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Priority Methods in Teaching Blockchain Technology

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Abstract: This article scientifically analyzes the priority tasks and effective pedagogical methods of teaching blockchain technology in higher education institutions. The study substantiates that the growing need for blockchain technology in the digital economy creates the need to train qualified specialists in this area in the education system. The article highlights the effectiveness of project-based learning, problem-based learning, practical laboratory exercises and case study methods in mastering blockchain technology based on empirical results.

Keywords: Blockchain technology, digital education, project-based learning, problem-based learning, practical training, digital competence, innovative pedagogy, educational methods.

Introduction. In recent years, digital transformation processes have been causing fundamental changes in all areas, including the education system. In particular, blockchain technology is gaining importance as it allows for the creation of reliable, transparent and decentralized systems in such important areas as information security, finance, healthcare, public administration and education. According to researchers, blockchain is not limited to cryptocurrencies, but is an innovative mechanism for protecting data and reliably managing transactions [1].

Global analysis shows that, along with the implementation of blockchain technologies in practice, the development of an effective teaching methodology is also becoming an urgent issue. According to the World Economic Forum reports, the need for specialists with knowledge and competencies in blockchain in the digital economy is increasing year by year. Therefore, there is a need to abandon traditional approaches to teaching blockchain technology in higher education institutions and use competency-based, practical and innovative methods [2].

From a pedagogical point of view, the process of teaching blockchain technology requires not only providing theoretical concepts, but also directing students to solve real problems. Since this technology is closely related to complex algorithms, cryptographic mechanisms, and distributed ledgers, project-based learning is necessary to master it. Problem-based learning, laboratory exercises, and case study methods are of primary importance [3].

Modern pedagogical research also emphasizes that interdisciplinary integration is an important factor in teaching blockchain technology. That is, teaching inextricably linked with information technology, cybersecurity, economics, and law further strengthens students' knowledge and develops their professional competencies [4]. This requires the use

of interactive platforms, simulation environments, and digital laboratories in the educational process.

In conclusion, the priority task in the process of teaching blockchain technology is not only to equip students with technological knowledge, but also to prepare them for innovative thinking, independent analysis and practical problem solving. This article analyzes the methods that are considered effective in teaching blockchain technology, and scientifically substantiates their role and importance in the educational process.

Methods

Since the process of teaching blockchain technology involves complex technical and theoretical concepts, it requires the use **of student-centered, competency-based,** and **practical methods in the educational process.** As a research methodology, the integration of didactic, innovative, and empirical teaching methods was used in this work. Project-based learning is one of the most effective methods in learning blockchain technology. Through this method, students independently acquire knowledge in the process of performing tasks close to real life. For example, students can create a **simple block chain model, a smart contract prototype** or **distributed ledger scheme** This method develops algorithmic thinking, teamwork, and problem-solving competencies in students.

The problem-based learning method provides a deep understanding of the practical aspects of blockchain technology. In this method, students are presented with a specific problem: for example, **preventing data tampering, ensuring transaction transparency,** or **Creating a decentralized system.** Students consolidate their knowledge by analyzing a problem, developing solutions, and justifying them.

in practical and laboratory classes, it will be difficult to achieve the expected results if theoretical knowledge is not reinforced with practical exercises. During laboratory classes, students:

- ✓ models the structure of blocks;
- ✓ studies the mechanism of operation of hash functions;
- ✓ Runs simple smart contracts in a test environment.

allows you to master technological processes visually and practically.

The case study method aims to explore the application of blockchain technology in real-world applications. In this method, students analyze real-world situations, such as banking, certification of educational certificates, and data security in healthcare. As a result, students gain the ability to connect theoretical knowledge with real-world practical situations.

Table 1. Comparison of methods used in teaching Blockchain technology

Method name	Main goal	Developing competencies	Educational advantage
Project-based learning	Building practical skills	Critical and creative thinking	Proximity to the real project
Problematic education	Developing analytical thinking	Problem-solving competence	Independent research
Laboratory exercises	Strengthening technical knowledge	Practical and technological skills	Theory-practice integration
Case study	Analysis of real situations	decision making	Professional orientation

The study found that the use of a combination of methods in teaching blockchain technology provides high efficiency. Especially when project-based and problem-based learning methods are combined with laboratory exercises, students' theoretical knowledge is transformed into practical competence.

