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DEVELOPMENT OF ANALYTICAL THINKING IN STUDENTS THROUGH AL-KHWARIZMI'S AL-JABR AL-MUQABILIA

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Abstract: This article is devoted to the analysis of the significance of Muhammad ibn Musa Al-Khwarizmi's work "Al-jabr va al-muqabila" in the modern educational process. The article highlights the historical role of the work in the formation of the science of algebra and its use as a pedagogical tool for the development of analytical thinking, algorithmic approach and creative thinking in modern education. The possibilities of integrating Al-Khwarizmi's methods with modern programming, artificial intelligence and interactive educational technologies are also analyzed. This article contains recommendations aimed at implementing the national scientific heritage in modern education and improving the educational process.

Keywords: Al-Khwarizmi, Al-jabr and al-muqabila, analytical thinking, algorithmic approach, algebra, modern education, pedagogical strategies, artificial intelligence, programming, interactive education, national scientific heritage.

РАЗВИТИЕ АНАЛИТИЧЕСКОГО МЫШЛЕНИЯ У СТУДЕНТОВ ЧЕРЕЗ РАБОТУ АЛЬ-ХОРАЗМИ АЛЬ-ДЖАБР АЛЬ-МУКАБИЛА

Аннотация: данная статья посвящена анализу значения произведения Мухаммада ибн Мусы Аль-Хорезми «Аль-джабр ва аль-мукабила» в современном образовательном процессе. В статье описывается историческая роль работы в становлении науки алгебры и ее использование как педагогического инструмента для развития аналитического мышления, алгоритмического подхода и творческого мышления в современном образовании. Также анализируются возможности интеграции методов Аль-Хорезми с современным программированием, искусственным интеллектом и интерактивными образовательными технологиями. В данной статье приведены рекомендации, направленные на применение национального научного наследия в современном образовании и совершенствовании образовательного процесса.

Ключевые слова: Аль-Хорезми, Аль-Джабр и Аль-Мукабила, аналитическое мышление, алгоритмический подход, алгебра, современное образование, педагогические стратегии, искусственный интеллект, программирование, интерактивное образование, национальное научное наследие.

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Introduction. The scientific legacy of this great scientist who lived in the 9th century made a huge contribution to the development of science not only in the Muslim world, but also in the whole world. One of the most famous works of Al-Khwarizmi - “Al-jabr va al-muqabila” - is known as a fundamental work that formed the foundations of the science of algebra. In this work, methods for systematically solving mathematical problems, the theory of equations and algorithmic approaches to solving practical problems were developed. These methods later played an important role not only in the development of mathematics, but also in many other natural and social sciences.

Literature analysis. The possibilities of using Al-Khwarizmi's work “Al-jabr va al-muqabila” to develop analytical thinking skills in students are analyzed. The content of the work, its significance in the modern educational process and methods of practical application in the educational process are also discussed in detail. This approach serves not only to increase the mathematical potential of students, but also to form their logical, systematic and creative thinking skills.

The importance of analytical thinking: Analytical thinking is the basis for effective problem solving not only in science, but also in everyday life. In developing these skills, historical scientific works, in particular, Al-Khwarizmi's "Al-jabr va al-muqabila", act as a kind of bridge in the learning process. Through this work, students have the opportunity to systematically analyze complex problems and develop alternative solutions in difficult situations.

"Al-jabr va al-muqabila" and algorithms: The concept of algorithmic thinking, which is the basis of modern technologies, began with the works of Al-Khwarizmi. His work on the theory of algorithms currently serves as the theoretical foundation of programming. This requires a deep understanding of the relationship between mathematics and technology, especially in the digital age. By explaining this knowledge in depth to students, it is possible to increase interest in mathematics and programming.

Pedagogical approach: Al-Khwarizmi's methods are based on step-by-step solving of complex problems. This method not only increases students' logical thinking skills, but also allows them to connect mathematical theory with practical life. For example, by applying the theory of equations from "Al-jabr va al-muqabila" to modern economic or engineering issues, students' interest in the subject increases. Importance in the context of Uzbekistan: Uzbekistan has identified the effective use of its rich scientific and cultural heritage as a priority area of educational reforms. The scientific heritage of scientists such as Al-Khwarizmi not only forms national pride in

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students, but also inspires them to scientific research. Also, studying such a heritage serves to strengthen Uzbekistan's position in the field of science on an international scale.

Research methodology. The importance of the work “Al-jabr va al-muqabila”, Al-Khwarizmi created the theoretical foundation of algebra with his main work “Al-jabr va al-muqabila” (The Science of Equation and Contrast). This work described the method of systematic solution of equations for the first time in the history of world science. The name of the work caused the emergence of the word “Algebra”, and its content covers the following important aspects:

Action through certain algorithms in solving equations. Step-by-step analysis of problems and their expression in the same form.

