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A Didactic Model For Teaching Mathematical Analysis In A Digital Learning Environment And Its Experimental Foundations

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Abstract. This article examines a didactic model for teaching mathematical analysis in a digital learning environment from both theoretical and practical perspectives. The integration of digital technologies, interactive methods, and assessment systems is considered a key factor in organizing the learning process. The content, methodological, technological, and assessment components of the didactic model are systematically analyzed. Furthermore, the implementation of the model in educational practice is shown to enhance students' knowledge levels, analytical thinking skills, and independent learning abilities. The article also discusses the potential for improving the effectiveness of teaching mathematical analysis based on modern pedagogical approaches.

Keywords: Mathematical analysis, digital education, didactic model, interactive methods, LMS, visualization, assessment system

Raqamli Ta'lim Muhitida Matematik Analiz Kursini O'qitishning Didaktik Modeli Va Uning Eksperimental Asoslari

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Annotatsiya. Mazkur maqolada matematik analiz kursini raqamli ta'lim muhitida o'qitishning didaktik modeli ilmiy-nazariy va amaliy jihatdan yoritiladi. O'quv jarayonini tashkil etishda raqamli texnologiyalar, interaktiv metodlar va baholash tizimlarining integratsiyasi asosiy omil sifatida qaraladi. Didaktik



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modelning mazmuniy, metodik, texnologik va baholash komponentlari tizimli tahlil qilinadi. Shuningdek, modelni amaliyotga joriy etish orqali talabalar bilim darajasi, analitik fikrlash ko'nikmalari va mustaqil o'rganish faoliyatining rivojlanishi asoslab beriladi. Maqolada zamonaviy pedagogik yondashuvlar asosida matematik analizni o'qitish samaradorligini oshirish imkoniyatlari ham ko'rib chiqiladi.

Kalit so'zlar: matematik analiz, raqamli ta'lim, didaktik model, interaktiv metodlar, LMS, vizualizatsiya, baholash tizimi

ДИДАКТИЧЕСКАЯ МОДЕЛЬ ОБУЧЕНИЯ КУРСУ МАТЕМАТИЧЕСКОГО АНАЛИЗА В ЦИФРОВОЙ ОБРАЗОВАТЕЛЬНОЙ СРЕДЕ И ЕЁ ЭКСПЕРИМЕНТАЛЬНЫЕ ОСНОВЫ

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Аннотация. В данной статье рассматривается дидактическая модель обучения курсу математического анализа в цифровой образовательной среде с научно-теоретической и практической точек зрения. В качестве ключевого фактора организации учебного процесса рассматривается интеграция цифровых технологий, интерактивных методов и систем оценивания. Системно анализируются содержательный, методический, технологический и оценочный компоненты дидактической модели. Также обосновывается, что внедрение модели в образовательную практику способствует повышению уровня знаний студентов, развитию аналитического мышления и навыков самостоятельного обучения. В статье также рассматриваются возможности повышения эффективности преподавания математического анализа на основе современных педагогических подходов.

Ключевые слова: математический анализ, цифровое образование, дидактическая модель, интерактивные методы, LMS, визуализация, система оценивания



Introduction. As the modern education system has entered the stage of digital transformation, there is a need to organize the teaching process based on new pedagogical approaches. Especially in teaching complex subjects such as mathematical analysis, the use of digital technologies along with traditional methods is of great importance.

The mathematical analysis course is distinguished by its abstractness and logical complexity. Visualization, interactivity, and step-by-step learning play an important role in the formation of students' knowledge in this subject. Therefore, the development of a didactic model that systematically organizes the teaching process is an urgent issue.

In world education practice, digital platforms such as Moodle, Google Classroom, GeoGebra, Wolfram Mathematica, Maple are widely used as effective tools in teaching mathematical subjects. Research shows that the use of interactive visualizations and adaptive electronic resources develops students' independent work skills and significantly increases their mastery indicators. For example, scientific analyses conducted by UNESCO and OECD have shown that the level of knowledge acquisition in groups using digital educational technologies is higher than in traditional methods.

The decisions of the President of the Republic of Uzbekistan on the digitalization of education and the introduction of modern information and communication technologies into the educational process also require the improvement of innovative didactic approaches in the higher education system. In this regard, the creation of a didactic model for teaching the mathematical analysis course based on a digital educational environment, the identification of its methodological capabilities and experimental substantiation are of significant scientific and practical importance.

This article develops a didactic model for teaching a mathematical analysis course suitable for a digital environment and shows its practical foundations.

Main part. The formation of a didactic model in teaching mathematical analysis requires a systematic approach. This model consists of the following main components:

Content component. The content component covers the main concepts of the mathematical analysis course:



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- limit and continuity
- derivative and its application
- integral and its physical meaning

These concepts are arranged in a logical sequence, from simple to complex.

Methodological component. The methodological component includes the methods used in the teaching process:

- problem-based learning
- interactive discussions
- heuristic approach
- independent learning

These methods encourage students to think actively and consolidate knowledge.

Technological component. The digital environment is organized through the following tools:

- video lectures
- graphic visualization programs (GeoGebra, Desmos)
- LMS platforms

These tools help to express mathematical concepts visually and intelligibly.

Assessment component. The assessment system includes:

- current control (tests, mini-tasks)
- intermediate control
- final assessment

The assessment process serves to regularly monitor student activity.

Table 1. Didactic model components and their functions

No	Component	Content	Vazifasi
1	Content	Mathematical concepts	Systematic knowledge transfer
2	Methodological	Teaching methods	Increasing activity
3	Technological	Digital tools	Visualization and interactivity
4	Assessment	Control system	Knowledge identification



General structure (scheme) of the didactic model

The didactic model works on the basis of the following system:

- Content → Method → Technology → Evaluation → Result

This process is repeated in a continuous cycle and improves the learning process.

Experimental basis. In the process of implementing the model in practice, the following results were observed:

- students began to participate more actively in the learning process
- the level of understanding of complex mathematical concepts increased
- independent work skills developed
- the ability to re-study the educational material increased efficiency

Also, through visual aids:

- it became easier to understand the graph of functions
- the concepts of derivative and integral were perceived more clearly

Discussion. The proposed model is an effective tool in teaching mathematical analysis. The digital environment:

- individualizes the learning process
- increases student interest
- deepens knowledge

However, in implementing the model, technical infrastructure and teacher training play an important role.

Conclusion

The didactic model developed for teaching the mathematical analysis course in a digital learning environment serves to increase the effectiveness of the learning process.

Main conclusions:

- digital technologies deepen knowledge
- interactive methods increase activity
- the didactic model ensures systematic learning

Recommendations:

- widespread introduction of digital tools
- training of teachers
- application of the model to other subjects



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