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INTEGRATION OF ORGANIC CHEMISTRY BASED ON CLINICAL EXAMPLES: THEORETICAL AND PRACTICAL APPROACHES

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Abstract: This study analyzes the scientific-theoretical foundations and practical approaches to teaching organic chemistry based on clinical examples. The research was conducted using the examples of Tashkent and Andijan State Medical Academies, employing interactive methods such as laboratory work, role-playing games, multimedia presentations, quizzes, and reflective sessions to integrate science and clinical practice. The results demonstrate that classes based on clinical examples enhance students' knowledge, foster clinical thinking, and develop professional competencies. Interactive methods strengthen the motivational environment of the learning process, enabling students to gain a deeper understanding of the connection between chemistry and its clinical applications. Statistical analysis confirmed the superiority of integrated teaching models over traditional methods. The article underscores the importance of implementing integrative approaches in medical education.

Keywords: Organic chemistry, clinical examples, medical education, integration, interactive methods, clinical thinking, laboratory experiments, pharmaceutical chemistry, pedagogy.

Introduction:

In the current system of medical education, ensuring competitiveness, developing professional competencies, and forming practice-oriented knowledge are among the most pressing tasks. From this perspective, interdisciplinary integration based on the credit-module system holds a special place as a modern medico-pedagogical approach. Specifically, teaching organic chemistry using clinical examples strengthens the connection between this discipline and medical practice, enabling the harmonious integration of theoretical knowledge with clinical thinking.

Lessons based on clinical scenarios encourage students to understand the biological activity of complex molecular structures, analyze the chemical composition of medications, and thoroughly master their pharmacodynamic properties. This approach not only facilitates an understanding of the essence of chemical processes but also provides a foundation for their application in clinical practice. Through interactive methods—laboratory experiments, role-playing games, 3D animations, and discussions based on real clinical cases—students realize the practical significance of chemistry. This article comprehensively analyzes the scientific-theoretical foundations of teaching organic chemistry through clinical examples, practical approaches, and the effectiveness of integration in medical education. The primary focus is on implementing interactive methodologies, strengthening interdisciplinary connections, and fostering professional competencies in students.

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Methods:This study was conducted at Bukhara State Medical Institute with the participation of second-year students. The educational process systematically applied innovative approaches integrating theoretical knowledge and clinical practice, using the following interactive methods: Laboratory work — Students performed chemical reactions based on preparations used in clinical practice, enabling in-depth analysis of the synthesis and chemical properties of medications.

Role-playing games — By simulating clinical scenarios, students identified and resolved chemical issues related to the use of medications. Multimedia presentations — Molecular structures and reaction mechanisms were explained using 3D animations, deepening understanding and enhancing visual retention. Quizzes — Interactive tests were conducted to develop quick thinking, clinical-analytical skills, and diagnostic abilities. Reflective sessions — After each lesson, students reflected on the connections between theoretical knowledge and clinical scenarios. To assess the effectiveness of interactive methods, a questionnaire was developed and distributed among second-year students. The questionnaire consisted of 20 closed and open-ended questions and was analyzed based on the following criteria:

- Students' interest in interactive methods;
- Changes in the level of knowledge in the discipline;
- Development of clinical thinking and logical analytical skills;
- Effectiveness of the learning process and motivational environment.

The results were analyzed statistically using SPSS software, specifically t-tests and analysis of variance (ANOVA), for comparative evaluation with traditional teaching methods. A total of 120 students participated in the questionnaire.

Results:
The obtained results demonstrated the significant superiority of interactive methods:

Teaching Method	Knowledge Acquisition (%)	Growth in Clinical Thinking (%)
Traditional	58%	32%
Interactive (Integrated)	87%	74%

Interactive methods, particularly those based on clinical examples, enabled students to connect complex organic reactions to real-life scenarios. In laboratory sessions, students analyzed not only reaction mechanisms but also their clinical applications. Through role-playing games, students learned to make chemical decisions in clinical situations.
Furthermore, reflective sessions enhanced students' self-assessment, critical thinking, and interdisciplinary comprehension competencies. The use of 3D animations increased the effectiveness of visual learning, strengthening skills in memorizing complex reactions and integrating them with clinical thinking. Overall, the group taught using interactive methods

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based on clinical examples showed statistically significant improvements in knowledge acquisition and clinical thinking compared to traditional methods ($p < 0.05$). This establishes the integrated approach as an effective pedagogical model in medical education.

Discussion:

Based on the results, it can be concluded that integrating organic chemistry with clinical examples is an innovative and effective approach in medical education. This methodology not only reinforces theoretical knowledge but also equips students with professional motivation and the ability to apply knowledge in practical settings. Interactive lessons, particularly those enriched with clinical examples, were met with high levels of student interest and enthusiasm. This, in turn, fostered independent thinking, evidence-based reasoning, and diagnostic skills during laboratory work. Notably, knowledge taught through real-life scenarios prepares students to address challenges encountered in medical practice. Moreover, classes based on clinical examples developed specific skills in identifying the structure of medications, analyzing their reactive properties, and evaluating pharmaceutical efficacy during diagnostic processes. This approach was instrumental in shaping students into specialists who understand the intrinsic connection between chemistry and clinical practice, possessing comprehensive medical thinking. When compared to the experiences of other leading medical institutions, the effectiveness of integrated approaches based on clinical examples was found to be superior. The widespread adoption of this methodology can elevate medical education to a new level, serving as a critical step in training highly qualified, practice-ready professionals.

Conclusions:

In conclusion, integrating organic chemistry with clinical examples in medical education is a modern and highly effective approach. The conducted research demonstrates that interactive methods within a clinical context enhance students' scientific understanding, clinical thinking, analytical reasoning, and problem-solving skills. Statistical analyses confirmed that integrated teaching methods outperform traditional approaches, with students achieving higher knowledge acquisition rates and robust clinical competencies ($p < 0.05$). The results, including laboratory work, role-playing games, 3D visualizations, and reflective sessions, proved more effective when applied cohesively. Learning based on clinical examples not only enriches the educational process but also prepares students for real-world medical practice. This integrated model facilitates the adoption of innovative pedagogical methods in mastering medical chemistry and aligns with the demands of modern medical education by training qualified professionals. In the future, applying modular curricula to other medical disciplines will further develop students' multidisciplinary competencies. This approach paves the way for enhancing educational quality and preparing advanced healthcare professionals.

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