank / P. Dixon – Moscow: Progress, 1976. – 421 p.
12. Kozlov, A.V. Inventive Education [Electronic resource] / A.V. Kozlov, T.V. Pogrebnaya, O.V. Sidorkina // Novosti VPK: site. – 2006–2015. – URL: http://vpk.name/news/124611_izobretayushee_obrazovanie.html, free. – Title from the screen (date of reference: 22.12.2015).
13. Guilford, J. Three Sides of Intellect / Joy Guilford // Psychology of thinking. – Moscow: Progress, 1965. – P. 434-437.
14. Pogrebnaya, T. V. TIPS and Intellectual Talents [Electronic resource] / T.V. Pogrebnaya, A.V. Kozlov, O.V. Sidorkina // Pedsovet. Org: the 16th All-Russian Internet Pedagogical Council. – [Moscow], 2012. – URL: http://pedsovet.org/forum/index.php?autocom=blog&blogid=4256&showentry=26894, free. – Title from the screen (date of reference: 22.12.2015).
15. Working Concept of Talent / D.B. Bogoyavlenskaya, V.D. Shadrikov, Yu.D. Babayeva et al. – 2nd edition. – Moscow, 2003. – 95 p.
16. Vikentiev I.L. TIPS-pedagogics / I.L. Vikentiev, A.A. Gin, A.V. Kozlov // Collection of creative problems on biology, ecology, and life-safety: teachers' manual / S.YU. Modestov. – Saint-Petersburg: AKCIDENT, 1998. – P. 162–165.
17. Gin, A.A. 150 Creative Problems About What Surrounds Us. / A.A. Gin, I.YU. Andrzheevskaya – Moscow: Vita-Press, 2010. – 216 p.
18. Methods of Knowledge and Innovative Project Invention Based on TIPS / T.V. Pogrebnaya, A.V. Kozlov, O.V. Sidorkina. – Krasnoyarsk: IPK SFU, 2010. – 180 p.

ENGINEERING EDUCATION
18'2015

19. TRIZ-based Engineering Education for Sustainable Development [Electronic resource] / A.A. Lepeshev, S.A. Podlesnyi, T.V. Pogrebnaya, A.V. Kozlov, O.V. Sidorkina // 16th Int. Conf. on Interactive Collaborative Learning, ICL 2013, Kazan, 25 – 27 Sept. 2013. – [Kazan: IEEE], 2013. – P. 489-493. – Accessible from http://ieeexplore.ieee.org; DOI: 10.1109/ICL.2013.6644632. – Title from the screen (date of reference: 21.12.2015).
20. Research-Education Center (department) of UNESCO "New materials and technologies" of Siberian Federal University [Electronic resource]: manual. – [Krasnoyarsk: 2013]. – 4 p. – URL: http://www.unesco.ru/media/2013/krasnoyar.pdf, free. – Title from the screen (date of reference: 21.12.2015).

UDC 378

On Necessity of Balance Between Professional Development and Rank Promotion of University Faculty Members

Far Eastern State Technical Fishery University
I.N. Kim

To ensure successful professional development, a faculty member should plan his/her development trajectory that would be perfectly coupled with the career growth. Promotion of a faculty member is an effective way to encourage his/her professional activity, which, in its turn, would speed up the competence acquisition and allow a faculty member to pass through "the zone of incompetence". The career growth of a faculty member should be slow but steady in its progression.

Key words: professional competency, position, professional trajectory, criteria of competency, qualification and job position of academic teaching staff.

A modern tendency in staff (engineering) training implies that objectives for the educational system are to be set by labour market demands rather than by university's policy. In other words, both employers and a University should develop competence requirements for the graduates [10]. One of the basic conditions for the requirements to be met efficiently is highly qualified faculty staff having necessary competences [2; 3].

ANALYSIS OF THE ISSUE

Professional development of teaching staff is an "eternal" issue, with research competence being in focus nowadays, which is conditioned by the fact that fresh graduates should be ready for ever-changing technological environment producing new constituents, unknown before [11]. In this regard, a teacher should foresee any changes in his/her academic field and develop the competences that are necessary now and will be required in the nearest future.

To become a highly qualified teacher it is not enough to have field (operating) experience or scientific degree, it requires longterm and systematic self-development that facilitates professional, pedagogical and psychological competences development [2; 6]. It is only close professional collaboration that can ensure such self-development by implementing research- and training projects and other activities.

However, professional development of faculty staff needs to be regularly motivated. One of the effective motivations is well-timed career promotion, for example, as an award for scientific or teaching achievements. The promotion is somewhat conditional and is aimed at stimulating a teacher to overcome "his/her incompetence" to prove his/her adequacy for the position. It makes faculty staff acquire new professional competences and make comparison between competence levels of the present and previous positions in order to comply with new professional requirements. There is no doubt that successful development of "new area" results in teaching competence improvement, which leads to better quality of educational process. If the new professional competences fail to be improved, demotion to previous position can take place, which is typically followed by dismission for professional impropriety.

Thus, for effective professional development, it is advisable for the rector's office to make every faculty member

I.N. Kim