

Integrated Approach to Mathematical Education in a Pedagogical University

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ANNOTATION

Currently, various pedagogical theories are emerging within the framework of the new educational paradigm. From the point of view of the competency-based approach, the psychological and pedagogical foundations for introducing new methodological objects - complexes into the didactics of mathematics of higher education are identified, and the expediency of studying structures by complexification in the context of integral concepts is substantiated.

Introduction. In the development of modern science, there are two trends associated, on the one hand, with an exponential increase in the number of phenomena studied, increasing specialization, detailed branching, and, on the other hand, with intensive unification, synthesis, and integration. At the same time, the connection between the individual branches of sciences, phenomena that until then seemed to have nothing in common with each other, is becoming clearer [1, 3]. We are interested in the second trend in the development of mathematical education in modern general education schools.

It should be noted that since the time of Pythagoras, after his school “reduced” astronomy and music to numbers, they turned out to be associated with arithmetic and geometry, and all four disciplines began to be considered mathematical. A complex consisting of four disciplines, called the quadrivium, was part of the general education program, and this situation remained until the middle Ages. It should be noted that modern theories are a much more subtle form of Pythagoreanism.

Recently, interdisciplinary areas of scientific research have often appeared (synergetics, biometrics, econometrics, mathematical cybernetics, mathematical informatics, computer mathematics, quantum mathematics), which set as their tasks the knowledge of more general patterns and principles underlying processes of different nature: physical, chemical, biological, technical, economic and social. At the present stage of human development, which is characterized by the transition to the information society, cardinal changes are taking place in all

spheres of life (economy, science, education, culture, healthcare, domestic sphere).

Today, an important category of an educated person, along with professionalism, is competence, which implies, in addition to technological, a number of other components that are mainly non-professional or over-professional in nature [2, 4]. These are, first of all, personality traits (independence, the ability to make responsible decisions, a creative approach to business), the ability to bring it to the end, to constantly learn, as well as the flexibility of thinking, which implies the presence of abstract, systemic and experimental components of thinking” [5, 6].

The formation of a new educational paradigm, which characterizes the transition to the competence of the individual instead of based on knowledge, skills and abilities, imposes completely different requirements on modern education in general and mathematical education in universities and educational schools in particular [6, 7, 8].

At the same time, the educational process should address issues related to the development of the individual, its socialization, be focused on the satisfaction and development of the cognitive needs of students. The new educational paradigm should provide conditions for self-determination and self-realization of the personality, opposing subject-object relations to the subject-subject positions of the teacher and the student [5, 8].

Pedagogical theories, systems, technologies began to appear, aimed at achieving a different educational result, defined by different researchers in different ways. In the system of developmental education, in addition to the formation of knowledge, skills and abilities, the issue of general development of the personality is considered, in the theory of developmental education - the transfer to children not so much of knowledge, skills and abilities as of ways of mental actions; in the technology of student-centered learning - the development of individual cognitive abilities of the child [9]. Within the framework of the new educational paradigm, an important place is occupied by a competency-based approach, which is understood as a specially organized learning process aimed not only at developing a system of knowledge, skills and abilities in students, but also competencies, which are a set of personality skills that are set in relation to a certain circle. Objects and processes and necessary to qualitatively, productively act in relation to them.

The formation of personality in the educational environment, in addition to psychological and pedagogical factors, is influenced by constantly changing economic and socio-political conditions that predetermine the moral and educational level of modern youth [8]. At the same time, the actualization of the relevant competencies, their formation in relation to algebra and the beginnings of analysis are predetermined by the principles for selecting the content of basic courses, especially at the faculties of physics and mathematics and at the faculties of the natural sciences of pedagogical universities.

To identify the structural characteristics (features) and principles of effective teaching of mathematics in a pedagogical university, a double sequence of intertwining methodological and mathematical ideas, which is based on the methods of scientific knowledge, in particular deduction is important. As the researchers note, when a “deductive chain of ideas” is built, then each link of it “can be overgrown with all sorts of non-scientific circumstances (social, economic, religious)”, thus the model of teaching mathematics becomes non-linear [6]. In accordance with the theory of contextual recognition, principles are distinguished, one of which is the principle of "cumulative interaction", according to which the formation of a representation is carried out in conditions of "constant restructuring and selection of features that are most significant for recognition" [7]. According to the principle of “binary organization of perception”, not one, but two components participate in perception - external (peripheral) and internal (central), as a binary pair, interacting forming a mental structure, which is subjectively represented as an image of the perceived object, and this difference is determined " mechanism of apperceptive enrichment” [9].

