METHODOLOGICAL ASPECTS OF IMPROVING EDUCATIONAL SOFTWARE FOR TEACHING MECHANICS

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ABSTRACT

The rapid development of digital technologies has significantly transformed the educational environment, creating new opportunities for improving the teaching and learning process. In physics education, particularly in the teaching of mechanics, the integration of digital tools and software applications has become an essential factor in enhancing students' understanding of complex physical phenomena. This study examines the possibilities of improving software support for teaching mechanics in higher education institutions under the conditions of digitalization. The research analyzes existing methodological and technological challenges associated with mechanics instruction and explores the pedagogical potential of virtual laboratories, computer simulations, interactive learning environments, and artificial intelligence-based educational systems. The findings indicate that the implementation of adaptive digital learning tools contributes to better conceptual understanding, increased student engagement, and more effective experimental learning. Furthermore, the integration of simulation technologies enables students to visualize mechanical processes, conduct virtual experiments, and develop analytical thinking skills. The study concludes that the improvement of software support for mechanics education is a crucial component of modernizing physics teaching and increasing the overall quality of higher education.

The digital transformation of education has become one of the most important priorities in modern higher education systems. Advances in information and communication technologies have changed traditional teaching methods and introduced innovative approaches to learning. In physics education, digital technologies provide opportunities to enhance the visualization of physical phenomena, improve experimental activities, and support student-centered learning environments.

Mechanics is one of the fundamental branches of physics and serves as the foundation for understanding many natural processes and engineering applications. However, students

often encounter difficulties in comprehending abstract concepts related to motion, force, energy, momentum, and mechanical interactions. Traditional teaching methods based primarily on lectures and textbook explanations are frequently insufficient for developing a deep understanding of these concepts. Therefore, the integration of modern educational software has become increasingly important for improving learning outcomes in mechanics courses.

One of the major challenges in teaching mechanics is the gap between theoretical knowledge and practical application. Many students can solve mathematical problems but struggle to interpret physical phenomena and apply theoretical concepts to real-life situations. Digital educational technologies help bridge this gap by providing interactive and visual learning experiences.

Virtual laboratories represent one of the most effective digital tools for mechanics education. Unlike traditional laboratory settings, virtual laboratories allow students to perform experiments repeatedly without physical limitations or safety concerns. Through virtual experimentation, learners can investigate the effects of different variables on mechanical systems and observe the outcomes in real time. Such environments encourage inquiry-based learning and improve students' scientific reasoning skills.

Computer simulations also play a significant role in modern mechanics instruction. Simulations enable the visualization of complex physical processes that are difficult to observe directly in classroom conditions. For example, projectile motion, harmonic oscillations, collisions, rotational dynamics, and gravitational interactions can be represented through dynamic models that facilitate conceptual understanding. By manipulating parameters and analyzing simulation results, students become active participants in the learning process.

Another important aspect of software development for mechanics education is adaptivity. Modern educational systems increasingly employ artificial intelligence technologies to personalize learning experiences. Adaptive learning platforms can assess students' performance, identify learning difficulties, and provide individualized recommendations. This approach allows learners to progress at their own pace while receiving targeted support in areas where they experience difficulties.

The effectiveness of educational software depends not only on technological functionality but also on its pedagogical design. Effective software should integrate theoretical explanations, multimedia content, interactive simulations, assessment tools, and feedback mechanisms into a unified learning environment. According to multimedia learning theory, the combination of visual and verbal information enhances cognitive processing and improves knowledge retention. Therefore, software designed for mechanics education should include animations, graphical representations, and interactive tasks that support meaningful learning.

Furthermore, digital technologies facilitate data collection and learning analytics. Educational software can monitor students' progress, evaluate learning outcomes, and generate detailed reports for instructors. Such capabilities contribute to evidence-based teaching practices and support continuous improvement of the educational process.

The digitalization of higher education requires the modernization of teaching methods and educational resources. Improving software support for teaching mechanics is an

important step toward increasing the effectiveness of physics education. Virtual laboratories, computer simulations, adaptive learning technologies, and artificial intelligence-based systems provide new opportunities for enhancing students' conceptual understanding and practical skills.

The integration of advanced digital tools into mechanics education contributes to the development of analytical thinking, scientific inquiry, and problem-solving abilities. Therefore, the design and implementation of innovative educational software should be considered a strategic priority for higher education institutions seeking to improve the quality of physics instruction in the digital era

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