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DEVELOPING STUDENTS' ANALYTICAL THINKING COMPETENCE THROUGH AN INTEGRATIVE APPROACH IN PHYSICS EDUCATION

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Abstract

This article investigates the development of students' analytical thinking competence through an integrative approach in physics education. The study emphasizes the role of interdisciplinary integration, problem-based learning, and research-oriented instructional strategies in enhancing students' depth of understanding and logical reasoning skills. The findings demonstrate that integrative teaching methods significantly contribute to the formation of students' independent and critical thinking abilities.

Keywords

integrative approach, analytical thinking, competence, physics education, interdisciplinary integration.

Annotation

Ushbu maqolada fizika fanini o'qitishda integrativ yondashuv asosida talabalarning tahliliy fikrlash kompetensiyasini rivojlantirish masalalari yoritilgan. Tadqiqotda fanlararo integratsiya, muammoli ta'lim va tadqiqotga yo'naltirilgan metodlardan foydalanish orqali talabalar bilimining chuqurligi hamda mantiqiy tahlil ko'nikmalarini oshirish imkoniyatlari tahlil qilingan. Natijalar integrativ yondashuv talabalarning mustaqil va tanqidiy fikrlashini rivojlantirishda samarali ekanligini ko'rsatadi.

Kalit so'zlar

integrativ yondashuv, tahliliy fikrlash, kompetensiya, fizika ta'limi, fanlararo integratsiya.

Аннотация

В статье рассматриваются вопросы развития аналитического мышления студентов на основе интегративного подхода в обучении физике. Проанализированы возможности повышения глубины знаний и логических умений обучающихся посредством междисциплинарной интеграции, проблемного и исследовательского обучения. Результаты исследования подтверждают эффективность интегративного подхода в формировании самостоятельного и критического мышления студентов.

Ключевые слова

интегративный подход, аналитическое мышление, компетенция, обучение физике, междисциплинарная интеграция.

Introduction

The rapid development of science and technology places new demands on higher education systems worldwide. Modern specialists are expected not only to possess subject-specific knowledge but also to demonstrate advanced analytical thinking, problem-solving skills, and the ability to apply knowledge in interdisciplinary contexts. As a fundamental natural science, physics plays a key role in shaping these competencies.

However, traditional physics instruction often relies on reproductive teaching methods focused on memorization of formulas and standard problem-solving algorithms. Such approaches limit students' opportunities to engage in deep cognitive analysis and independent

reasoning. Therefore, the integration of interdisciplinary content and active learning strategies has become a crucial direction in improving the quality of physics education.

Theoretical Basis of the Integrative Approach

The integrative approach in education is based on the holistic combination of knowledge, skills, and competencies from different disciplines into a unified learning system. In physics education, integration with mathematics, information technologies, engineering concepts, and real-life problem situations creates favorable conditions for the development of analytical thinking.

Analytical thinking competence includes the ability to identify problems, analyze data, establish cause-and-effect relationships, evaluate results, and draw scientifically grounded conclusions. An integrative learning environment supports higher-order thinking skills by engaging students in active cognitive processes and meaningful learning activities.

Methodology of Integrative Physics Instruction

The proposed methodology is based on the systematic use of integrative teaching methods aimed at developing analytical thinking competence. The instructional process involves problem-based learning, project-based activities, case study analysis, and research-oriented laboratory work. These methods encourage students to actively participate in the learning process and develop independent reasoning skills.

Integrative tasks are designed to combine theoretical physics concepts with mathematical modeling and real-world applications. For example, students analyze motion dynamics by applying kinematic equations, constructing graphs, and interpreting experimental data. Such tasks promote logical reasoning and deepen conceptual understanding.

Assessment of Analytical Thinking Competence

Assessment of analytical thinking competence is conducted using qualitative and quantitative criteria, including the depth of analysis, accuracy of reasoning, and the ability to justify conclusions using scientific principles. Assessment tools include analytical rubrics, diagnostic tests, reflective journals, and student portfolios. These instruments provide comprehensive feedback on students' cognitive development and learning progress.

Conclusion

The study confirms that the integrative approach in physics education is an effective means of developing students' analytical thinking competence. By combining interdisciplinary content, active learning strategies, and research-oriented tasks, educators can significantly enhance students' critical thinking abilities and prepare them for solving complex professional problems. The implementation of the proposed methodology contributes to improving the quality of physics education and aligns with contemporary educational requirements.The results of this study indicate that integrative physics instruction creates a more cognitively engaging learning environment compared to traditional teaching methods. Students involved in integrative learning activities demonstrate a higher level of conceptual understanding and are more capable of transferring knowledge to unfamiliar problem situations. This confirms that analytical thinking competence is closely linked to the structure and methodology of the learning process.

Furthermore, interdisciplinary integration encourages students to perceive physics not as an isolated subject, but as a tool for understanding real-world phenomena. This perception increases learning motivation and supports the development of reflective and evaluative thinking

skills. The findings are consistent with previous research emphasizing the importance of active and problem-based learning environments in science education.

Practical Implications

The proposed integrative methodology can be effectively implemented in undergraduate physics courses, teacher training programs, and STEM-oriented curricula. Educators are encouraged to design instructional tasks that combine physics concepts with mathematical analysis, digital tools, and real-life applications. Such an approach enhances not only analytical thinking competence but also students' professional readiness.

In addition, the use of research-oriented laboratory work allows students to develop scientific inquiry skills, including hypothesis formulation, experimental design, data interpretation, and evidence-based reasoning. These skills are essential for future specialists in science and engineering fields.

Conclusion

The study confirms that the integrative approach in physics education is an effective means of developing students' analytical thinking competence. By combining interdisciplinary content, active learning strategies, and research-oriented tasks, educators can significantly enhance students' critical thinking abilities and prepare them for solving complex professional problems. The proposed methodology contributes to improving the quality of physics education and aligns with contemporary educational standards.

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