DEVELOPMENT OF MATHEMATICAL COMPETENCE OF FUTURE PROGRAMMERS IN THE PROCESS OF DIGITAL EDUCATION

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Abstract. *The article examines modern methodological approaches to the formation of mathematical competence of future programmers in a digital educational environment on a scientific basis. The course will consider ways to enhance the professional training of programmers through the use of digital technologies in the educational process, the formation of mathematical thinking, and interactive solution methods. The integration of mathematics with programming and the importance of functional and applied mathematical knowledge in the development of algorithmic thinking are revealed.*

Key words: *digital education, mathematical competence, programming, algorithmic thinking, educational technologies, integrated approach, professional training.*

RAQAMLI TA'LIM JARAYONIDA BO'LAJAK DASTURCHILARNI MATEMATIK KOMPETENTLIGINI RIVOJLANTIRISH

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Annotatsiya: *Mazkur maqolada raqamli ta'lim muhiti sharoitida bo'lajak dasturchilarning matematik kompetentligini rivojlantirishning zamonaviy metodik yondashuvlari ilmiy asosda yoritiladi. Ta'lim jarayonida raqamli texnologiyalardan*

foydalanish, matematik tafakkurni shakllantirish va yechimga yo'naltirilgan interfaol usullar orqali dasturchilarning kasbiy tayyorgarligini mustahkamlash yo'llari ko'rib chiqiladi. Matematika fanining dasturlash bilan integratsiyasi, algoritmik tafakkurni rivojlantirishda funksional va amaliy matematik bilimlarning ahamiyati ochib beriladi.

Kalit so'zlar: *raqamli ta'lim, matematik kompetentlik, dasturlash, algoritmik tafakkur, ta'lim texnologiyalari, integratsiyalashgan yondashuv, kasbiy tayyorgarlik.*

РАЗВИТИЕ МАТЕМАТИЧЕСКОЙ КОМПЕТЕНТНОСТИ БУДУЩИХ ПРОГРАММИСТОВ В ПРОЦЕССЕ ЦИФРОВОГО ОБРАЗОВАНИЯ

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Аннотация *В статье рассматриваются современные методические подходы к формированию математической компетентности будущих программистов в цифровой образовательной среде на научной основе. В ходе курса будут рассмотрены пути усиления профессиональной подготовки программистов за счет использования цифровых технологий в образовательном процессе, формирования математического мышления, интерактивных методов решения. Раскрывается интеграция математики с программированием и значение функциональных и прикладных математических знаний в развитии алгоритмического мышления.*

Ключевые слова: *цифровое образование, математическая компетентность, программирование, алгоритмическое мышление, образовательные технологии, комплексный подход, профессиональная подготовка.*

INTRODUCTION

TodayOne of the main challenges facing the education system in the era of digital transformation is to provide future programmers with not only knowledge of programming languages, but also deep mathematical skills, skills in building models

and solving algorithmic problems. Mathematical competence is a set of skills in analytical thinking, mathematical modeling, algorithm development and systematic problem solving that play an important role in the programmer profession.Along with information, the volume of relevant knowledge that must be acquired for successful professional activity in any field also increases[15]. Education must keep pace with the modern level of technological development, and due to the abundance of knowledge, it is no longer relevant for teachers to transfer it to students in the traditional way. In such a situation, the education system based on the re-equipment of knowledge, skills and qualifications cannot prepare highly qualified personnel for the development of the economy, industry and science. Transformation of the knowledge paradigm and the competence-based approach in education are considered as a method for developing educational experience in the field of cognition, communication, independent solution of organizational, ethical and other problems. The competence-based paradigm does not deny "knowledge", but forms and develops the student's readiness to apply the acquired knowledge in professional activity from the standpoint of the competence-based approach. By organizing the educational process on the basis of the competence-based approach, the formation of professional competencies, the socialization of education, education is aimed at developing individuality and self-activation[21].

