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FORMATION OF INFORMATION MODELING COMPETENCE IN THE PROCESS OF PHYSİCS EDUCATION

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ABSTRACT

The rapid development of information and communication technologies has significantly transformed educational practices, particularly in science education. One of the essential competencies required in modern education is information modeling competence, which enables learners to represent, analyze, and interpret physical phenomena through various models. This article examines the formation of information modeling competence in the process of physics education. The study explores theoretical foundations, pedagogical approaches, and digital technologies that support the development of modeling skills among students. Special attention is given to computer simulations, virtual laboratories, mathematical modeling, and problem-based learning as effective tools for enhancing students' understanding of physical concepts.

KEYWORDS

Information modeling, physics education, modeling competence, digital technologies, computer simulation, scientific literacy, problem-based learning.

Introduction

Annotatsiya. Axborot-kommunikatsiya texnologiyalarining jadal rivojlanishi ta'lim amaliyotini, ayniqsa, fan ta'limida sezilarli darajada o'zgartirdi. Zamonaviy ta'limda talab qilinadigan muhim kompetensiyalardan biri bu axborot modellashtirish kompetensiyasi bo'lib, u o'quvchilarga turli modellar orqali jismoniy hodisalarni ifodalash, tahlil qilish va talqin qilish imkonini beradi. Ushbu maqolada fizika ta'limi jarayonida axborot modellashtirish kompetensiyasining shakllanishi ko'rib chiqiladi. Tadqiqotda talabalar o'rtasida modellashtirish ko'nikmalarini rivojlantirishni qo'llab-quvvatlovchi nazariy asoslar, pedagogik yondashuvlar va raqamli texnologiyalar o'rganiladi. Kompyuter simulyatsiyalari, virtual laboratoriyalar, matematik modellashtirish va muammoga asoslangan o'qitish talabalarning jismoniy tushunchalarni tushunishini oshirishning samarali vositalari sifatida alohida e'tiborga loyiqdir.

Kalit so'zlar. axborot modellashtirish, fizika ta'limi, modellashtirish kompetensiyasi, raqamli texnologiyalar, kompyuter simulyatsiyasi, ilmiy savodxonlik, muammoga asoslangan o'qitish.

Аннотация

Быстрое развитие информационно-коммуникационных технологий значительно изменило образовательную практику, особенно в области естественнонаучного образования. Одной из

важнейших компетенций, необходимых в современном образовании, является компетенция в области информационного моделирования, которая позволяет учащимся представлять, анализировать и интерпретировать физические явления с помощью различных моделей. В данной статье рассматривается формирование компетенции в области информационного моделирования в процессе обучения физике. В исследовании изучаются теоретические основы, педагогические подходы и цифровые технологии, способствующие развитию навыков моделирования у учащихся. Особое внимание уделяется компьютерному моделированию, виртуальным лабораториям, математическому моделированию и проблемно-ориентированному обучению как эффективным инструментам повышения понимания учащимися физических концепций.

Ключевые слова. информационное моделирование, обучение физике, компетенция в области моделирования, цифровые технологии, компьютерное моделирование, научная грамотность, проблемно-ориентированное обучение.

Modern society increasingly relies on information technologies and data-driven decision-making processes. Consequently, educational systems must prepare learners to work effectively with information, analyze complex phenomena, and construct models that explain real-world processes. In physics education, information modeling plays a particularly important role because many physical phenomena cannot be directly observed or experimentally reproduced under classroom conditions.

Information modeling competence refers to the ability to create, interpret, evaluate, and apply models for understanding and solving scientific problems. It involves the use of mathematical, graphical, conceptual, and computer-based models to represent physical systems and processes. The development of this competence enables students to better understand the relationships between theoretical concepts and practical applications.

Physics, as an experimental and theoretical science, provides an ideal environment for the formation of information modeling competence. Through modeling activities, students learn to simplify complex systems, identify essential variables, formulate hypotheses, and predict outcomes.

The purpose of this study is to investigate the role of information modeling in physics education and identify effective pedagogical approaches for developing modeling competence among students.

