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PHILOSOPHICAL AND PEDAGOGICAL DEVELOPMENT OF CREATIVITY OF TECHNICAL STUDENTS

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Summary. The paper analyzes philosophical and pedagogical development of creativity. This is a basis of purposive change of a personality, growth of once own professional level. The problem of creativity and development of creative personality is a subject of scientific research in different fields like philosophy, psychology, pedagogics. Similarity and difference of approaches towards determination of creativity are revealed while comparing scientific interpretations. Every school, solving problems and using various methods, suggests a new particular consideration on the nature of creativity, sets some specific problems. The analysis of such approaches to the problem statement and problem solving of creativity helps us to expand this definition. And we can form deeper notions about creativity phenomenon.

Modern notions about creativity and creative process are examined in the paper. Authors explored and learnt a range of issues of creative development, and researched a model of education that tends to develop engineering students' creativity.

Keywords: creativity, self-perfection, self-development, engineer, creation, thinking, personality.

ФІЛОСОФСЬКО-ПЕДАГОГІЧНИЙ РОЗВИТОК КРЕАТИВНОСТІ СТУДЕНТІВ ТЕХНІЧНИХ ВНЗ

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У статті розглядається філософсько-педагогічний розвиток креативності, що виступає фундаментом цілеспрямованої зміни особистості, підвищення рівня власного професіоналізму. Кожне наукове спрямування, вирішуючи певні задачі та використовуючи свої методи, передбачає особливе бачення на сутність креативності, що у подальшому висуває специфічні проблеми. Аналіз поданих підходів стосовно вирішення проблем креативності дозволяє розширити це поняття, сформулювати власне бачення стосовно феномену креативності.

Ключові слова: креативність, самовдосконалення, саморозвиток, інженер, творчість, мислення, особистість.

Problem statement: the research of creativity as common ability of a person to creation has been a subject-matter of the discussions of different schools' members such as psychologists and educators, economists and neurophysiologists, experts in artificial intelligence and philosophers for a long time. Every school in solving problems and using various methods, suggests a new particular consideration on the nature of creativity, sets some specific problems. The analysis of such approaches to the problem statement and problem solving of the creativity helps us to expand this definition. And we can form deeper notions about the phenomenon creativity. Studying creativity, and especially for technical students, is a creative potential and development of self-actualization in professional and social sphere. Creative education in engineering is an ongoing critical issue for universities, in the sense that it helps meet the expectations for professional engineers, as well as completes the intellectual development of individuals.

What is now proved was once only imagined (Blake).

Universities are increasingly expected to provide more opportunities that foster and nurture creativity in students studying engineering. The profession of engineering demands that engineers recognize, validate, and solve problems on their own or through team work. More over, they should demonstrate original and critical thinking, and creativeness and innovativeness in their methodologies. In short, engineers need a creative mind to meet the advancing goal of the engineering profession — to design new products or systems and improve existing ones for the benefit of humankind. Unfortunately, little has been done in many universities to place teaching emphasis on developing and facilitating creativity in their engineering students. This paper reviews the current understanding of creativity and the creative process, attempts to identify and examine blocks to the development of creativity, and explores a teaching model that tends to foster creativity in engineering students.

The analysis of main researches and publications. The sophistication of the definition creativity and creative thinking (J.P. Guilford, Y.P. D'yachenko); "creative abilities" or "creative giftedness" (M.A.Anderson, M.A. Wallach, V.N. Druzhynin, T.V. Galkina and others); specific character of professional becoming, self-regulatory processes in organization of once own life (L. Abolin, B.Anan'yev, V.Ivkonnikova, Z. Kuryand, R. Khmyelyuk and others), dispositional control of behavior (O.Kyrychuk, O.Koval'ov, V. Yadov).

The paper's aim formulation. The paper is devoted to the problem of creativity and development of creative individuality of technical students.

The statement of main research's material. The problem of creativity and development of creative individuality – is a subject of research of many sciences: philosophy, psychology, pedagogy. The similarity and difference of approaches to definition of creativity is shown in comparison of scientific interpretations. Thus, there are three approaches in creativity research in philosophy and psychology. They are examined as:

Personal category linked with self-development and self-actualization;

Creative process;

The result of activity connected with creation of something new.