LITERATURE REVIEW

In scientific, psychological, pedagogical, philosophical literature, scientific research and practice, the concepts of "competence" and "competence" are widely used to describe the results of education, but there are different interpretations of these concepts, which causes uncertainty in understanding. D.I. YunusovaResearch has been conducted on training programmers for innovative activities, allowing them to adapt their professional competencies to the developing educational process and improve the quality of professional and pedagogical training. In addition, interdisciplinary integration training; Mechanisms for motivating students for professional activity and implementing step-by-step preparation for professional activity through pedagogical technologies are presented. In the research work of N.I. Taylakov, scientific and pedagogical foundations for the creation of educational

literature for the system of continuous education were developed [0], K.T. In his scientific works, Olimov outlined in detail the principles and requirements for the creation of a new generation of educational literature on specialized subjects, as well as the shortcomings of electronic textbooks.**Ошибка! Источник ссылки не найден.**18].

In the dissertation of D.N. Mamatov "Pedagogical design of professional educational processes in the electronic information and educational environment" the design of the electronic information and educational environment within the framework of personalized education is considered [**Ошибка! Источник ссылки не найден.**].

In his doctoral dissertation, U.Sh. Begimkulov describes the importance of conceptual pedagogical foundations for the creation of modern distance learning courses as follows[1]. The main focus in the learning process is on the student's independent learning activity (not reading, not teaching).

It is important that the student independently acquires knowledge, has the skills to work and use various sources of information. Independent acquisition of knowledge should not be passive, but on the contrary, the listener should be involved in active cognitive activity. Teaching students using computer networks requires new pedagogical technologies. Such pedagogical technologies include cooperative learning, project-based methods, and problem-based teaching methods. You can bring it. Distance learning involves, in addition to active communication between the student and the teacher, also communication with other students. The monitoring system should be permanent and based on rapid feedback and an automated testing system [10].

RESEARCH METHODOLOGY

Principles of gamification in e-learning environments: The feedback principle. Gamification should provide constant, accurate feedback that allows students to adjust their actions in a timely manner and implement the learning process in an e-learning environment. The principle of motivation. In gamification, motives are a functional means of effectively influencing students in an e-learning environment. The principle of development. The game process of e-learning helps to achieve goals,

strengthen self-esteem and form a positive behavior model. The principle of encouragement. Effective actions in the e-learning environment should be motivated by the importance of the results obtained[20]. The principle of limitation. When implementing this principle of gamification in an e-learning environment, it is recommended to use educational theory and practice. Gamification functions in the e-learning environment: The function of self-awareness. Self-awareness is important. Gamification creates an opportunity for self-development in achieving educational goals in an e-learning environment. Therapeutic function. It is used to overcome various difficulties in human learning in an e-learning environment. Thus, it was justified to clarify the concepts of individualization of independent learning and the trajectory of independent learning, to consider existing models of e-learning, the use of gamification to increase student motivation in the e-learning environment, as well as the development and implementation of an e-learning course that ensures the development of professional competence of programmers in the e-learning environment. Modeling for programmers is a tool for evaluating, assimilating, quantitative and qualitative analysis, collecting, synthesizing and processing professional information. The axiological component of modeling competence includes the ability to create professional models, that is, it is the ability to update knowledge and create a model based on the conditions of a certain professional activity situation[23]. The following skills are proficient in modeling methods: - analytical skills to identify professional problems;- computational skills for constructing models (processing using application software packages, working in a programming environment).

The main content of the axiological component is the ability to determine the main parameters of an object when constructing models, which is used to obtain new information in the modeling process. This skill reflects a deep understanding of modeling in professional practice.

It is important to understand the importance of professional skills when constructing models that include motivational and value components of modeling professional competencies.

The reflective-evaluative component of professional competence is the

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analysis and assessment of one's own level when creating models.

