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THEORETICAL BASIS OF PROBLEM-BASED TEACHING OF MATHEMATICS IN HIGHER EDUCATIONAL INSTITUTIONS

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Abstract. *The article examines the theoretical foundations of problem-based learning of mathematics in higher educational institutions, as well as in mathematics lessons.Improving Blended Learning Methods in Digital Learning EnvironmentsThe article highlights the content of the use of digital technologies in the process of expanding the possibilities of independent learning in digital education, and also determines the level of effectiveness of the results obtained on the basis of experiments.*

Keywords: *problem-based learning,digital education, blended learning, cognitive, creative, talent, motivation, innovation, creativity, critical thinking,*

OLIY TA'LIM MASSASALARIDA MATEMATIKA FANINNI MAMAMALA OQITISHNING NAZARIK ASOSLARI

Annotatsiya. *Ushbu maqolada oliy ta'lim muassasalarida matematikani muammoli o'qitishning nazariy asoslari yoritilgan bo'lib ayni vaqtda matematika darslarida raqamli ta'lim muhitida aralash o'qitish metodikasini takomillashtirish raqamli ta'lim sharoitida mustaqil bilim olish imkoniyatlarini oshirish jarayonida raqamli texnologiyalardan foydalanish mazmuni yoritilgan, shuningdek, tajribalar asosida olingan natijalarning samaradorlik darajasi aniqlanadi.*

Kalit so'zlar: *muammoli o'qitish, raqamli таълим, аралаш ўқитиш, kognitiv, kreativ, iste'dod, motivatsiya, innovatsiya, ijodkorlik, tanqidiy fikrlas*

ТЕОРЕТИЧЕСКИЕ ОСНОВЫ ПРОБЛЕМНОГО ОБУЧЕНИЯ МАТЕМАТИКИ В ВЫСШИХ УЧЕБНЫХ ЗАВЕДЕНИЯХ

Аннотация. *В статье рассматриваются теоретические основы проблемного обучения математике в высших учебных заведениях, а также на уроках математики. Улучшение методов смешанного обучения в цифровой среде обучения Освещено* *содержание использования цифровых технологий в процессе расширения возможностей самостоятельного обучения в цифровом образовании, а также определен уровень эффективности полученных на основе экспериментов результатов.*

Ключевые слова:*проблемно-ориентированное обучение,цифровое образование, смешанное обучение,когнитивный, творческий, талант, мотивация, инновации, креативность, критическое мышление,*

INTRODUCTION

In mathematics there is no barrier between the problem and the thinking. Purely economic thinking often leads to contradictions. However, philosophical thinking often does not lead to any results. In mathematics you can not only solve a problem, but also prove the correctness of the solution. You need to learn to think correctly, and mathematics is the best way to do this. Many people have told me that they love mathematics for the satisfaction it brings, because it leads to accurate and reliable results. There is no doubt that everyone likes to think correctly[5].

The author then quotes the following statement by T. Jefferson, one of the Founding Fathers of the United States: "Mathematics and natural philosophy (the natural sciences) are so inspiring that they invite every man to study them. They sharpen our minds and reasoning. Thus, mathematical thinking and deduction also enable us to understand legal ideas more deeply.

An important component of problem-based learning is the creation of conditions for the mental development of the individual, the main source of which is the student's need for knowledge. The source of creating such conditions are "problem situations that help overcome psychological barriers in cognition and the emergence of new needs for cognition, which are a prerequisite for the development of motivation for cognition in students"[11].

A problematic situation is felt as an approach to the known, as a threshold of discomfort. It is necessary to expand this boundary and create conditions for approaching the known. The stronger the boundary between the known and the unknown, the more active is the need to move it[9] According to L.D. Kudryavtsev, the main reasons why first-year students cannot master higher mathematics at the proper level and subsequently do not know how to apply mathematical methods to solve practical problems are the following:

a) inability to distinguish what is understandable from what is not;

b) inability to conduct a conversation: understand the teacher's question, answer it and formulate your own question;

c) Perception of information in one form, perception in a distorted and even incorrect form. Therefore, one of the important issues of problem-oriented learning is the maximum distinction between what students know and what they apparently know from each other. The teacher must systematically interrupt the seemingly obvious mental dissonance of students and teach them to do this independently [15; 25 p.].

LITERATURE REVIEW

S.N. Kosarev in his[14; pp. 34–61]In his work, he examines in detail the issues of general cultural competence in education, emphasizing that today, more than ever, the student and his independent development are at the center of the educational process. At first, the teacher gave knowledge, but now he must help the student become a subject of learning and self-development. The main idea of the new pedagogical paradigm is personality-oriented learning.

