ASPECTS OF THE DEVELOPMENT OF CREATIVITY DURING STUDIES AT THE PHYSICS AND MATHEMATICS FACULTY OF IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE

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Creativity, including the scientific-technical one, can take completely different definitions and applications that students might individually use for achieving academic and, eventually, scientific goals [1, p. 1-7]. Ingenuity is characterized by novelty, low restrictions, detailing, usefulness and communication. In particular, in scientific-technical direction problems setting and solution of, the specific characteristic of efficiency is accentuated. That is, a creatively developed scientist or specialist should be able to find and substantiate a solution to the given task or recognize and select a new problem. This problem usually doesn't have a large number of known conditions and requires an innovative approach. Creativity needs the ability to straightforwardly describe and explain acquired solutions and results and the corresponding view on the problem so that everyone else can fully grasp the whole process [1, pp. 29-42].

The objective of this review is to find the signs of individual creative skills growth and their applications by future scientists and suggest general recommendations for the modernization of educational programs in order to create favourable conditions for the creative development of students.

Students of the faculty of Physics and Mathematics of Igor Sikorsky KPI are future specialists, scientists and teachers who must have a high level of innovative skills in the search for modern problem solutions and optimization of existing research methods. It requires constant renewal of educational programs and requirements according to the contemporary pictures of the world and the state of technologies. Thus, higher education institutions have to prepare future professionals for the current scientific-technical world with the ability to form its future [1, p. 17].

Creativity is successfully developed in certain conditions. This development is expressed individually, but some general aspects can be nurtured.

Let us examine certain characteristic features of an ingenious person. For example, in work [3], there are five processes emphasized that predetermine the creative aspects: choice of the problem, greater efforts towards the solution, problem

sets, setting change, verification and explanation. In work [4], special attention is paid to the effective growth of basic scientific knowledge. It's explained by the fact that creativity, in any form, must have a particular set of tools for solving problems (including modern ones). With the development of the latest technologies, it is necessary to use various materials and forms of information in a versatile way, in order not only to promote the mental perception of new material but also to train students to work with modern equipment and methods of information processing. There are many misconceptions, inappropriate definitions, and characteristics of creativity, and also ways for its development and improvement. In general, it happened due to the popularity of the cult of efficiency, success, and creativity in the business sphere. That's why when creating educational plans, programs and methods for the development of scientific-technical ingenuity in higher education institutions, it is necessary to use and rely only on reviewed and modern research [5].

The creativity of students of the faculty of Physics and Mathematics was first developed during their studies at school. Still, during the first and second years of studying at the KPI, this development had a significant boost. It can be explained by the introduction to the large number of disciplines of scientific-technical direction that experienced professors – scientists and experimenters teach. They educate the students on the various scientific-technical approaches to theory and practice. It develops the students' ability to create their own tools for the growth of creative skills and scientific personality, future education planning, and choosing the topic and scientific advisor for their master's thesis. For example, such discipline as methods of mathematical analysis builds their knowledge and skills for establishing the conditions of any given task and analysing for the right problem setting. Specialized subjects (for example, general physics) further their knowledge of physics and improve the intuitive perception of hard and complicated concepts, which is very important for looking at the task from different sides and removing the line between disciplines.

The educational-professional program of the first (Bachelor) level of higher education for the "104 – Physics and astronomy" specialty [6, p. 9] states such program results of studying, which include the development of scientific-technical creativity, the graduates must know how to: plan research, choose optimal methods and means of reaching the research goals, find ways to solve scientific problems and upgrade the techniques used; order, explain and systemize the obtained scientific and practical results and make conclusions; present obtained scientific-technical answers, participate in discussions related to the contents and gathered data from their scientific research.

Students of the Faculty of Physics and Mathematics note that the personal skill of teachers did not always influence the growth of their creativity, and a large number of exercises were aimed only at consolidating factual knowledge, which inhibited the creative approach to learning. And a personal view of teachers on the educational material had a significant effect on the development of their creativity, taught them to execute quality analysis of the material, and introduced them to the idea of the inexistence of absolute concepts in science.

The analysis of literature and personal experience of the researchers made it possible to suggest recommendations for composing new educational programs for increasing the level of creative growth in students. In our opinion, such programs should account for the following:

- the environment around students should have minimal restrictions on their educational work, i.e., requirements from teachers, assignments, and the atmosphere among other classmates mustn't have a bad influence on the student in a way that prevents them from formulating new and non-standard ideas;

- students should be given a choice in the form of encouragement, for example, accessibly informed on the details about the difference in possible solution methods, initial conditions and the general problem setting (for the mitigation of the understanding of relevance and use of their examination);

- there have to be varying discussions, problems, and conversations on their solutions in the academic space. Prompting communication between students, and students and teachers helps in gaining knowledge and the ability to explain one's ideas;

- teachers should encourage students to analyse the relevance, the expediency of the setting, possible solutions (with meaningful and understandable explanations) of the set tasks;

- students have to be able to openly break down problems and experiment with their settings;

- with the help of non-intrusive directions, teachers must make the process of scientific-technical creative growth easier and also care about the level of interest and stress in students (the former has to be as high as possible while the latter – not cross the limit of mental exhaustion [2]);

- the significant number of problems directed towards intensive and monotonous material consolidation should be replaced with exercises that require careful study of the proposed theory to search for its applications in an ambiguous problem. Students need to be stimulated to discuss such assignments, for they are naturally more complicated and confusing;

- the control of the completion of such assignments in the initial stage should be carried out only based on presence of progress, not a final result;

- the teacher should highlight the aspects of students' work that promote their success and also point out those aspects that make them unable to generate a possible solution. Mentioned problems are compound and might stretch over a long period, unlike standard exercises. They require more time for the students to freely discuss with the teacher and other students the solutions and problems they might previously have to deal with;

- students need to be taught to properly formulate problems on different topics with the possibility to change the settings (it involves prior analysis and talking over the naturality of the problem).

In conclusion, the development of the scientific-technical creativity of students is an individual process. There are certain aspects and signs of creativity presence that speed up its growth.

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