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STAGE-BY-STAGE PROCESSES OF STUDENTS' CREATIVE ACTIVITY IN PERFORMING PROBLEM-BASED EXPERIMENTS IN PHYSICS USING ARTIFICIAL INTELLIGENCE

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ABSTRACT

This article examines the stage-by-stage processes of students' creative activity in performing problem-based experiments in physics using artificial intelligence technologies. The study analyzes how didactic principles and innovative pedagogical approaches contribute to the development of students' creative thinking and cognitive engagement. Particular attention is given to the role of motivation, curiosity, and emotional involvement in the learning process. Artificial intelligence tools, including virtual laboratories and intelligent learning systems, provide opportunities for personalized instruction and interactive experimentation. The results show that the integration of artificial intelligence with problem-based experimental learning significantly improves students' analytical thinking, creativity, and conceptual understanding of physics.

Keywords

problem-based learning, physics education, creative activity, artificial intelligence in education, experimental learning, cognitive development, innovative pedagogy.

Introduction

Modern educational systems emphasize the development of students' analytical thinking, creativity, and independent learning skills. In physics education, experimental activity plays a crucial role in understanding scientific concepts and developing research competencies [6].

Traditional teaching approaches often focus on memorization and passive learning. However, contemporary pedagogical research highlights the importance of problem-based and experimental learning methods that encourage students to explore scientific phenomena and develop solutions independently [4].

The integration of artificial intelligence technologies in education provides new opportunities for improving teaching effectiveness. AI-based learning environments allow educators to analyze students' learning behavior, adapt instructional strategies, and provide personalized feedback [9].

Therefore, combining problem-based experimental learning with artificial intelligence technologies represents an important direction for improving physics education.

Literature Review

Research in educational psychology emphasizes the importance of motivation and cognitive processes in effective learning. Bogoyavlenskaya noted that creative thinking develops through active intellectual engagement and problem-solving activities [3].

Similarly, studies conducted by Dorno and Zvereva demonstrated that problem-based learning environments significantly stimulate students' cognitive activity in physics lessons [4][5].

Recent studies also highlight the role of artificial intelligence in education. AI-based systems allow educators to create adaptive learning environments that respond to students' learning needs and provide individualized instruction [10].

In addition, virtual laboratories and simulation technologies make it possible for students to explore complex physical processes that cannot always be demonstrated in traditional classroom settings [11].

Methodology

This research is based on theoretical analysis of pedagogical literature and the examination of problem-based experimental learning in physics education.

The study focuses on the interaction between students and learning materials within the "student–learning material" system. This approach allows researchers to analyze how creative activity develops through interaction between symbolic representations and real scientific phenomena [2].

Artificial intelligence tools such as intelligent tutoring systems, adaptive learning platforms, and virtual laboratories were analyzed as additional instruments supporting students' experimental learning activities [9].

Results and Discussion

The analysis shows that problem-based experimental learning significantly improves students' creative thinking and cognitive engagement.

Students who perform experiments in AI-supported environments become active participants in the learning process. Such environments allow them to visualize physical phenomena, test hypotheses, and analyze experimental results [11].

Moreover, artificial intelligence technologies help teachers monitor students' learning progress and provide individualized support. Adaptive learning systems increase students' motivation and improve their conceptual understanding of physics [10].

Conclusion

The study demonstrates that problem-based experimental learning supported by artificial intelligence technologies provides an effective framework for developing students' creative activity in physics education.

The integration of artificial intelligence tools into the educational process enhances students' cognitive engagement, analytical thinking, and experimental skills.

Therefore, combining innovative pedagogical strategies with artificial intelligence technologies represents a promising direction for improving the quality of physics education.

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