Psychologist V. Frankl sets up three categories of values in his book “Men's search for meaning”. The first one – “creative values”, those are implemented in productive creative actions. The second – “values of emotional experience”. It becomes apparent in our sensibility to the phenomena of the world around us, for example, our awe of beauty of the nature or art. And the third category – “values of relationships” that, “implemented everywhere, where we are no longer able to change a situation” [1].

There is a great deal of approaches to the values problems in philosophy, psychology, and pedagogics. The authors study value system towards emotional sphere of a person or person's intellect or person's emotional experience. It is emotional and rational interpretation of values. There are also naturalistic, humanistic, ontological approaches to researching value system. Values and frames of references are studied beginning with their origin as creature of culture and taking into consideration their functions for the body (functional conception).

A.G. Maslow asserted that “one should look for values induced by a man in human's nature or essence of events around him... Values worth to be searched, but not invented. It must be realized that they exist”. Higher values are revealed to the man in moments of the “higher experiencing”. The “higher experiencing is a quite good method of “understanding of existence”, cognition of Plato's essences, internal values that, undoubtedly, help... to the personal growth” [2].

The opinion of A.G Maslow is interesting in the light of our research: “Global aims, that face the new variety of education that understand as becoming of “creative”, “humanistic” or “integral” personality, it coincides a lot with the list of higher values or even identical to them” [2].

The frames of references are related to the problem of ideal of the man. The ideal of a man dimmed and almost disappeared in minds of XIX and XX centuries - writes N.A. Byerdyayev, - The ideal of a man changed the ideal of society. Character of man-creator that carries out mission in the world and realizes given to him from God gifts in the name of service to God is an ideal character of a man, integral and uncrushed” [3].

Philosophical conception of creativity is based on the synergistical approach related to self-creativity of personality on the basis of self-generation and self-organization of the creative beginning; spiritual - as principle of creative personality's self-creation and the approach of axiology, based on the key values of creativity.

The sphere of creativity is difficult for psychological researches and causes the enormous amount of controversies in pedagogical researches, as the empiric field of facts that refer to this problem is extraordinarily wide. The process of determination of creativity requires a creative action.

Analyzing the existent concepts and determinations of creativity in the works of foreign researchers, P. Holman writes: “Creativity is alloy of the perceptions carried out by a new method (Mackellar), ability to find new copulas (Kubee), origin of new relations (Rodgers), appearance of new works (Murray), transformation of experience in new organization (Tailor), imagination of new constellations of values (Gizyelin)” [4, c.18].

As early as 60th more than 60 definitions of creativity were considered. The definitions were analyzed and divided into six types: gestalt (describing a cremation process as destruction of existent gestalt for a construction of the best one), innovative (estimating creativity after the novelty of final good), aesthetic and expressive (accenting a creator on a self-expression), psychoanalytic or dynamic (describing creativity, coming from mutual relations It, I and Over - Me), problem (determining creativity in the process of solving of problem tasks, to this digit it was taken and definition of G. Guilford : “Creativity is a process of divergent thinking”), a sixth type was entered by definitions as: “adding to the supply of common to all mankind knowledge” [5, c.118-119]. E.P. Torrance [6] in the process of the protracted research collected metaphorical determinations of creativity, it: to dig deeply, feel scents, look through, stretch out a hand in tomorrow, to listen a lady-cat, to sing in once own key.

We can find the best composed definitions in works of researchers that pay attention to determination of creativity on peculiarities or peculiarities` qualities. Yes, J. Guilford determines creativity as universal ability, yet assists the successful creative thinking [5, c.52], and E.P. Torrance - as a capacity for the strained perception of the problems related to the lack of knowledge [7]. In Russian psychology creativity is examined as a general capacity for work (V.N. Druzhinin), some special property of man, predetermining ability to find out socially meaningful creative activity. Thus for distinction of concepts “work” and “creativity” use two descriptions: judicially - effective (for denotation of work) and subjectively - stipulating (for denotation of creativity).

It is necessary to mention that a concept of “creativity” is examined closely in some researches, and in many

cases and identically by a concept "creative thinking" (J.Guilford, E.P. D'yachenko), "creative capabilities" or "creative gift" (Anderson, M.A. Wallach, V.N. Drudgynin, T.V. Galkina and other). Singer and Griffiths consider those terms "creativity", "fantasy" and "imagination", it can be used as interchangeable.