Since an accurate description of the structure of the entire system as a whole with all sorts of conditions for each element is impossible, then in order to resolve many methodological problems, taking into account the realities of the modern development of society, the need arose for a new direction of pedagogical science, “pragmatic pedagogy”, which would “operate with categories, concepts and facts”, on the one hand, adequate to real pedagogical activity and formed on its basis, and on the other hand, satisfying the requirements of scientific reliability” [2].

Therefore, by introducing the concept of a methodical object, we assume a distraction from non-essential features and properties of the object, invariability during its formation at different points in time, and we can consider all real objects to be isomorphic from the point of view of the logical procedure being carried out. Replacing one object in the structure with another, we perform a certain action, and this set of actions makes it possible to highlight the general properties (invariants) of the structure. Following, we adhere to the following two postulates of pragmatism:

- 1) the system of actions, in relation to which concepts are formed, defined and the facts of pragmatic pedagogy are established, should be characteristic of pedagogical activity;
- 2) the set of conditions in relation to which the object is considered as a function should be as close as possible to the set of conditions that are completely characteristic of pedagogical activity.

With the help of these postulates, we get a tool for connecting pragmatic pedagogy with other areas of psychological, pedagogical, mathematical and other sciences in the form of two hierarchies - a hierarchy of conditions in which the corresponding objects are formed, and a hierarchy of actions with these objects that define concepts. Moreover, from a formal point of view, the correctness of the formation of new concepts is determined not by the meaning of the objects themselves, but by the absence of an internal contradiction in the rules of action and organization.

As we notice, for the optimal management of various processes in modern society, objects are created in the form of some complexes (agricultural, industrial, energy, trade and economic, space, rocket, medical and health, housing). From these positions, the creation of complexes in the education system should be a natural, logical continuation of the study of the educational process in general and teaching mathematics in particular. Moreover, the creation of complexes in the theory of learning is not only the construction of a new methodological object and the development of complex thinking with the help of a certain set of elements, but also the identification and study of more essential properties and features in the educational-mathematical and psychological-pedagogical construction, consisting of various kinds structures, relations of interaction and interdependence, providing a holistic perception of the object.

The components of the complex will be called components, and the subcomplex, which includes two or more components, will be called a module. We will call the process of creating complexes in mathematical education the complexification of mathematical education. In a broad sense, under complex thinking in mathematical education we will understand complex thinking as a kind of generalization of the form of thinking defined in psychology, and mathematical thinking, which is characterized by abstractness, flexibility, originality, logicity, the ability to formalize mathematical material and spatial representations, the ability to generalize mathematical material, isolate the main thing, being distracted from the insignificant.

"Consideration of the process of mathematical education of future teachers proceeds from the need to search for optimal methods, means and forms of organization that contribute to the formation of an integral system of scientific knowledge, professionalization and self-realization of the individual." At the same time, “relevant is the disclosure of the functional, operational and

motivational components of the integrity of the perception by students of sign-symbolic activity in the direction of optimizing the teaching of mathematics, accessibility and sustainability of the perception of complex mathematical objects.” One of such methods of teaching mathematics, in our opinion, is the complexification of mathematical education, which, ultimately, from an ideological point of view, contributes to a relatively complete understanding of the surrounding world as a reasonable and harmonious whole.

Depending on the specialties and specific learning objectives, complexes can be compiled both within one subject discipline and to solve the problems of organizing a holistic process. Moreover, the general patterns of the main types of mathematical structures (order, algebraic, topological) allow solving the problems of integrating the content of educational subjects, thus mathematical structures can serve as the foundation for building a unified school mathematics course.

Conclusions. Exploring the problem of the school course in mathematics, the author came to the conclusion that “the introduction of mathematical structures into school mathematics makes it possible to implement a unified approach to the study of new sections of algebra and geometry”, contributes to the solution of “integration of general secondary education”; and one should “construct a course of mathematics without dividing into algebra and geometry.” Thus, at this level, it is possible to successfully implement the idea of complexification of mathematical education. On the other hand, the ideas of the functional dependence of mathematical structures, mathematical modeling are the most important in the mathematical development of integral concepts for the construction of interdisciplinary complexes.

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