Al-Khwarizmi's scientific heritage is not only of historical importance, but also relevant in the present day. His work “Al-jabr va al-muqabila” serves as a great source for the development of analytical thinking, algorithmic methods and mathematical theory. This work remains an important tool in developing analytical thinking in education today, increasing students' interest in solving complex problems. Al-Khwarizmi's scientific approaches serve not only as a historical heritage, but also as an important source for modern education and technology. The role of "Al-jabr va al-muqabila" in education Al-Khwarizmi's work "Al-jabr va al-muqabila" with its content and approach occupies a special place not only in the history of mathematics, but also in modern education. This work inspires students not only to study mathematical theories, but also to apply them to practical life issues. The following three main skills are formed through the work: Systematic thinking, Systematic thinking refers to the process of analyzing problems by dividing them into separate parts and bringing each part to a specific solution.

Demonstration in "Al-jabr va al-muqabila":

• Al-Khwarizmi suggests solving mathematical problems systematically. He breaks each problem down into smaller parts and leads to a step-by-step solution.

• The work presents logical steps for solving first- and second-degree equations. For example:

Step 1: Arrange the equations.

Step 2: Try alternative solutions.

Step 3: Apply the solutions to the equations to practical life problems.

Demonstration in “Al-jabr wa al-muqabila”:

• Al-Khwarizmi’s work encourages students to find creative solutions to complex problems. He connects mathematical equations to everyday life problems.

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• For example, the work presents equations aimed at solving practical problems such as economic problems, dividing property, or calculating commercial transactions.

Role in education: Through a creative approach, students learn to apply their knowledge and develop new approaches to solving complex problems. This skill is especially important in:

• Creating startup projects,

• Solving problems with a creative approach,

• Developing innovative technologies.

Methods of application in education

Practical exercises: Creating interactive exercises by connecting equations and problems from “Al-jabr va al-muqabila” with modern life issues. For example, students can construct and solve mathematical equations to solve economic problems.

Project-based learning:

To teach students how to apply the methods from “Al-jabr va al-muqabila” to modern technologies, such as programming or artificial intelligence. Interactive learning tools: Using visual programs and simulations to explain the theory of algebra and equations.

Research results. Al-Khwarizmi's work "Al-jabr va al-muqabila" was innovative for its time, and the algebraic methods in it are still relevant today. This work is an important source for systematic problem solving, the formation of an algorithmic approach, and the development of analytical thinking, and its integration with modern educational technologies opens up new opportunities.

Applying algebraic methods to programming

Al-Khwarizmi's approach:

• One of the important principles in the work "Al-jabr va al-muqabila" is the step-by-step solution of problems. This approach forms the foundation of modern programming.

• The algorithmic methods in the work teach how to analyze complex problems by breaking them down into parts and solving them.

Visual learning tools:

• Using visual programs and graphic tools to explain the problems in the work “Al-jabr va al-muqabila”.

• Interactive programs:

Students understand the processes through visual simulations when solving equations.

Using programs such as Mathematica or GeoGebra, develop logical and analytical thinking in students.

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Presenting problems in the form of games:

• Presenting Al-Khwarizmi's work to students in an interesting and understandable way by adding gamification elements.

For example, creating games that encourage students to solve mathematical problems step by step.

Introducing a reward system for solving equations at each stage.

Project-based learning:

• Creating projects that encourage students to work together. For example:

Analyzing engineering problems using the work "Al-jabr va al-muqabila".

Creating a program that solves algebraic equations based on artificial intelligence.

Practical exercises and research

Exercises:

• Organizing exercises for students on transforming mathematical problems into software solutions based on "Al-jabr va al-muqabila".

• Example: Solving complex calculations in the field of economics based on algebraic equations.

Research projects:

• Involving students in research projects on applying equations from Al-Khwarizmi's work to modern life issues.

• Arousing interest among students in studying the relationship of Al-Khwarizmi's work with other disciplines, such as physics or chemistry.

Combining Al-Khwarizmi's work "Al-jabr va al-muqabila" with modern educational technologies creates unique opportunities for developing analytical thinking. Applying these methods in practice through the use of programming, artificial intelligence and visual learning tools not only increases students' interest, but also prepares them to solve modern problems. This integration not only improves the quality of education, but also demonstrates the adaptability of mathematical approaches to practical life.

Conclusion. Al-Khwarizmi's scientific heritage, in particular his work "Al-jabr va al-muqabila", is of great importance not only in the development of mathematics, but also in modern educational processes. The work is distinguished by its approaches aimed at systematically solving complex problems and is an important source for the formation of analytical thinking, logical reasoning and a creative approach in students. The importance of Al-Khwarizmi's work in education is of great importance in the development of analytical thinking. The basic principles of

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the work "Al-jabr va al-muqabila" teach students to analyze problems step by step and make logical decisions. This prepares students to solve complex problems. The use of Al-Khwarizmi's work "Al-jabr va al-muqabila" in the educational process allows not only to study the historical heritage, but also to harmonize it with modern needs.

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