Some psychologists think such processes, as "originality" and "curiosity" are the most related to creativity (E.P. Torrance, J. Guilford, L. Terstown, Ya.A.Ponomar'ov, V. Wallach). Direct researches confirmed a connection of the processes listed above.

Investigating the nature of creativity, till the present day scientists did not make an arrangement concerning the fact if creativity exists at all or it is a scientific construct; whether independent process of creativity or creativity is a sum of other psychical processes, or absence of socially meaningful product talks about absence of creativity.

The analysis of theories of creativity allowed distinguishing a few approaches of understanding the nature of creativity. One of the earliest approaches determines creativity equivalent to the general capabilities, intellect that is their top expression. First an idea about an equipollence and intercommunication of intellectual and creative capabilities was expounded Ph. Galton [8]. In this time intellectual approach has already been formed in psychology of the productive thinking. In works of the German psychologist O. Saltison we find an idea about existence of a few main intellectual operations that in different combinations result in the decision of creative tasks. Conception of intellectual operations assumes that creativity is filling of blanks in the matrix of problem situation, carried out by means of reproduction of similarity, addition of complex and abstraction.

One major component of creativity is divergent thinking, which involves producing new and possibly multiple solutions or answers or ideas to a problem or question from the available information [5]. It is measured by four main characteristics.

The first one is **fluency**, the ability to generate many responses or ideas. To achieve high fluency requires much training in brainstorming, with emphasis on the quantity of responses.

The second is **flexibility**, the ability to change the form, modify information, or shift perspectives. In other words, a flexible student is able to generate varied ideas from new perspectives.

The third is **originality** or the ability to generate unusual or novel responses. Here an engineering student should be encouraged to practice bold imagination, and take risks of identifying and rationalizing the novelty.

The fourth is **elaboration**, the ability to embellish an idea with details. To elaborate a novel idea and finally turn it into an innovative product requires a solid and broad knowledge of science and engineering.

Team-working should be encouraged here in order to bring a diversity of expertise together. In general, personalities such as the following are needed to motivate divergent thinking [4]:

- openness
- flexibility
- nonconformity
- willingness to take risks
- tolerance of ambiguity
- the courage of one's own convictions.

Convergent thinking centers on deriving the single best solution or answer to a given problem or question from the available information [11]. Convergent thinking differs qualitatively from divergent thinking in that the latter leads to the variability whereas the former leads to the singularity of information production [11]. Although divergent thinking is believed to be the cognitive basis of creativity [5], both schools of thinking are interactively involved in the development of creativity [11, 12]. Interestingly, convergent thinking may play a more important role in the early stage of creativity development. According to a threshold model, a minimum level of conventional and factual knowledge (singularity) is needed to produce new ideas (variability) [11]. Whatsoever, creative engineers are usually skilled at both divergent and convergent thinking [13].

Creativity involves the process of creating or creative activities [14]. The creative process, starting from a problem or question, has been described in many ways [1, 15, 16], and basically contains four phases: preparation, generation, incubation, and verification [1].

The preparation phase includes defining, reformulating, and redefining the problem or question. 'The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science', claimed Einstein and Infeld [17]. Once planned, the student can move toward implementing the actions needed to solve the problem, starting with experimentation of the most possible solution.

Not included in this literature is an evaluation phase of the effectiveness with which the student was able to implement the solution efficiently. We propose that as part of the creative development of the future engineer, students engage in reflecting on the effectiveness of their creative approach to solving the problem. Flow diagrams capturing the variety of processes entertained or engaged to accomplish the solution provide meaningful visuals to the student as to patterns of problem solving. This evaluative reflection provides further learning for improving

future means of solving problems based on past experiences.

Before explanation of creativity as independent universal creative ability first the American psychologist J. Guilford put into words an idea about two types of thinking: "convergent" - linear, necessary for being only of faithful decision, and "divergent" - differently directed, that examines as many as possible amount of decision variants of task that results in unexpected conclusions. J. Guilford, equated a capacity for the convergent thinking with a general intellect, and considered the operation of divergent basis of creativity as general creative ability, next to the operations of transformation and implication [9].