The didactics of mass school education that had developed by the 19th century was conceptually formulated in the works of the German philosopher, educator and psychologist I. F. Herbart. According to this concept, the student is a passive object of learning, and therefore the teacher only needs to arm himself with knowledge of how to manage the learning process, that is, how to present information, what requirements it must meet, how to ask questions, what the curriculum should be, etc. At the same time, that part of the pedagogical process that Herbart called "managing children" was hypertrophied, that is, excessively expanded. It should be noted that Herbart's system was far from the system of Comenius, which did not deny humanistic principles, such as students' interest in learning and problem-oriented teaching methods, and did not require them. Herbart's concept had a huge influence on theoretical pedagogy and school practice in many countries. Herbart's concept played a key role in the formation of traditional didactic approaches and methods known as authoritarian pedagogy, which have not yet gained dominance in teaching.

The Socratic method of teaching, known to us from the works of Plato (427-347 BC), is a method of lecture-conversation, in which the teacher presents the audience with pre-prepared correct and incorrect ideas, and the students express their opinions, accepting or rejecting them. Socrates' pedagogical method, called maieutics, based on "placing the interlocutor's opinion in a contradictory position", is one of the main ways of creating a problematic situation.

RESEARCH METHODOLOGY

It remains unclear how this definition relates to the proven properties. In some cases, textbooks provide a graphical explanation of the properties after the formal proof. In addition, university programs, especially those at technical colleges, do not take into account the full demonstration of these properties. Therefore, in many cases, the proofs are completely or partially omitted. It is clear that such an introduction to new information-topics does not stimulate the students' desire to learn, since the students were not informed in advance that this is a new problem situation and that they need to know it. In the context of problem-based learning, this topic can be considered, for example, as follows [7]. At the initial stage of preparation, the students' existing knowledge is determined. For this purpose, it is useful to discuss with the students what properties of functions they know. Usually, they remember such things as the periodicity property and the even-odd property. Then the question is asked: "Which of the following properties apply to all continuous functions and only to them?" This question can be called a problem question, since it allows us to generalize the concept of "function properties". Indeed, after analyzing the answers, students independently come to a very important conclusion that when it comes to the properties of functions belonging to a certain class, the following two conditions must be met[6]:

1) this property is true for all functions belonging to the specified class;

2) Among the functions that do not belong to the specified class, there are those that do not have this property.

At the initial stage of preparation, the following question is asked and discussed in the form of "give a definition of a continuous function on a cross section." Students are encouraged to do this work independently. Then, Euler's definition is analyzed: "A function whose graph can be drawn without lifting the pen from the paper is called a continuous function on the given section," as well as various other definitions suggested by students. Experience shows that students independently come up with appropriate examples and counterexamples and are convinced that continuous functions are characterized by only one of the properties known to them, namely, boundedness[2]. Now, when asked "What other properties do continuous functions have?" students develop a need for new, unknown information, that is, such a problem situation is created. Then specific tasks are given for solving problems that lead to the formulation of a theorem. In problem-oriented learning, it is advisable to give students only a certain part of the theorem: For example, its condition is given, the derivational part is determined by the student independently, or, conversely, the student is given the derivational part of the theorem, and the student must independently determine the conditions under which the conclusion is valid. As an example, we cite the Bolzano-Cauchy theorem [1]. It can be formulated as follows:

If $f(x)$ function$[a,b]$What property does an arbitrary function have if it is continuous on an interval and takes non-zero values of different signs at its edges?

ANALYSIS AND RESULTS

In answering this question, it is necessary to give students the opportunity to independently formulate the following statement, using Euler's definition of a continuous function given above, applying the principle of "reasonable confidence": (a,b) at the same time like this ξ There is a moment when $f(\xi)=0$ will.

In this case, the use of the principle of "reasonable certainty" removes the problem of proving the existence of a zero of a continuous function, making it a simple matter, and students no longer have to prove it rigorously. It should be noted that such a situation is widespread in mathematics. It is not for nothing that they say that mathematicians prove the obvious using complex methods. There are two approaches to this. We will discuss this below[2].

The first approach is to use the principle of "reasonable clarity", in which the proof is shortened and replaced by visual aids with graphic explanations. The second approach is problematic because it requires convincing students that what is considered obvious only seems so due to the limitations and stereotypes of knowledge.

Students will have to be convinced that it is really appropriate to doubt the teacher. It is obvious that the second approach to the development of human reason is the right one, while the first approach is far from scientific research[4].

Thus, struggling with clarity is one of the problematic teaching methods.

Returning to the example, to keep students motivated, we either need to convince them that the idea that a continuous function has zeros on an interval is obviously wrong, or we need to rephrase the problem as a problem. In the first case, students $[0,2]\cap Q, Q-$ (here the set of rational numbers is also given) $y = x^2 - 2$ It is necessary to set the task of constructing a graph of a function and discuss the issue of the completeness of a segment on a number line [3].

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