Information modeling is a cognitive and technological process through which real-world objects, events, and phenomena are represented in a simplified form. Models serve as tools for understanding, explanation, prediction, and decision-making.

In educational contexts, information modeling competence includes several interconnected components:

Knowledge of modeling principles and methods;

Ability to construct conceptual and mathematical models;

Skills in using digital modeling tools and software;

Capacity for analyzing and interpreting modeling results;

Critical evaluation of model accuracy and limitations.

The competency-based approach in education emphasizes the development of practical skills and the application of knowledge in authentic situations. Information modeling competence aligns with this approach by encouraging students to engage in active learning and scientific inquiry.

Modeling is one of the fundamental methods of scientific investigation in physics. Scientists use models to explain natural phenomena, test hypotheses, and predict future events. Therefore, introducing modeling activities into physics education helps students understand how scientific knowledge is generated.

Models help students visualize abstract concepts such as electric fields, atomic structures, wave propagation, and quantum phenomena. Visualization facilitates deeper understanding and reduces misconceptions.

Physics problems often require students to represent situations mathematically or graphically before finding solutions. Modeling develops analytical and logical thinking skills necessary for effective problem-solving.

Students engage in hypothesis formation, experimentation, data analysis, and interpretation when constructing models. These activities promote scientific reasoning and research skills.

Information modeling integrates knowledge from mathematics, computer science, engineering, and physics, encouraging interdisciplinary thinking and application.

Digital Technologies for Developing Information Modeling Competence

Advancements in educational technology have created new opportunities for incorporating modeling into physics education.

Computer simulations allow students to investigate physical phenomena that may be difficult, dangerous, or impossible to observe directly. Simulations provide interactive learning experiences and support experimentation in virtual environments.

Examples include simulations of:

Planetary motion;

Electromagnetic fields;

Molecular interactions;

Wave behavior;

Energy transformations.

Virtual Laboratories

Virtual laboratories complement traditional experiments by providing flexible and accessible environments for scientific investigation. Students can manipulate variables, collect data, and test hypotheses without physical limitations.

Software applications such as MATLAB, GeoGebra, Python, and spreadsheet tools enable students to construct and analyze mathematical models of physical systems.

These technologies facilitate:

Data visualization;

Numerical calculations;

Graphical analysis;

Predictive modeling.

Animations, interactive diagrams, and digital visualizations enhance understanding of complex physical processes and support the development of modeling competence.

Problem-based learning encourages students to solve authentic scientific problems through investigation and modeling activities. Students develop critical thinking and decision-making skills while applying theoretical knowledge.

Inquiry-based approaches promote active exploration and scientific discovery. Students formulate questions, design experiments, construct models, and evaluate results independently.

Projects involving real-world physical phenomena encourage collaborative work and practical application of modeling techniques.

Research activities allow students to experience the complete modeling cycle, from problem identification to interpretation of results and presentation of findings.

The development of information modeling competence provides numerous educational benefits: Improved understanding of physics concepts; Enhanced analytical and critical thinking skills; Increased motivation and engagement; Better problem-solving abilities; Greater scientific literacy; Preparation for professional and academic careers in STEM fields.

Furthermore, modeling competence supports lifelong learning by enabling students to adapt to rapidly changing technological environments.

Despite its advantages, several challenges may hinder the effective integration of modeling into physics education: Limited access to technological resources; Insufficient teacher training; Lack of appropriate educational software; Time constraints within the curriculum; Variations in students' digital literacy levels.

Addressing these challenges requires institutional support, curriculum modernization, and continuous professional development for educators.

Information modeling competence has become an essential component of contemporary physics education. The ability to create, analyze, and apply models enables students to understand complex physical phenomena, develop scientific thinking, and solve real-world problems effectively. Digital technologies such as computer simulations, virtual laboratories, and mathematical modeling software provide powerful tools for enhancing modeling competence.

The successful formation of information modeling competence requires the integration of innovative pedagogical approaches, including problem-based learning, inquiry-based learning, and project-based activities. Educational institutions should prioritize the development of modeling skills to prepare students for future academic, professional, and technological challenges.

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