



TECHNOLOGY OF TEACHING FUNDAMENTAL CONCEPTS RELATED TO ENERGY-SAVING TECHNOLOGIES BASED ON THE INTEGRATION OF SCIENCES IN PHYSICS.

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Tayanch soʻzlar: energiya tejamkorlik, fanlararo integratsiya, fizika taʼlimi, ekologik samaradorlik, texnologik yondashuv.

Ключевые слова: энерго эффективность, междисциплинарная интеграция, обучение физике, экологическая эффективность, технологический подход.

Key words: energy efficiency, interdisciplinary integration, physics education, ecological efficiency, technological approach.

Резюме:

Ushbu maqolada fizikada fanlar integratsiyasi asosida energiya tejamkor texnologiyalarga oid fundamental tushunchalarni oʻqitishning ahamiyati tahlil qilinadi. Talabalarga energiya samaradorligi haqida chuqur bilim berish uchun fizika, matematika, kimyo, ekologiya va iqtisodiyot fanlari bilan integratsiyalashgan yondashuv qoʻllaniladi. Tadqiqot natijalari fanlararo integratsiya orqali oʻqitish talabalarning bilim va amaliy koʻnikmalarini oshirishga yordam berishini koʻrsatdi.

Резюме:

В данной статье рассматривается важность обучения основным понятиям, связанным с энергосберегающими технологиями, на основе интеграции наук в физике. Междисциплинарный подход, объединяющий физику, математику, химию, экологию и экономику, используется для обеспечения студентов всесторонними знаниями об энергоэффективности. Результаты исследования показывают, что междисциплинарное обучение повышает знания и практические навыки студентов.

Summary:

This article examines the importance of teaching fundamental concepts related to energy-saving technologies based on the integration of sciences in physics. An interdisciplinary approach combining physics, mathematics, chemistry, ecology, and economics is used to provide students with a comprehensive understanding of energy efficiency. The research findings demonstrate that interdisciplinary teaching enhances students' knowledge and practical skills.

Introduction. In the 21st century, one of the critical global challenges is the efficient use of energy. As technological advancements rapidly grow, the necessity to teach and implement energy-saving technologies becomes more relevant.



Energy-saving technologies help optimize energy consumption and mitigate environmental harm, making them a crucial area of study for future specialists.

The integration of sciences within the teaching process, especially in physics, has emerged as a powerful method for deepening students' understanding of these technologies. This interdisciplinary approach not only helps learners grasp the theoretical underpinnings of energy-saving technologies but also fosters practical applications in real-world scenarios. For example, studying the physical principles of solar panels, wind turbines, and heat pumps enables students to understand their scientific, economic, and ecological benefits.

The goal of this study is to explore the technology of teaching fundamental concepts related to energy-saving technologies by integrating physics with other sciences such as mathematics, chemistry, ecology, and economics. This article discusses how this integration enhances the learning experience and better equips students with the knowledge and skills to address modern energy challenges.

Methods. The methodological framework of this research involves several approaches aimed at analyzing the effectiveness of interdisciplinary teaching methods. The following methods were used in the study:

1. **Literature Review** – A thorough analysis of existing literature on energy-saving technologies and their educational methods was conducted. This helped assess the role of integrating physics with other disciplines in enhancing students' understanding of the subject matter. Key studies on pedagogical strategies and technological innovations were reviewed to form the foundation of the research.

2. **Experimental Methods** – To examine the effectiveness of interdisciplinary approaches, a series of integrated lessons and laboratory experiments were developed and tested. These included experiments on solar panel efficiency, wind turbine mechanisms, and heat transfer in thermal insulation. By linking these practical experiments to theoretical concepts from physics and related disciplines, the study aimed to assess how well students understood and applied these technologies.

3. **Surveys and Interviews** – Surveys were distributed to both students and teachers to gather insights into the effectiveness of the interdisciplinary approach. Feedback on the clarity of concepts, engagement levels, and the ability to apply knowledge practically was analyzed. Additionally, interviews provided qualitative data on students' experiences and learning outcomes.

4. **Theoretical Analysis** – The role of integrating physics with other sciences was theoretically examined to identify pedagogical benefits. The analysis focused on how combining multiple scientific disciplines fosters a more holistic understanding of energy-saving technologies and enhances students' critical thinking and problem-solving skills.



