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MODERN MATHEMATICAL PACKAGES IN THE EDUCATION SYSTEM

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Abstract

The article examines the role of modern computer mathematical systems in the educational process. A comprehensive comparative analysis of leading software products, including Mathematica, Maple, MATLAB, and MathCad, is carried out, and their functional features, advantages, and disadvantages are identified. Special attention is paid to the applicability of these tools for solving educational tasks in schools and higher education institutions, as well as to their influence on the development of students' ICT competence.

Keywords: Mathematical packages, symbolic computations, information technologies in education, Mathematica, Maple, MATLAB, MathCad.

Introduction

СОВРЕМЕННЫЕ МАТЕМАТИЧЕСКИЕ ПАКЕТЫ В СИСТЕМЕ ОБРАЗОВАНИЯ

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Аннотация

В статье рассматривается роль современных компьютерных математических систем в образовательном процессе. Проведен глубокий сравнительный анализ ведущих программных продуктов (Mathematica, Maple, MATLAB, MathCad), выявлены их функциональные особенности, достоинства и недостатки. Особое внимание уделено применимости данных инструментов для решения образовательных задач в школах и

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вузах, а также их влиянию на формирование ИКТ-компетентности учащихся.

Ключевые слова: математические пакеты, символьные вычисления, информационные технологии в образовании, Mathematica, Maple, MATLAB, MathCad.

Introduction

Socio-economic changes in the Republic of Uzbekistan pose the task of bringing the quality of education up to international standards before the system of continuous education. In the context of economic digitalization, improving the quality of specialist training requires the introduction of multifunctional teaching tools capable of implementing interdisciplinary connections and visualizing complex mathematical processes.

Traditional methods of teaching mathematics often face the problem of “routine calculations,” when a significant part of class time is spent on arithmetic or algebraic transformations to the detriment of understanding the essence of the problem. The rapid development of IT technologies necessitates a reconsideration of the structure of mathematics courses and the active use of mathematical packages. These systems make it possible to automate cumbersome calculations and focus on analyzing results, formulating hypotheses, and interpreting data.

Classification and Main Tasks of Mathematical Packages

Modern software for mathematical calculations, often referred to as Computer Algebra Systems (CAS), makes it possible to solve a wide range of tasks:

- **Mathematical research:** the use of analytical derivations for deriving formulas and proving theorems.
- **Algorithmization and modeling:** the development and analysis of complex algorithms and simulation modeling of physical and biological systems.
- **Visualization:** the creation of scientific and engineering graphics, including 3D animation of processes, which is critically important for the visual clarity of instruction.

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- Application development: the creation of specialized interfaces for performing calculations in specific fields of science.

Comparative Review of Leading Mathematical Packages for Higher Education

1. Wolfram Mathematica

This system is one of the most universal and is widely used in academic and scientific research. It is based on a powerful symbolic core.

- Advantages: Exceptional speed of symbolic transformations and high accuracy of numerical calculations. It has a very powerful functional programming language, Wolfram Language.
- Disadvantages: A specific syntax that requires considerable time to master, which may become a barrier for junior students.

2. Maple

Maple is considered the “patriarch” of symbolic mathematics systems. Interestingly, its computational engine is so reliable that it is used as a component in many other engineering packages, such as MATLAB and MathCad.

- Advantages: Best-in-class capabilities for abstract transformations. The system creates an intelligent environment for experimentation, where variables do not require strict preliminary formalization.
- Disadvantages: The commercial license is quite expensive. Users also note that the system may occasionally become “slow-thinking” when performing extremely complex iterative calculations.

3. MATLAB

Unlike Maple, MATLAB is primarily focused on numerical methods and matrix operations. It is the de facto standard in engineering education worldwide.

- Advantages: Unmatched speed of numerical computations. The availability of the Simulink package and a vast set of libraries, known as Toolboxes, makes it possible to model virtually any dynamic system, from electrical circuits to satellite flight.

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- Disadvantages: The interface is overloaded with numerous auxiliary windows. The help system and code editor require the user to have the skills of a professional programmer.

4. MathCad

MathCad occupies a unique niche: it is an international standard for technical calculations with a “natural” interface.

- Advantages: A very simple visual interface in which formulas are written in the same way as in a notebook. It is ideal for preparing educational reports and coursework due to its integration with MS Excel.
- Disadvantages: Its capabilities in the field of “pure” computer algebra and symbolic transformations are significantly limited compared to the market leaders.

Packages for Use in Secondary Schools and Colleges

Due to the high cost and complexity of professional systems, it is advisable to use alternative and more accessible tools in school practice.



1. Universal Math Solver (UMS): A specialized program focused on the school curriculum. Unlike “adult” packages, UMS does not simply provide an answer but describes the solution process in detail using methods accepted in textbooks. This makes the system an indispensable assistant for students’ self-checking and teachers’ methodological work.

2. Microsoft Excel: Although Excel is a spreadsheet processor, its functionality makes it possible to solve highly complex problems through built-in mathematical functions and add-ins. It is widely available and helps develop data analysis skills that will be useful to graduates in any field of activity.

3. GeoGebra: Today, this is one of the most dynamically developing free applications for mathematics education. It combines geometry, algebra, spreadsheets, graphs, statistics, and arithmetic in one convenient package.

Methodological Aspects of Implementing Mathematical Packages

The introduction of these systems into the educational process should not be reduced to simply replacing manual calculations with machines. The methodology should be based on the following principles:

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- Research approach: using software to generate hypotheses (for example, studying the behavior of a function when changing parameters).
- Interdisciplinary integration: solving problems in physics, chemistry, and economics using mathematical packages.
- Results verification: using systems to verify the correctness of problem solutions solved traditionally.

Conclusion

Modern mathematical packages have come a long way: from complex tools for a small group of scientists to mass-market educational products. Their integration into the educational process is not just a passing fad, but a necessity. The use of such systems not only increases interest in mathematics but also develops skills in working with modern professional software, a prerequisite for preparing competitive specialists in the digital age.

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