

LOGICAL THINKING IN THE PROCESS OF TEACHING
GEOMETRY TO FUTURE ENGINEERS

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Annotation. Descriptive geometry explores practical problems, being a means to move from the qualitative study of phenomena to the study of quantitative patterns. Computer technology has taken on many computational responsibilities, but this does not mean that it is not necessary to develop geometric thinking and the ability to apply geometric methods in solving technical problems.

Keywords: descriptive geometry, practice, task, means, study, computer technology, develop, geometric thinking, skill, technical tasks.

The analysis of pedagogical and specialized literature made it possible to identify ways to intensify geometric training in schools and universities aimed at reforming the content and introducing intensive learning technologies.: 1) to strengthen the professional orientation of geometric courses by strengthening and integrating meaningful scientific and methodological lines into them; 2) to develop integrative courses based on the implementation of intrasubject relationships in higher geometry and school courses; 3) to develop multilevel and differentiation in geometric education; 4) to develop students' skills of creative thinking and research, imaginative apparatus and spatial thinking based on the introduction of personality-oriented and productive technologies; 5) to solve the problem of activating and managing cognitive activity based on the development of elements of independent self-government and self-control.

A number of publications are devoted to the issues of improving the content and methods of teaching higher geometry in technical universities. In this regard, it is necessary to identify a number of scientists whose work is aimed at intensifying the educational process at universities, achieved by improving the content of educational materials and teaching methods, optimizing the process of geometric education at a technical university, and intensifying geometry teaching to university students through the use of computer technology. The theoretical foundations of the use of computer graphics for the study of the university course of analytical geometry have been developed, aimed at the development of spatial thinking and conceptual apparatus, in the following sections: vectors on a plane and in space; movements on a plane; the relative position of points, lines and planes; determining the type of a second-order line by its equation; the study of second-order surfaces The method is the house of sections.

Let's analyze the main foreign trends in the modern theory of geometric education.

The most influential of them are the French "didactics of geometry", constructivism, "problem solving research", the analytical-synthetic approach, and the simultaneous introduction of plane and space (fusionism).

Let us outline the main developments of French didactics. The training is conducted using didactic or didactic situations. A didactic situation is a learning situation without a teacher, when a child is involved in a game in a well-chosen "learning environment" (milieu), and is "forced" to use geometric concepts if he only decides to participate in the game. Didactic situations are built with the help of a teacher. At the same time, the relationship and mutual responsibility of teachers and students in a didactic situation are regulated by a didactic contract. One of the simplest types of didactic situation is devolution. The teacher can put the problem in front of the student and quietly leave the stage himself, as if delegating responsibility for solving the problem to the students. Knowledge independently constructed by students in classroom time must then be synthesized and "legalized". This action is called "institutionalization." To develop didactic situations, it is necessary to conduct an epistemological analysis of their content. The activity of such analysis is called didactic engineering. In particular, didactic engineering is designed to analyze epistemological obstacles (familiar concepts unsuitable for explaining new content, but preventing the acquisition of new knowledge) that are important for establishing the meaning of acquired knowledge.

In addition to "French didactics", another important area in the study of problems of geometric education not only in Europe, but also in other parts of the world (in the USA, Japan, Australia) was the study of problem solving. The intensification of problem-solving research was also stimulated by attention to solving artificial intelligence problems. And if European and American authors develop strategies for solving problems in the spirit of D.However, Japanese specialists effectively use the "open tasks" method.

The fundamental principles of constructivism are: knowledge is not perceived passively, but is actively built by the cognizing subject; the function of cognition is adaptive and serves to organize the world given in experience, rather than to discover an ontological reality. Constructivism is based on the ideas of J. Piaget and his followers (specialists in geometric education) on the development of genetic structures (behavior, thinking) through the adaptation of a cognitive subject to environmental conditions. The attention of constructivists is focused not on the general patterns of concept formation (as in the activity-based approach, or "French didactics"), but on the features of building knowledge for given specific students, given a specific class. At the same time, feedback and reflection in the learning process become very important: for teaching certain topics, not plans are developed, but strategies that can be adjusted according to the reactions and achievements of students. For a constructivist, each

lesson, a series of lessons, or the passage of a section or topic is a learning experiment, according to the results of which he draws conclusions for the further education of these students.

Among the foreign geometers who have made a significant contribution to the development of the theory of teaching geometry and are theorists of the analytical-synthetic approach and fusionism, we note the following: F. Klein, J. Caron, A. Lebesgue, M. Berger, etc. Here, two directions in the evolution of geometry teaching can be distinguished, related to the two higher schools founded in Paris at that time - the "Polytechnic School" and the "Higher Normal School". The first of them, responding to the needs of the technology that had received a new boost at that time, was supposed to train civil and military engineers, and the second was to train high school teachers. The famous A. Monge had the greatest influence at the Polytechnic School. He created there the kind of teaching of geometry that still exists in higher technical schools, and at that time A. Legendre worked at the Normal School, which for a long time influenced his famous "Principles of Geometry".

We do not consider it possible to completely abandon the development of logical thinking in the process of teaching geometry, and it seems to us desirable rather something in between both possible extremes in teaching geometry in higher education, so that along with the intuitive construction of geometry based on practical experience, logical evidence does not remain in the pen." Secondly, spatial intuition should take the first place, for this it is necessary to simultaneously interpret the plane and space. Thirdly, practical skills and greater clarity of teaching should be combined with the transfer to the higher school course of issues that have long been considered to belong to fundamental geometry. Fourth, spatial intuition, practical skills, and clarity of teaching in higher education must be developed simultaneously with analytical abilities.; Fifth, when selecting the material, one should try to select from the entire field of pure and applied geometry those parts that seem to correspond to the target orientation of geometry in the framework of all teaching at a technical university. Sixth, the teaching of various types of geometries with groups of transformations could bring integrity to the presentation of applied geometry, always putting its group and its invariants in the foreground as a characteristic of each geometry. "In the connection we have established between various types of geometries and groups of transformations, we can see the basic principle that serves to characterize all possible geometries in general. This is precisely the main idea of my Erlangen program: let us give a group of spatial transformations that contains the main group as its part; then the theory of invariants of this group will give a certain kind of geometry, and thus any possible geometry can be obtained. As a characteristic of each geometry, its group is always highlighted"

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