Results. The findings from the research demonstrated that integrating physics with other sciences significantly improves students' knowledge and application of energy-saving technologies. The main results of the study are detailed below:

1. Integrated Laboratory Work: One of the most effective methods observed was the use of interdisciplinary laboratory experiments. For example, **solar energy utilization experiments** allowed students to understand the fundamental physics behind photovoltaic cells while linking this knowledge to ecological and economic considerations. The experiment involved calculating the efficiency of solar panels and analyzing their long-term sustainability. Students were able to observe how physics principles such as the photoelectric effect could be applied in a real-world context through interdisciplinary discussions involving chemistry (materials science) and mathematics (efficiency calculations).

Another experiment on **thermal insulation** demonstrated the heat transfer properties of various materials. Physics principles related to heat conduction and convection were linked with environmental and economic benefits. By applying these concepts, students were better able to understand how energy-saving technologies like thermal insulation can be implemented in the construction industry to reduce energy consumption.

2. Interdisciplinary Problem Solving: Exercises combining physics with mathematics, chemistry, and ecology proved to be a valuable educational tool. For instance, students worked on **solar panel efficiency calculations**, requiring them to use physics to understand energy conversion while applying mathematical models to optimize efficiency. Furthermore, **wind turbine efficiency calculations** involved learning about mechanical energy conversion in physics, while also exploring the environmental benefits of renewable energy through an ecological lens.

These interdisciplinary exercises deepened students' understanding of how energy-saving technologies operate in real-world conditions, providing them with the skills to critically assess and improve upon these technologies in the future.

3. Visual and Demonstrative Models: The use of visual aids and demonstration models was found to significantly enhance students' learning experience. For instance, a **solar panel model** allowed students to visualize how sunlight is converted into electricity through photovoltaic cells. This visual representation of complex physical phenomena helped students grasp the concepts more quickly and apply them to practical situations.

Similarly, models of **wind turbines** and **heat pumps** illustrated how mechanical energy from wind and thermal energy can be used in energy-efficient technologies. These models facilitated a more interactive and engaging learning



environment, encouraging students to actively participate in discussions and problem-solving.

4. **Surveys and Feedback:** Survey results indicated that students were more engaged and better understood the material when interdisciplinary methods were applied. Many students reported that they found the lessons more interesting and practical, especially when they could see the connections between physics and other subjects. Teachers also expressed positive feedback, noting that this approach encouraged deeper critical thinking and problem-solving skills among students.

Discussion. Based on the research results, it is clear that interdisciplinary approaches offer several advantages in teaching fundamental concepts related to energy-saving technologies. Below are some key points for further discussion:

1. ****Integration of Theoretical and Practical Knowledge**** – The interdisciplinary method allows students to connect theoretical knowledge with real-world applications. For example, understanding the physics of photovoltaic cells in solar panels becomes more meaningful when linked with mathematical calculations of efficiency and ecological benefits, providing students with a broader perspective on how these technologies contribute to sustainability.

2. ****Effectiveness of Practical Learning**** – Laboratory experiments that combine physics with related sciences offer a more hands-on approach to learning. When students physically construct models or perform experiments, they better internalize the knowledge, developing skills that are crucial for their future careers. For example, through experiments on solar energy, students not only understand the scientific principles but also learn to evaluate the environmental and economic implications of these technologies.

3. ****Student and Teacher Feedback**** – Feedback gathered through surveys and interviews suggests that students are more motivated and engaged when they see the relevance of their studies to real-life challenges. This indicates that interdisciplinary learning is more effective in retaining students' interest and improving their problem-solving abilities. Teachers also benefit from this approach as it provides a more dynamic and comprehensive framework for teaching complex technological concepts.

4. ****Challenges and Opportunities**** – While the interdisciplinary approach offers numerous benefits, there are challenges to its implementation. For one, teachers must be well-versed in multiple disciplines, which requires additional training and preparation. Additionally, developing appropriate teaching materials and resources that adequately integrate multiple subjects can be time-consuming. However, these challenges are outweighed by the benefits, as the interdisciplinary



approach prepares students to think more critically and creatively, skills that are essential in addressing modern energy challenges.

Conclusion. The integration of sciences in teaching fundamental concepts related to energy-saving technologies has proven to be a highly effective pedagogical approach. This method not only enhances students' theoretical knowledge but also equips them with the practical skills necessary to apply energy-saving technologies in real-world scenarios. Laboratory work, interdisciplinary problem-solving, and the use of visual aids contribute to a deeper understanding of the physical, environmental, and economic aspects of these technologies.

By embracing interdisciplinary teaching methods, educators can better prepare students to address the growing global need for energy efficiency and sustainability. This approach fosters critical thinking, innovation, and a holistic understanding of the technologies that will shape the future of energy use.

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