ANALYSIS AND RESULTS

Competence in modeling practical software packages. Implementation of models requires solving various professional problems. Software packages Mathematica, MathCAD, MATLAB and Maple provide functions that simplify writing programs by formalizing model components based on symbolic or analytical transformations, as well as differentiation, grouping and rearrangement of integral and symbolic expressions, compression of similar terms, simplification of expressions and much more. [13]. Modeling and symbolic substitutions are important for teaching modeling as part of professional training.

The essence and meaning of mathematical competenceMathematical competence is a harmonious combination of theoretical knowledge and practical skills, which plays an important role in the professional activities of programmers. This competence consists of the following elements:

Mathematical thinking– logical thinking, deductive and inductive thinking;

Mathematical modeling– modeling real problems using mathematical expressions;

Solving problematic tasks– use mathematical algorithms to solve ambiguous or complex problems;

Mathematical analysis of information– analyze and interpret data using mathematical tools. These competencies play a key role in the programming process: for example, when defining an algorithm when creating a program, choosing optimal solutions and evaluating the efficiency of the code.

Possibilities of the digital learning environmentThe modern digital educational environment creates ample opportunities for training programmers. An individual approach can be provided through online platforms, interactive modeling and artificial intelligence-based learning systems. For example:

MATLAB– a convenient environment for mathematical modeling and visualization;

GeoGebra – to clearly display mathematical expressions and develop spatial imagination in students;

NumPy and SciPy libraries with Python– allows you to perform statistical and mathematical analysis based on programming;

Wolfram Mathematics– used as a universal tool for complex mathematical analysis.

With the help of these tools, the teacher will be able to visualize, model and automate the educational process.

Methodological approaches and educational projectsThe following methodological approaches are effective in developing the mathematical competence of future programmers:

Development of algorithmic thinkingAlgorithmic thinking is the most important skill of a programmer. The following tools are important in its formation:

Pseudocodes and flowcharts;

Mathematical algorithms(Eureka algorithm, recursive computations);

Analysis and coding of software problems based on mathematical formulas.

By developing algorithmic thinking, a student not only writes code, but also understands and can improve the logic behind the code[18].

Project-based learning– students learn by applying mathematical models to real programming projects;

Problem-based learning-tasks that encourage students to think critically and test different algorithms;

Gamification-stimulation through games based on mathematical problems;

Blended learning– flexible learning through a combination of traditional and online classes.

Methodological example:Students are given the following assignment: "Build models of planetary motion based on mathematical equations and develop visual representations in the Python programming language."

In this assignment, students will learn mathematical equations, practice modeling software, and master graphical interface visualization[15].

Students of vocational schoolsIncreasing the efficiency of activities, as well as the formation of independent knowledge in students (independent learning), self-study and the ability to learn (learn to learn) are of great importance in continuous education, supporting "lifelong learning". E-learning and distance learning technologies make it possible to solve a number of functional tasks of continuous education: from organizing independent work of students to building a distance learning model.[7].

In the field of education and information technology: the international program for assessing educational achievements of students PISA (Programme for International Student Assessment); the CDIO (Conceive-Design-Implement-Operate) Initiative, an integrated approach to training programmers; a system of professional standards in the field of the digital economySFIA (Skills Framework for *Information age)*exists[8].

The CDIO initiative reflects a comprehensive approach to educational programming through a set of common principles for curriculum, teacher selection, and training. The list of learning outcomes (CDIO program) includes a set of competencies for these programmers. The list consists of four sections, each of which contains several levels. These sections combine technical knowledge and personal learning outcomes and skills in creating software systems[7].

CONCLUSION

Formation and development of mathematical competence of future programmers in the context of digital education is a strategic direction of modern education. Thanks to visualization, modeling, analysis and development of algorithms using digital technologies, a programmer not only acquires mathematical knowledge, but also gets the opportunity to effectively apply it in practice. In the future, integrated teaching methods based on artificial intelligence and virtual laboratories will contribute to the further development of this direction[4].

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