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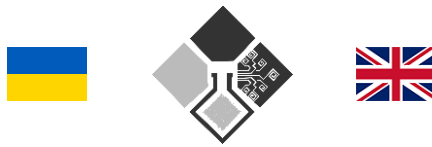


**PROCEEDINGS OF THE
X INTERNATIONAL SCIENTIFIC
AND THEORETICAL CONFERENCE**

THEORETICAL AND PRACTICAL
SCIENTIFIC ACHIEVEMENTS:
RESEARCH AND RESULTS OF
THEIR IMPLEMENTATION

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A NEW PERSPECTIVE ON TEACHING HIGHER MATHEMATICS USING ARTIFICIAL INTELLIGENCE CAPABILITIES

The digital transformation of education has reached a critical point with the emergence of large language models (LLMs). Over the past century, the methodology of teaching higher mathematics has remained one of the most conservative branches of pedagogy. The main emphasis has traditionally been on mastering formal algorithms: differentiation, integration, solving systems of linear equations. However, the rapid expansion of artificial intelligence (AI) and generative models (LLMs) in 2024-2026 has confronted the academic community with the fact that most routine mathematical operations are now performed automatically with accuracy exceeding human capabilities [1].

Higher mathematics, traditionally considered a fundamental and conservative discipline, is facing a challenge: most exam tasks can now be instantly solved by AI with step-by-step explanations. This creates a need to revise not only assessment methods, but also the very purpose of teaching the subject. The question is no longer whether to use AI, but how to transform teaching so that it develops uniquely human competencies – critical thinking, problem-solving and interpretation of complex systems.

Transformation of didactic goals. Traditionally, mathematics was perceived by students as a set of abstract rules. The introduction of AI allows us to overcome this barrier. Instead of spending hours on mechanical transformations of expressions, the student is able to focus on the substantive part of the problem. This corresponds to the modern theory of cognitive load: by freeing working memory from low-level operations, we direct it to a deep understanding of mathematical structures.

In the new learning model, the teacher ceases to be a translator of algorithms and becomes an architect of the educational experience. The main goal is to teach the student to interact with intelligent agents to solve applied problems at the intersection of mathematics, programming, and physics.

New teaching architecture. The new teaching architecture of higher mathematics has several components.

1. **Redistribution of cognitive resources.** The use of AI allows you to change the structure of learning time. If previously 70% of the time was spent on mastering integration or differentiation algorithms, the new model offers the following distribution [2]:

- 20% – Basics of manual calculations (to understand the process).
- 40% – Problem formulation and construction of a mathematical model.
- 40% – Interpretation of results, verification and analysis of boundary values.

2. *Implementation of the "AI-Enhanced Problem Solving" method.* This method involves using AI as an assistant at different stages. For example, when studying differential equations, a student uses AI to write Python code to visualize the phase portrait of the system, which provides a deeper understanding of stability than simply formally solving the equation.

3. *Transformation of teaching components.* The corresponding transformation of components during the teaching of higher mathematics is given in Table 1.

Table 1

Transformation of teaching components

Component	Traditional approach	New Perspective (with AI)
Lecture	Translation of ready-made formulas	Discussion on modeling strategies
Practical activity	Solving many similar examples	Case study: solving one complex applied problem
Homework	Written exercises on technique	Project: Researching a real process with AI validation
Assessment	Test work without gadgets	Oral defense of the algorithm and "debate" with AI

Methodology of integration of AI tools. The study is based on the analysis of cognitive theories of learning (in particular, the theory of cognitive load of J. Sweller [3]) and a comparative analysis of modern software tools:

- Symbolic calculators: Wolfram Alpha, Maple (for accuracy).
- Generative models: ChatGPT-4o, Claude 3.5 (for explaining concepts).
- Visualization tools: Manim, Plotly (for cognitive support).

Effective teaching of higher mathematics in modern conditions should be based on a hybrid approach. Three key vectors of such integration can be distinguished:

1. *Conceptual visualization.* Using generative AI to create dynamic models. For example, instead of a static graph on the board, a student can instantly generate Python code (Manim or Plotly library) to visualize a tensor field or multidimensional space by asking the AI to “see” the abstraction in the dynamics.

2. *Symbolic validation.* Using systems like Wolfram Alpha in synergy with

ChatGPT. This allows the student to compare verbal explanations of language models with rigorous logical calculations of symbolic AI, developing data verification skills.

3. *Adaptive tutoring.* AI can act as a personal assistant that adapts the complexity of the material to the student's pace [4]. If there is difficulty understanding Stokes' theorem, the AI can offer five different analogies – from hydrodynamics to economic flows – until cognitive resonance is found.

Problems of using AI. The use of AI in the educational process entails certain main problems.

The problem of academic integrity and critical thinking. One of the most acute challenges is the risk of complete automation of learning, which can lead to intellectual passivity [5]. A new view of teaching involves changing the nature of tasks. Instead of tasks of the “calculate” type, tasks of the “analyze the error of AI”, “compare two models” or “prove the incorrectness of the system's response” type are becoming relevant.

The teacher should teach the student to recognize the “hallucinations” of neural networks. Mathematics is an ideal platform for training critical skepticism, since any statement of AI can be checked by logical proof or counterexample. Thus, the study of mathematics turns into an intellectual investigation.

The problem of “Adaptive Intelligence”. One of the key conclusions is that teaching should focus on *metacognition*, that is, on the student's awareness of the logic of all processes of higher mathematics. Students should understand why the AI chooses a certain solution method. The teacher should stimulate “healthy skepticism” by offering tasks where AI is prone to errors (for example, problems with parameters or non-standard logical paradoxes).

Conclusions. The integration of artificial intelligence into the teaching of higher mathematics at the university is not just a replacement of paper for a screen, but a fundamental shift in priorities. The mathematical education of the future is a combination of classical logic and the power of modern algorithms. A university graduate should not be a “calculator man”, but a specialist who owns the mathematical apparatus to control complex technological processes using AI.

Universities that are the first to integrate these tools into curricula not as a means of copying, but as a powerful research tool, will gain a strategic advantage in preparing the elite of the digital age.

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