On the basis of the researches J. Guilford distinguished four anchorwomen characteristics of creativity: originality (unusual answers); semantic flexibility (an ability to distinguish the function of object and offer new usage of it); vivid adaptive flexibility (ability to change the form of object, to see new possibilities in him) and semantic spontaneous flexibility (a capacity is for producing of various ideas) [9].

Afterwards a look of psychologist to these parameters was some extended. J. Guilford distinguished six parameters to creativity:

- a capacity to exposure and raise problem;
- a capacity to generate ideas;
- a capacity to produce of ideas is flexibility;
- ability non-standard to answer on irritants - originality;
- a capacity for perfection by addition of details;
- ability to allow ideas, in other words a capacity is for an analysis and synthesis [7]

E.P. Torrance adhered to J. Guilford's conception. Creativity was examined by E.P. Torrance as a natural process that is generated by the strong requirement of man in a deenergization, that arises up in her situation of discomfort caused by a vagueness or incompleteness of activity [7].

During creative process, according to his opinion, next constituents are included: sensitiveness to the problems, deficit of knowledge, their disharmony; fixing of these problems, search of their decision, pulling out of hypotheses; stay and generalization of results of decision of task.

On the basis of the researches of E.P. Torrance came to the conclusion, that development of creativity is not determined genetically, but depends on that culture personality is brought up in that, and proved experimentally, that a slump in development of creativity can be taken off by the special studies. Practical part of our research confirms it in a great deal.

To popularity to conceptions of J. Guilford and E.P. Torrance promoted the tests "on creativity", main dignity of that consists in lifting restrictions in research of creative potential of personality, peculiar to the method of problem situations and tests on IQ, worked out on their basis.

To conception of creativity as independent process independent of intellect, the idea of the "marginal (lateralis) thinking" appears [10]. The marginal thinking brings a man over to the creative opening logically not shown out of decision. This thinking is divergence: a creative process is related to the generation of new idea on the basis of remote value units, distant value associations. Logic at the marginal thinking performs the attendant duty.

In the further researches of creativity as creative ability it was suggested to do in the unstimulated situation, search continuation of decision outside the considered task. Most brightly this approach is presented in conception of D.B. Bogoyavlenska. The secret of higher forms of work she sees at the "situation unstimulated productive activity", in ability to "see in to the object something a new, such, whatever is seen by other". By the creative capabilities of D.B. Bogoyavlenska defined a capacity for "self-development of activity", gift to realization of the "situation unstimulated activity". It property of integral personality that removes co-operation of cognitive and motivational factors is determined by a term "intellectual activity" ("cognitive independent action") [52]. D.B. Bogoyavlenska suggested the worked out method of the "creative field", sent to diagnostics of the same phenomenology, that and tests of J. Guilford and E.P. Torrance, but not on results, but after judicial to the constituents. From data of research of D.B. Bogoyavlenska we can distinguish three levels of intellectual activity and corresponding to them types of work:

- productive - activity can have the productive character conditioned by external stimuli;
- heuristic - activity accepts creative character, new conformities to law are opened by an empiric way;
- creative - empirical regularity is independently educed not used as making decision, but comes forward as a new problem. Here we run into the phenomenon of goal-setting [11].

D.B. Bogoyavlenska comes to the conclusion, that results of creative actions far wider than initial aim: in an advanced form they result in the generation of aim [11].

The same position is spoken out in papers of R. Arngamer, he thinks that "about work it is already impossible to judge on the thing, that he does... Creativity is a complete deployment of knowledge, actions and desires"[12]

An important for understanding of work nature aspect we find in determination of Y.A. Ponomariov in accordance with that "work in wide maintenance is examined as a mechanism of development, as co-operation that conduces to development" [13]. In his conception creativity comes forward as the integrated quality of personality.

Two personal lines are related to creativity - intensity of searching motivation and sensitiveness to side formations that arise up in a mental process. In accordance with his theory about the central mechanism of work there is a fundamental similarity between the stages of becoming in ontogenesis of such ability, as ability to operate in mind, and by the stages that characterize the process of decision of creative task. Applying the method of introduction of auxiliary tasks, Y.A. Ponomariov educed conformity to law of influence of such tasks on the decision of problems. Y.A. Ponomariov's position is important for our research. It is about a creative process on the initial stage of resolution of problems and on the final stage of selection and verification of rightness of decision. It is related to conscious activity, but on the basic stage of decision of problem flows under act of sphere of irresponsible, conscious intellectual activity in this moment is broken up to disconnecting. As a product of creativity can be the by-product of activity, then truly a creative person has an ability to feel it, find and use then [13]