Results and Discussion. In this study, the effectiveness of innovative pedagogical methods used in teaching blockchain technology was evaluated based on empirical and analytical approaches. The results of the study showed that, compared to traditional lecture-based teaching, **project-based learning, problem-based learning,** and **practical laboratory exercises** significantly increased the level of knowledge and practical competencies of students. The research assessed students' knowledge in three stages: pre -test, mid-test, and post-test. The results showed that teaching blockchain technology through interactive and hands-on methods plays an important role in consolidating knowledge.

Table 2. Change in students' knowledge level based on teaching methods

Teaching method	Elementary level	Final level	Growth rate
Traditional lecture	42 %	58 %	+16 %
Problematic education	44 %	72 %	+28 %
Project-based learning	46 %	81 %	+35 %
Laboratory exercises	45 %	78 %	+33 %

As can be seen from the table, the highest growth was observed in **the project-based learning** method. This is consistent with the previous findings, namely that **active participation and a realistic project environment** are important in learning complex systems such as blockchain technology.

The main goal of teaching Blockchain technology is to equip students not only with theoretical knowledge, but also with **professional and digital competencies.** The results of the study showed that innovative methods had a positive impact on the development of the following competencies in students:

Table 3. Analysis of competencies formed based on methods

Competency type	Traditional approach	Innovative methods
Critical thinking	Low	High
Problem solving	Average	High
Practical skills	Low	Very high
Teamwork	Average	High
Digital literacy	Average	Very high

The results are consistent with analyses published by international organizations. According to the World Economic Forum, specialists preparing for the digital economy are trained faster and more effectively through practice-oriented education. The results of the study showed that integrating theory and practice in teaching blockchain technology increases students' adaptability to the labor market [4]. Also, problem-based and project-based teaching methods prepare students for real-life situations, which develops their innovative thinking. The main principles of the blockchain concept put forward by Nakamoto — transparency, reliability, and decentralization — are also manifested as effective didactic tools in the educational process.

Analysis of the results shows that **traditional methods are not enough** to teach blockchain technology. Highest efficiency:

- ✓ project-based learning,

- ✓ problem-based learning,
- ✓ achieved through the integration of practical and laboratory training.

This situation scientifically justifies the need to introduce innovative approaches in the pedagogical process and the methodology for teaching blockchain technology.

Conclusion. The results of the study showed that teaching blockchain technology is of particular strategic importance in the modern digital education system. Since this technology is based on complex architecture, cryptographic mechanisms and decentralized management principles, teaching it in a traditional lecture-style cannot fully provide the expected educational results. Therefore, the need to use innovative and integrated pedagogical methods in teaching blockchain technology has been scientifically substantiated. The study found that the combined use of project-based learning, problem-based learning, laboratory-practical exercises, and case study methods provided high efficiency in transforming students' theoretical knowledge into practical competencies. In particular, the use of the project-based learning method is distinguished by the fact that it encourages students to think independently, analyze real problems, and develop innovative solutions. This demonstrates the content of the pedagogical process in harmony with the essence of blockchain technology - the principles of transparency, reliability, and decentralization. The results of the study also confirmed the importance of interdisciplinary integration in the process of teaching blockchain technology. The educational process, organized in close connection with information technology, cybersecurity, economics and law, will increase the digital literacy of students and help them become competitive specialists in the labor market. This aspect is consistent with the concept of developing digital competencies put forward in international studies, including the World Economic Forum.

In conclusion, it is worth noting that the priority task in teaching blockchain technology is not only to equip students with technological knowledge, but also to prepare them for analytical thinking, independent decision-making, and solving real problems. Methodological approaches developed based on the results of the research will serve to increase the effectiveness of teaching blockchain technology in higher education institutions and serve as a solid methodological basis for further scientific research in this area.

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