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PEDAGOGICAL FOUNDATIONS FOR THE USE OF DIGITAL TECHNOLOGIES IN TEACHING GENERAL ASTRONOMY AT PEDAGOGICAL UNIVERSITIES

Begzatova Shaxnoza Paxriddinovna
Senior Lecturer, Chirchik State Pedagogical University, Uzbekistan

Abstract
The article examines the pedagogical and methodological foundations for the effective use of digital technologies in teaching general astronomy to students of pedagogical universities. It analyzes the didactic potential of interactive computer models, digital simulators, and multimedia tools in enhancing the effectiveness of the educational process and fostering students' independent learning. The study emphasizes that integrating digital technologies into astronomy education enables the visualization of complex spatial phenomena, promotes analytical thinking, scientific observation, and reflective learning skills among students. The research also highlights the need for localized digital resources and proposes the development of digital learning environments tailored to the Uzbek educational context.

Keywords: Digital technologies, astronomy education, independent learning, interactive models, multimedia, visualization, pedagogical methodology, ICT, reflection.

Introduction

Аннотация
В статье рассматриваются педагогические и методические основы эффективного использования цифровых технологий в процессе обучения общей астрономии студентов педагогических университетов. Анализируется дидактический потенциал интерактивных компьютерных моделей, цифровых симуляторов и мультимедийных средств в повышении эффективности образовательного процесса и развитии самостоятельной учебной деятельности студентов. Подчеркивается, что интеграция цифровых технологий в преподавание астрономии способствует

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визуализации сложных пространственных явлений, формированию аналитического мышления, научной наблюдательности и рефлексивных умений обучающихся. В исследовании также отмечается необходимость разработки локализованных цифровых ресурсов и предлагается создание цифровых образовательных сред, адаптированных к узбекскому образовательному контексту.

Ключевые слова: цифровые технологии, обучение астрономии, самостоятельное обучение, интерактивные модели, мультимедиа, визуализация, педагогическая методология, ИКТ, рефлексия.

Introduction

The current stage of modern social development is characterized by the digitalization of education, which underscores the importance of integrating digital technologies at all levels of the educational system. Among various directions of educational digitalization, the integration of modern computer technologies into specific academic disciplines has special significance (Robert, 2008). This process is particularly relevant in the teaching of general astronomy at pedagogical higher education institutions, where the effective use of information and communication technologies (ICT) becomes a key requirement. General astronomy occupies a unique place within the system of natural sciences and is an essential field of knowledge for students majoring in physics and science education (Ilina, 1984). This discipline plays an important role in shaping future teachers' worldviews, fostering an understanding of humanity's place and role in the Universe, and forming a modern scientific picture of the world based on contemporary cosmological concepts. Astronomical knowledge provides epistemological foundations for understanding the structure of the Universe and the physical processes occurring within it (Rysin, 2012).

Main Part

In today's era of rapid digital transformation, the use of innovative digital tools-such as e-textbooks, multimedia resources, animations, and virtual simulators-has become increasingly important in astronomy education (Gomulina, 2010). At the same time, the lack of localized digital resources in the Uzbek language remains a pressing issue. The Internet, however, provides opportunities for new

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interactive forms of education, including access to digital databases, astronomical maps, and computer-based simulations (Polozhenetseva, 2006). These tools enrich the learning environment, help visualize complex concepts, and deepen students' scientific understanding.

The integration of interactive computer models into astronomy teaching represents a crucial pedagogical and research task (Laptev, 2014). Their use in the classroom allows educators to enhance the quality of instruction, strengthen students' independence, and improve learning efficiency through visualization, interactivity, and self-assessment mechanisms. Modern ICT-based approaches combine static (text, graphics, color) and dynamic (animation) information types, helping students construct cognitive images of complex phenomena (Sobenina & Pabolkov, 2015).

Such interactivity transforms students from passive recipients of knowledge into active participants in the learning process, enabling them to manage their educational paths and pace independently (Pidkasistiy & Kirsanov, 1990). This individualized approach fosters cognitive engagement, motivation, and scientific curiosity. The synergy of interactivity, visualization, and modeling contributes to improved comprehension, creative reasoning, and overall learning outcomes in astronomy and related disciplines (Yarmak, 2015).

Numerous studies demonstrate that digital technologies have become an integral part of modern education (Gomulina, 2010; Laptev, 2014; Robert, 2008). The use of interactive computer models increases students' engagement, stimulates interest, and enhances the depth of subject comprehension (Rysin, 2012). Researchers such as Pabolkov, Sobenina, and Yarmak emphasize that digital technologies facilitate efficient information exchange between teachers and students, improve understanding, and develop independent analytical thinking (Yarmak, 2015).

Digital approaches in pedagogical education also serve as powerful tools for enhancing students' motivation, cognitive activity, and research interest (Ilina, 1984). In this context, the teacher's role evolves from being merely a transmitter of knowledge to an organizer and facilitator of the learning process in a digital environment (Robert, 2008). Therefore, future teachers of physics and astronomy must be proficient in using digital tools effectively and in interpreting astronomical data in dynamic contexts.

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Given the interdisciplinary and complex nature of astronomy, the integration of digital technologies plays a particularly significant role. It enables modeling of educational content, visualization of cosmic processes, automation of calculations, and development of spatial imagination (Rysin, 2012). As a result, students develop not only scientific knowledge but also critical thinking, analytical reasoning, and observational skills.

Independent learning in a digital environment transforms students into self-directed learners who define their educational goals, choose resources, analyze results, and reflect on their learning process (Yarmak, 2015). This fosters self-regulation, responsibility, and life-long learning competencies. Digital learning environments also promote personalized learning by allowing students to select content that matches their proficiency level and learning pace (Gomulina, 2010).

Conclusion

Integrating digital technologies into the teaching of general astronomy represents a vital step toward improving the quality and effectiveness of education in Uzbekistan. Digital tools make learning more engaging, individualized, and scientifically meaningful, while also fostering analytical, reflective, and independent thinking.

To achieve sustainable improvement, it is essential to enhance teachers' digital competencies, expand ICT infrastructure, and develop digital learning platforms in the Uzbek language. The proposed **"Independent Learning in Astronomy"** platform serves as a practical example of how digital transformation can support science education and encourage self-directed learning among future teachers.

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