The analysis of these theories shows that as compared to early researches, where creativity comes forward as the exceptional and unique phenomenon, in modern researches creativity understands as a process and complex of cognitive and personal features peculiar to everybody. Creativity is investigated not only to connection with the result of creative activity, naturally, not every personality comes to that, but also as personal meaningful quality. Debates are mainly conducted in relation to clarification of its interpretation, namely: creativity as a divergence thinking (J.Guilford, O.K. Tikhomirov, E.de Bono), or intellectual activity (D.B.Bogoyavlenska), or as the integrated quality of personality (Y.A. Ponomariov and others).

Trying to generalize a report about creativity, F. Barron and D. Harrington did the following conclusions, coming from researches from 1970 to 1980:

Creativity is adaptive ability to react on a necessity for new approaches and new foods, to realize a new in existence, although a process can carry both conscious and irresponsible character.

Creation of creative product depends on personality of creator and force of him internal motivation.

Specific features of creative product, process and personality is their originality, possibility, validity, adequacy of task and fitness.

Creative products are very different by nature: new decision of problem in mathematics, jurisprudence, in the field of social, opening of chemical process, creation of music, picture or poem, new philosophical or religious system and other [14].

As we see, researches examine four basic aspects of creativity:

a creative process and his connections are with other cognitive processes;

creative product;

creative personality;

creative environment or terms of origin and forming of creativity.

These approaches are often used together. Let's consider the points of view on the judicial side of creativity. The first problem that appears on our way touches connection of creative process and work's end product. Most scientists prefer to judge about the presence of creative process at presence of product. Other assert about possibilities to examine them independent of each other (F. Barron, T. Tardif, Stenberg, A.Maslow)

F. Barron [14] creativity as internal process that spontaneously proceeds in an action determines. From this point of view absence of product does not talk about absence of creativity.

A. Maslow divides creativity into primary (stage of the inspired work) and secondary (process of working out in detail of creative product and giving him of concrete form). A. Maslow does support on improvisation and inspiration and beware to examine creativity from the point of view of practical benefit, productivity, as it would direct us "to the study of other human virtues, such, as zeal, patience, industriousness and endurance" [15].

In this connection it is interesting to remember reasoning of N.A. Berdyaev about primary and secondary creative acts. A primary creative act that is "fiery motion from bottomless will" yet is not an art. "Art is secondary, and creative fire cools off in it. And there is always a tragic disparity between the creative burning, where creative intention, intuition, character, is conceived and by the cold of legal realization of work... Herein tragedy of work and limit of human work" [3] O.K. Tikhomirov's opinion is "including of object in new ties" and "it's return by other side" can come true by both a standard method and to take form of a real creative process [16]. Thus some creative products are unnecessarily created as a result of creative process.

Conclusion. Thus, it is necessary to mark that philosophy determines methodological conception of creativity, based on the key values of creativity; spiritual - as principle of self-creation of creative personality; sinergistical approach related to self-creativity of personality on the basis of self-generation and self-organization of the creative beginning. In psychology creativity comes as valued-personal formation and characteristic of the creative thinking.

Among present determinations of creativity, the most corresponding to our research, are following: creativity is a capacity for the strained perception of problems, feeling of dissatisfaction and insufficiency of the knowledge, sensitiveness to the absent elements and disharmony (E.P.Torrance); it is a general capacity for work, some special property of man that stipulates ability to find out socially meaningful creative activity (V.N.Druzhynin).

An idea about phasing of creative process got approved (origin of problem, its realization, incubation,

intuitional decision, formalization of idea, verification). Its central link is the intuitional phase. Researchers pay much attention to time in a creative process, they emphasize on the protracted period of idea's ripening.

The analysis of researches through question of influence of different factors on development of creativity showed that:

- Creativity yields to development;
- it is necessary to create favorable psychological and pedagogical conditions for its development;
- for achieving positive results one should simultaneously influence both on the mental aspect of creativity and on other spheres of personality - emotional, volitional, intellectual, motivational;
- the effective form of influence on creativity is co-operating of methods of problem studies with creation of the special psychological and pedagogical terms.

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